Session 2016-2017

Mody University of Science & Technology

B.Sc. (Hons) Biotechnology

Session 2016-2017

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H)-Biotechnology-Three years programme
2016-2017 and onwards
FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	CORE (Compulsory)									
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	CH 113	Chemistry I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Laboratory I	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 171	Biotechnology and Human Welfare	2	-	-	2	3	25	25	50
	BT 181	Bioethics and IPR	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	80
		Sub Total	15	1	6	19				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CORE (Compulsory)									
	BT 152	Genetics	3	1	-	4	3	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
	CH 114	Chemistry II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Laboratory II	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 172	Basics of Drug Designing	2	-	-	2	3	25	25	50
	BT 182	Basics of Forensic sciences	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	16	1		20				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H)-Biotechnology-Three years programme
(2016-2017 and onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	Core Compulsory (CC)									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Bio-Instrumentation Lab	-	-	2	1	4	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Laboratory	-	-	2	1	4	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BO 211	Plant Anatomy and Physiology	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 291	Introductory Biomedical Science	2	-	-	2	3	25	25	80
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-I‡	3	-	-	3	2	25	25	50
		Sub Total				21				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	Core Compulsory (CC)									
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	BO 212	Plant Developmental Biology	2	-	-	2	3	25	25	50
	BO 222	Plant Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 381	Modern Biology	3	-	-	3	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total				18				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology-Three years programme
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Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	Core Compulsory (CC)									
	BT 311	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 341	Genetic Engineering Lab	-	-	2	1	4	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocess Engineering Laboratory	-	-	2	1	4	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	4	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 333	Introduction to Research Methodology	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
		Sub Total				22/25				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology-Three years programme
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Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	Core Compulsory (CC)									
	BT 352	Bioinformatics	3	-	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	BT 322	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 313	Animal Tissue Culture	3	-	-	3	3	25	25	50
	BT 323	Tissue Culture Laboratory	-	-	2	1	4	25	25	50
	BT 342	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 392	Environmental Biotechnology Laboratory	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 334	Enzyme Technology	3	-	-	3	3	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	BO 132	Botany -II	3	-	-	3	3	25	25	50
		Sub Total				23/26				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

The syllabus for already approved courses is not enclosed herein.

*The student has to take maximum two courses in each semester of Third year from the DCS. The minimum strength of student should be five (5) in the particular DCS course.

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BT 171 Biotechnology and Human Welfare **2-0-0-2**

[8]

UNIT I

Industry Application: protein engineering; enzyme and polysaccharide synthesis, Metabolites: Alcohol and antibiotic production.

UNIT II [8]

Agriculture Application: N_2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III [10]

Human Health: Diagnostics and Treatment: development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, Human genome project.

Text Book

1. Concepts in Biotechnology by Balasubrahmanian et. al.,University press, 2010

Reference Book

2. Recombinant DNA technology by Watson et. al., Scientific American Books, 2012.
3. Principles of Gene Manipulation by Old and Primrose. Blackwell, 2010
4. Biotechnology: Applications In Human Healthcare Hardcover, Sampat Nehra, Pointer Publishers (2009)

BT 181 Bioethics and IPR **2-0-0-2**

UNIT I [11]

Bioethics – Meaning and Necessity of Bioethics, different paradigms of Bioethics – National & International, Ethical issues against the molecular technologies

UNIT II [8]

IPR- Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions.

UNIT III [7]

Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

Text Book:

1. Patterns of Entrepreneurship 2005: Jack M. Kaplan. Wiley,
2. Sateesh MK. 2010 Bioethics and Biosafety, I. K. International Pvt Ltd.

References:

3. Entrepreneurship: New Venture Creation: David H. Holt Tata McGraw – Hill 2002
4. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BT 172 Basics of Drug Designing 2-0-0-2

UNIT I [5]
Drug designing-Meaning and Introduction, Disease and drug target identification

UNIT II [5]
Identification of Lead compound, SAR, optimising target interactions

UNIT III [8]
Toxicology and safety issues, Development and Production, Clinical trials, Patenting issues

UNIT IV [8]
Newer drugs, Drug discovery in cancer research/new target based drugs in clinical trials. Microbial genomics for new antibiotics, immunotoxin drug

Text Book

1. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
2. J.M. Haile , Molecular Dynamics Simulation Elementary methods, , John Wiley and Sons ,1997

References:

3. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
4. Remington's Pharmaceutical Science, Mark Publishing and Co.
5. The Organic Chemistry of Drug Design and Drug Action, by R. B. Silverman
6. An Introduction to Medicinal Chemistry by G. L. Patrick

BT 182 Basics of Forensic Science 2-0-0-2

UNIT I [8]
Introduction and principles of forensic science, tools and techniques in forensic science, Classification of injuries and their medico-legal aspects, method of assessing various types of deaths

UNIT II [6]
Fire arms and explosives, Handwriting analysis, Significance of toxicological findings

UNIT III [6]
Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification

UNIT IV [6]
Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Introduction to Cyber security.

Text Book:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

References:

3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

BT 291 Introductory Biomedical Science 2-0-0-2

UNIT I [8]

Introduction to human biology, Clinical biochemistry of human diseases, microbiology, epidemiology, and biomedical engineering

UNIT II [6]

Screening for disease, Application of biochemical techniques to inborn errors of metabolism, tumor markers, liver function, iron and porphyrins

UNIT III [7]

Enzymes and their use in laboratory medicine, clinical applications of protein biochemistry, nutrition in health and disease, lipids and atherosclerosis

UNIT IV [5]

Electronic devices used as sensors

Text Book

1. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

Reference

2. Campbell, N.A. and Reece, J.B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

BO 212 Plant Developmental Biology 2-0-0-2

UNIT I

Development and morphology of gametophyte – formation of vegetative and generative cells, microsporogenesis, organization of mature pollen grain, types of ovules, integument, nucellus, megasporogenesis, types of embryo sacs. [6]

UNIT II [4]
Pollination and fertilization – Pollen transfer, artificial pollination, pollen germination, double fertilization, self-incompatibility.

UNIT III [5]
Endosperm – development, cytology and functions of endosperm
Endosperm types - nuclear, cellular - helobial - Ruminate endosperms, function of endosperms.

UNIT IV [5]
Embryo – Development of embryo in Dicot (Capsella) and Monocot (Najas). A brief account on Polyembryony, parthenocarpy.

UNIT V [6]
Seed – Development, classification, dispersal and dormancy

Text Book

1. Plant Physiology by Taiz and Zeiger, Sinauer Associate Inc. Publishers

Reference

2. The Arabidopsis Book, ASPB publication (available freely at www.aspb.org)
3. Biochemistry and Molecular Biology of plants Ed. Buchanan, Grussem and Jones, ASPB publication.
4. Bhojwani. S.S. and Bhatnagar. S.P. 1978. The embryology of Angiosperms. Vikes Publishing Pvt. Ltd., Delhi.
5. Maheswari P.1971. An introduction to embryology of Angiosperms Tata Mc Graw Hill, Delhi.
6. Swamy B.G.L. and Krishnamurthy K.V. 1950. From flower to fruit. Tata Mc Graw Hill, Hew Delhi.

BO 222 Plant Developmental Biology Laboratory 0-0-2-1

Assignments are based on the course BO 212 Plant Developmental Biology containing exercises on plant developmental studies using permanent slides and embryo development related experiments.

BT 333 Introduction to Research Methodology 2-0-0-2

UNIT I [5]
Introduction to Research Methodology: Objectives and motivation in research

UNIT II
Defining the Research Problem, Selecting and defining a research problem, Reviewing and conducting literature search, developing a research plan [7]

UNIT III

Designing of Experiment, Number of Different experimental designs – single and multifactorial design [6]

UNIT IV

Making measurements and sources of error in measurements, Methods of data collection and record keeping. Report writing, Writing a research paper - abstract, introduction, methodology, results and discussion. [8]

Text Book

1. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi)

Reference

2. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
3. Montgomary, Douglas C. &Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
4. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT II [8]

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital

UNIT III [8]

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 **Plant and Animal Biotechnology** **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 **Tissue Culture Laboratory** **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics.	**[3]**
2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering.	**[3]**
3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases.	**[4]**
4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology.	**[3]**
5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs.	**[4]**
6. **Tissue Engineering** – Skin, Liver, Pancreas.	**[3]**
7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues.	**[3]**
8. **Drug delivery** – conventional & new approaches to drug delivery.	**[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,

2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.

4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their **[6]**

functions.

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
   (a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

   (b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**
   Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.

6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, **[6]**

Animal Environment, Extreme Habitats.

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]

3. Natural Resources: Renewable and Nonrenewable resources. [**2**]

4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. [**3**]
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of

Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION

B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.

6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of

Zoology; WCB Mc Graw-Hill, New Delhi

5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface **[4]**

tension and viscosity and parachore.

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and

racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.

2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics 2-0-0-2

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing

House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut

3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 Bio-Instrumentation 3-1-0-4

Principle of pH meter.	[1]
Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow.	[6]
Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications.	[8]
Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.	[8]
Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE.	[8]
Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography.	[8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson
and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith
G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, [4]

thermoregulation.

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.

3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.

4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory

based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination **[7]**

compounds, valence bond theory of transition metal complexes.

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T- [5]

lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's

equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV 2-0-0-2

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk and hazard associated with their use; Potential uses and applications [12]

of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc.

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory.

[7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture.

[8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement.

[8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement.

[8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods.

[8]

MB 331 General Microbiology **3-0-0-3**

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph [12]

Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters.

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al*.; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New

Delhi.

4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation. [4]

Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium). [5]

Biofuels: Bioethanol, Biodiesel, Methanogenesis. [4]

Biopesticides: Bacterial, Fungal and Viral pesticides. [4]

Biofertilizers: Nitrogen fixing microbes and their application in crop productions. [5]

Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and pesticide biodegradation, Biobleaching of industrial effluents. [6]

Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling. [6]

Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process. [5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.

6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 Environmental Biotechnology Laboratory **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 Tissue Culture Laboratory

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 Internship **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 Genetic Engineering **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase. [6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors.

[6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for selection of recombinant DNA molecules.

[6]

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing.

[7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen.

[6]

BT 352 Bioinformatics **3-0-0-3**

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP)

[5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized

[7]

databanks).

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X-ray crystallography), Algorithm for modeling protein folding. [5]

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 Bioprocess Engineering 3-0-0-3

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's [10]

mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation.

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics. [10]

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.), Bioprocess Engineering, Prentice Hall PTR, New Jersey. 1.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.* 2.
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York. 3.

***latest edition**

BT 334 Enzyme Technology 3-0-0-3

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes. [12]

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular emphasis on change in pH and hydrophobicty [8]

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of Biochemistry , MacMillian Worth Publishers, US.
2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.
3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.
4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.
5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.
6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different

biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory 0-0-2-1

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory 0-0-2-1

Assignments are based on the course BT 334 Enzyme Technology containing exercises on enzymes kinetics.

Mody University of Science and Technology

College of Arts, Science and Humanities

BSc PCM
2016-17

Department of Science

B. Sc. (PCM/PMC)
Physics, Mathematics, Computer Science/ Chemistry
Three-Year Programme
Academic Curriculum (2012 – 13 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[$]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total				**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total				**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total				**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢				**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry*** *<u>Or</u>* ***Computer Science*** *may only be opted in each semester.*

Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 321	Physics Laboratory-V	-	-	4	2	4	25	25	50
		Mathematics								
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 221	Database Management System	3	-	-	3	3	25	25	50
	CA 261	Database Management System Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	4			
		Sub Total				**20.5/18**				
		Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	Elements of Nuclear Physics	2	-	-	2	3	25	25	50
	PH 332	Physics Laboratory VI	-	-	4	2	4	25	25	50
		Mathematics								
	MS 312	Special functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 222	Computer Networks	3	-	-	3	3	25	25	50
	CA 262	Windows Programming Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry–VI	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	4			
		Sub Total				**21.5/19**				
		Proficiency (Non-Credit) #				**1**				

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

$ *Evaluation of internship would comprise project report and viva-voce.*

Optional Courses

§ -***Chemistry courses***

¢ -**Computer Science**

Note: **1**.*The Programme includes two different combinations:*

(i) PCM (Physics, Chemistry and Maths) &

(ii) PMC (Physics, Maths and Computer Science)

2. *In addition to the compulsory courses, either all courses of* ***Chemistry Or Computer Science*** *may only be opted in each semester*

Overall Credits: Physics: 41; Mathematics:40; Chemistry: 41: Computer Science: 36 (+5)

Total Credits (With Chemistry as optional) 135
Total Credits (With Computer Science as optional) 130

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics

2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz [12]

force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect.
Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics

2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for [8]

Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other

electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, **S**. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its [6]

Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix,	[13]

Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

MS 112 Abstract Algebra 3-0-0-3

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition.	[11]
Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group	[10]
Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem.	[10]
Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation.	[8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.

   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines.	[4]
First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form.	[14]
Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters	[12]
Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only)	[9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.

D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation [8]

formulae, Sterling, Bessel Formula.

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985

   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi

4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.

5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, “Information Systems for Modern Management”, PHI, New Delhi
2. Jawadkar, “Management Information System”, TMH, New Delhi

Reference Books:

1. Sadagopan, “Management Information System”PHI, New Delhi
2. Parker, Case, Thomas, “Management Information System: Strategies and Action”, TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between

critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D.

Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and **[8]**

chemical reactions of cycloalkenes.

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law

of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised

Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998,

Prentice Hall.

2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, [6]

Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India.

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge

Publications, UK.

CH 291	**Physical Chemistry-I**	**2-0-0-2**
	Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition.	**[7]**
	Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.	**[8]**
	Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects.	**[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213	**Inorganic Chemistry-I**	**2-0-0-2**
	Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[6]**
	Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[5]**
	Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.	**[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic .

substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept [8]

and embryonic induction. Embryo sexing and ageing.

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.

4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3-H_2O$) and ($CuSO_4-H_2O$) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-$HCl-H_2O$ and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass **[12]**

electrodes.

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides.

Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 **Laboratory Course in Chemistry-IV** **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

B.Sc. (Hons) Maths
Session 2016-2017

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc (Honours) in Mathematics
(Mathematics, Physics and Computer Science*/Chemistry)**
Three-Year Programme
Academic Curriculum
First Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
						5				
	Mathematics									
	MS 111	Calculus	3	-	-	3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 111	Mechanics, Properties of Matter and Relativity	3	-	-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 121	Programming concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 181	Physical and Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 23*/23.5**									
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 23
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

First Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
						6				
	Mathematics									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2	-	-	2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 122	Data Structure Through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
						8				
	Chemistry*									
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 27*/24.5**									
	GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 27

**Mathematics, Physics and Chemistry 24.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language I ‡	3	-	-	**3**	3	25	25	50
	Mathematics									
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
						7				
	Physics									
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
						8				
	Computer Science*									
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
						8				
	Chemistry**									
	CH 291	Physical Chemistry- I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry -III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry -III	-	-	3	**1.5**	4	25	25	50
						7.5				
	Total Credits: 26*/25.5**									
	GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Autumn Semester

*Mathematics, Physics and Computer Science 26

**Mathematics, Physics and Chemistry 25.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language II ‡	3	-	-	3	3	25	25	50
	Mathematics									
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3	3	25	25	50
						7				
	Physics									
Spring Semester	PH 212	Mathematical Physics and Special theory of Relativity	3	1	-	4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
						6				
	Computer Science*									
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 272	Physical Chemistry- II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry- II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry -IV	-	-	3	1.5	4	25	25	50
						7.5				
	Total Credits: 21*/23.5**									
	GE 202	Proficiency (Non-Credit) #	-	-	-	1	-	-		

‡ *Refer to the Foreign Languages Section*

*Mathematics, Physics and Computer Science 21
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Third Year -Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	Mathematics									
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
	MS 331	Combinatorics	3	-	-	3	3	25	25	50
	MS 341	Vector Calculus	3	-	-	3	3	25	25	50
	MS 351	Probability and Statistics	3	1	-	4	3	25	25	50
	MS 361	Analytical Solid Geometry	3	1	-	4	3	25	25	50
	Total Credits:21									
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Third Year - Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	Mathematics									
	MS 312	Special Functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
	MS 332	Advanced Calculus	3	-	-	3	3	25	25	50
	MS 342	Graph Theory	3	-	-	3	3	25	25	50
	MS 352	Basic Differential Geometry	3	-	-	3	3	25	25	50
	MS 362	Dissertation	-	-	-	5	-	100		
	Total Credits:21									
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Total Credits (all Semester)- 139/139

$ CW (Course work): It would include attendance, assignments, class /quiz test.

MS 331 **Combinatorics** **3-0-0-3**

1. Relation: Definition, different forms, properties and operations on sets, principle of inclusion and exclusion, partition of a set, definition of relation, types of relation, composition, properties and graphical representation of relation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice and different forms. **[10]**

2. Function: Properties, definition of function and different forms, composition and properties of functions, recursively defined functions, applications of functions. **[10]**

3. Induction: Mathematical induction, strong induction and well-ordering, definition of recursive, structural induction. **[10]**

4. Counting: Basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.

Reference Books:

1. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd edt., Mc Graw Hill Education, New Delhi.
2. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International

MS 341 **Vector Calculus** **3-0-0-3**

1. Vector Differentiation I: Vector algebra, operations with vectors, scalar and vector product of three vectors, product of four vectors, reciprocal vectors, scalar-valued functions over the plane and the space, vector function of a scalar variable, curves and paths, vector differentiation. **[10]**

2. Vector Differentiation II: Directional derivative, gradient of a scalar function, conservative field, divergence, curl, related properties of gradient, divergence and curl of sums, second order differential operator, cylindrical and spherical coordinates. **[10]**

3. Vector Integration I: Integration of a vector function of a scalar argument, line integral, work done , potential, conservative field and area, surface integrals, surface area and flux, volume integrals. **[10]**

4. Vector Integration II: Green's theorem in plane, transformation between line integral and double integral, area in Cartesian and polar coordinate, Stoke's theorem, Gauss divergence theorem. **[09]**

Text Books:

1. Shanti Narayna, A Text Book of Vector Calculus by, S. Chand & Co., New Delhi.
2. R.Murrary, Theory and Problems of Advanced Calculus by Spiegal, Schaum's Publishing Company, New York.

Reference Books:

1. N. Saran and S.N. Nigam, Introduction to Vector Analysis by Pothishala Pvt. Ltd., Allahabad.
2. Thomas, Calculus by Thomas, 11 Editions, Pearson.
3. G. Paria, A Text Book on Vector Calculus by Scholar's Publishing House, Indore.
4. B.V. Ramana(2006), Higher Engineering Mathematics by TMH.

MS 351 **Probability and Statistics Theory** **3-1-0-4**

1. Basic Statistics: Mean, mode, median for grouped and ungrouped data, variance, standard deviation, dispersion and measures of dispersion, skewness and measures of skewness, moments. **[10]**

2. Probability Theory: Recapitulation of basic probability theory, law of addition and law of multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[10]**

3. Random Variables and Distribution: Discrete and continuous random variables, types of distribution, probability mass and density functions, mean variance and standard deviation of distribution, discrete distributions (binomial and Poisson), continuous distributions (normal and uniform). **[10]**

4. Hypothesis and Correlation-Regression: Simple and composite hypothesis, type I and type II errors, tests of significance, simple correlations, linear regression. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics, 3rd ed., SCS Publisher.

MS 361 **Analytical Solid Geometry** **3-1-0-4**

1. Plane and Straight Line: Different form of plane, angle between two planes, perpendicular distance of a point from a plane, plane through intersection of two planes, bisectors of two intersecting planes, locus of a plane, different form of straight line, angle between two lines, distance of a point from a straight line, coplanarity of straight lines, shortest distance between two lines, intersection of three planes. **[10]**

2. Sphere: Different form of sphere, plane section of a sphere, intersection of two spheres, sphere through a given circle, intersection of a straight line and sphere, tangent planes and normal, touching spheres and condition of orthogonality. **[10]**

3. Conicoids I: Different form of cone, equation of the cone with given vertex and a given conic for its base, angle between the lines in which a plane cuts a con, tangent lines and tangent plane, reciprocal con, right circular con, different form of cylinder, equation of tangent plane, enveloping cylinder, right circular cylinder. **[10]**

4. Conicoids II: Ellipsoid, hyperboloid of one and two sheets, elliptic paraboloid , hyperbolic paraboloid, tangent plane , equation of normal, director sphere, polar plane and pole of the plane. **[09]**

Text Books:

1. R.J.T. Bell (1994), Elementary Treatise on Co-Ordinate Geometry of Three Dimensions by, Macmillan India Ltd.
2. Shanti Narayan, Analytical Solid Geometry by S. Chand & Company, New Delhi.

Reference Books:

1. Deepak Chatterjee, Analytic Solid Geometry by PHI Learning Private Ltd., New Delhi.
2. H.M. Vasavada (1992), Analytical Geometry of Two and Three Dimensions.

MS 332 **Advanced Calculus** **3-0-0-3**

1. Preliminary: Functions, continuity, the derivative, composite functions Rolle's theorem, theorem of the mean, Taylors's series with remainder indeterminate forms, fundamental theorems on infinitesimals. **[10]**

2. Power Series: Definition, tests for convergence, region of convergence, uniform convergence, integral and derivative of power series, operations with two power series, exponential, trigonometric, hyperbolic and dominant functions, conditionally convergent series. **[10]**

3. Partial Differentiation: Functions of two variables, partial derivatives of composite function, Euler's theorem on homogeneous functions, directional derivative, higher differential, implicit functions, one equation of two or more variables, two equations of four variables, four equations of six variables, Jacobians. **[10]**

4. Definite Integral: Definition and properties, existence proof, Simpson's rule, change of variables, differentiation of a definite integral, differentiation under the integral sign, differentiation and integration of integral with infinite limit, infinite integrand, multiple integrals, beta and gamma functions, Dirichlet's integral. **[09]**

Text Books:

1. Frederick S Woods (1934), Advanced Calculus by Ginn and Company.
2. George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Thomas Calculus by Pearson.

Reference Books:

1. R.C Buck , Advanced Calculus by Waveland Press, Inc.
2. Walter Rudin, Principles of Mathematical Analysis by McGraw-Hill.
3. Gerald B. Folland, Advanced Calculus by Pearson.

MA 342 **Graph Theory** **3-0-0-3**

1. Graphs: Introduction, definition and applications of graphs, finite and infinite graphs, null graph, sub graphs, incidence and degree, isolated vertex, pendant vertex, walk, path and circuits, connected graphs, disconnected graphs and components, isomorphism, Euler graphs, operations on graphs, Hamiltonian paths and circuits, the travelling sales man problem, matrix representation of graphs, properties and some standard theorems on graphs. **[10]**

2. Directed Graphs: Definition, in-degree, out-degree, isomorphic digraphs, types of digraphs, digraph and binary relations, relation matrices, directed paths and connectedness, Euler digraphs, fundamental circuits in digraphs, properties and some standard theorems on digraphs. **[10]**

3. Trees: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's algorithm and Prim's algorithm. **[10]**

4. Cut-Sets and Cut-Vertices: Cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism, some standard theorems. **[09]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science, PHI.
2. Chartland G., Zhang P. (2006) Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.

MS 352 **Basic Differential Geometry** **3-0-0-3**

1. Preliminaries: Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces orientation, the gauss map. **[10]**

2. Tensors: Definition of tensors and basic properties, Christoffel symbols, uses of tensors in differential geometry. **[10]**

3. Geodesics I: Parallel transport, Weingarten map, curvature of plane curves, arc length and the line integrals, curvature of surfaces. **[10]**

4. Geodesics II: Envelops and evolutes, first fundamental form, metric potentials, direction coefficient and angle between two curves on a surface. **[09]**

Text Books:

1. Chuan-Chih Hsiung (1997), A First Course in Differential Geometry by International Press, Cambridge.
2. T.J. Willmore(1964), An Introduction to Differential Geometry by Oxford University Press.

Reference Books:

1. M. Abate and F. Tovena, Curves and Surfaces by Springer.
2. A. K. Peters (2010), Differential Geometry of Curves and Surfaces by Ltd., Natick.
3. D.J. Struik(1988) , Lectures on Classical Differential Geometry by 2nd Edition, Addison-Wesley.

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0\mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 *Physics Laboratory-I* 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. [7]

Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission [10]

grating and its resolving power.

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.

3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10] [8]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and [8]

grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments.

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of [6]

cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon-nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and [6]

Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]
Applications of Matrices: Applications of matrices to a system of linear	[9]

(both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.

2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem.	[10]
Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence.	[9]
Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence.	[12]
Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus.	[8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd.,

Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 *C Language Laboratory* 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi
4. Achyut S Godbole, "Operating Systems", TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and [8]

Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes.

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, "Let Us C++", BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, "Mastering C++" , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, "C++ The Complete Refernce", TMH, New Delhi.
2. Lafore R, "Object Oriented Programming Using C++", GalgotiaPulications, New Delhi
3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 *Computational Numerical Analysis Laboratory* **0-0-4-2**

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular

velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's **[5]**

equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey,

reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child [5]

Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and

pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand

& Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223	**Organic Chemistry-III**	**2-0-0-2**
	Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones.	**[6]**
	Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds.	**[6]**
	Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol.	**[5]**
	Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction.	. **[5]**
	Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.	**[4]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing [8]

mechanism

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology 3-0-0-3

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons, Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal

system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.

4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

B.Sc. (Hons) Psychology
Session 2016-2017

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (Hons.) Psychology
Starting from year 2015-2016
College of Arts, Science and Humanities

A new programme B.Sc. (Hons.) Psychology is being proposed as a new programme. Since one student had already taken admission in this programme in academic year 2015-16, therefore, the new programme would be effective with retrospective approval from academic year 2015-16. The first year of the programmes comprises a few existing courses from B.Sc. / B.Sc. (Hons.) programme along with few additional existing courses of B.A / B.A. (Hons.) Psychology. The need, input qualification, number of seats, the first year curricular structure etc. is given as under. The second and third year curricular structure would be approved in due time.

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)

No. of Seats: 10

Introduction:

Psychology is one of the important disciplines in the area of behavioural sciences. It is the scientific study of human behaviour. In the present era of stress and change, there has been rapid increase in the demand of professionals in the various fields of Psychology. Considering such requirements, it is proposed to start an undergraduate programme in Psychology, namely, B. Sc. (Hons.) in Psychology, with the aim of acquiring basic knowledge and skills in the fields of Psychology. The first batch of the programme in CASH is proposed to be admitted in the session 2015-2016.

Input Qualification:

Candidate should have passed 10+2 from a recognized Board with proficiency in English. The candidates should have studied Physics, Chemistry and Biology at 10+2 or equivalent stage.

Programme and Teaching Methodology

The teaching methods include lectures, practicals, field visits, workshops, seminars, field visits, guest lectures etc.

Evaluation Procedure:

Students are assessed through examinations, assignments, laboratory skills and presentations as per the University examination system.

B.Sc. (Hons.) Psychology
Three-Year Programme
Academic Curriculum (2015 – 16 onwards)
College of Arts, Science and Humanities
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab. -I	-	-	2	1	4	25	25	50
	PL 111	Basic Psychological Processes-I	3	-	-	3	3	25	25	50
	PL 121	Experimental Methodology & Elementary Statistics-I	3	-	-	3	3	25	25	50
	PL 131	Psychology - I	-	-	2	1	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	ZO 132	Animal Diversity - II	3	-	-	3	3	25	25	50
	BT 152	Genetics	3	1	-	4	3	25	25	50
	PH 112	Basic Physics	2	-	-	2	3	25	25	50
	ZO 142	Animal Diversity Lab. -II	-	-	2	1	4	25	25	50
	PL 112	Basic Psychological Processes-II	3	-	-	3	3	25	25	50
	PL 122	Experimental Methodology & Elementary Statistics-II	3	-	-	3	3	25	25	50
	PL 132	Psychology - II	-	-	2	1	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	**20**	**2**	**4**	**24**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (Hons.) Psychology
Three-Year Programme
Academic Curriculum (2015 – 16 onwards)
College of Arts, Science and Humanities
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Lab	-	-	2	1	3	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	BT 271	Food Technology	2	-	-	2	4	25	25	50
	BT 261	Food Technology Lab.	-	-	2	1	4	25	25	50
	PL 221	Psychology of Human Development - I	3	-	-	3	3	25	25	50
	PL 231	Applied Psychology - I	3	-	-	3	3	25	25	50
	PL 241	Psychology Lab - III	-	-	2	1	4	25	25	50
		Foreign Language-I[‡]	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue culture Laboratory	-	-	2	1	4	25	25	50
	PL 212	Psychology of Human Development - II	3	-	-	3	3	25	25	50
	PL 222	Applied Psychology - II	3	-	-	3	3	25	25	50
	PL 242	Psychology Lab - IV	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

[‡] *Refer to the Foreign Languages Section*

B.Sc. (Hons.) Psychology
Three-Year Programme
Academic Curriculum (2015 – 16 onwards)
College of Arts, Science and Humanities

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW *	MTE	ETE
Autumn Semester	PL 311	Social Psychology-I	3	-	-	3	3	25	25	25
	PL 321	Biological Basis of Behaviour	3	-	-	3	3	25	25	50
	PL 331	Systems of Psychology	3	-	-	3	3	25	25	50
	PL 341	Psychopathology-I	3	-	-	3	3	25	25	50
	PL 351	Industrial and Organizational Psychology-I	3	-	-	3	3	25	25	50
	PL 361	Psychological Testing-I	3	-	-	3	3	25	25	50
	PL 371	Psychology Lab.-V	-	-	4	2	3	25	25	50
		Sub Total	**18**	**-**	**4**	**20**				
	GE 303	Proficiency (Non-Credit) #				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW *	MTE	ETE
Spring Semester	PL 312	Social Psychology-II	3	-	-	3	3	25	25	25
	PL 322	Guidance and Counseling	3	-	-	3	3	25	25	50
	PL 332	Experimental Psychology	3	-	-	3	3	25	25	50
	PL 342	Psychopathology-II	3	-	-	3	3	25	25	50
	PL 352	Industrial and Organizational Psychology-II	3	-	-	3	3	25	25	50
	PL 362	Psychological Testing-II	3	-	-	3	3	25	25	50
	PL 372	Psychology Lab.-VI			4	2	3	25	25	50
		Sub Total	**18**	**-**	**4**	**20**				
	GE 306	Proficiency (Non-Credit) #				1				

Total Credits **130**

PL 111 Basic Psychological Processes-I 3-0-0-3

UNIT-I
Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

UNIT-II
Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

UNIT-III [6]
Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance.

UNIT-IV [9]
Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.

UNIT-V [8]
Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

UNIT-I
Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

[5]

UNIT-II
Problems and Hypothesis: Nature, Type and Sources.

[7]

UNIT-III
Variables: Nature and Types; Control of Variables.

UNIT-IV [5]
Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement.

UNIT-V
Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

UNIT-VI [8]
Measures of Central Tendency: Mean, Median and Mode.

UNIT-VII
Reliability of Statistics: Significance of Difference Between Two Means [3]

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., &Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 131 Psychology Lab.-I 0-0-2-1

Assignments are based on the course PL 111 Basic Psychological Processes-I containing exercises on learning and personality.

PL 112 Basic Psychological Processes-II 3-0-0-3

UNIT-I
Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

UNIT-II
Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

[6]

UNIT-III
Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.

[9]

UNIT-IV
Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation.

[9]

UNIT-V
Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference:

2. Atkinson, R. L., Atkinson, R. C., &Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 122 Experimental Methodology & Elementary Statistics-II 3-0-0-3

UNIT-I [4]
The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales.

UNIT-II [7]
Sampling Methods: Probability and Non-Probability Sampling Methods.

UNIT-III [8]
Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs.

UNIT-IV [5]
Measures of Variability: Range, Quartile Deviation and Standard Deviation.

UNIT-V [4]
Normal Probability Curve: Properties and Applications. Skewness and Kurtosis.

UNIT-VI [6]
Reliability of Statistics: Chi-Square.

UNIT-VII [5]
Correlations: Product-Moment and Rank Order.

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., & Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 132 Psychology Lab.-II 0-0-2-1

Assignments are based on the course PL 112 Basic Psychological Processes-II containing exercises on memory and intelligence.

PL 221 Psychology of Human Development-I 3-0-0-3

UNIT-I [8]
Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.

UNIT-II [6]
Determinants of Development: Biological and Socio- Cultural.

UNIT-III [9]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.

UNIT-IV [8]
Prenatal Development: Stages and Factors Affecting Prenatal Development.

UNIT-V [8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.

Text Books:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 231 Applied Psychology-I 3-0-0-3

UNIT-I [8]
Introduction: Nature and Fields of Applied Psychology.

UNIT-II
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services. [7]

UNIT-III [6]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling.

UNIT-IV [9]
Psychology in Education: School as an Agent of Socialization, Factors

Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.

UNIT-V [9]
Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. Rao, S. N. Counselling and Guidance. Tata McGraw-Hill, New Delhi.
4. Charles, J. G., & Bruce, R. F. Counseling Psychology: Practices, Issues and Intervention. CENGAGE Learning, New Delhi.
5. Sue, R., Sue, D., & Sue, S. Understanding Abnormal Behaviour. Houghton Mifflin.

PL 241 Psychology Lab.-III 0-0-2-1

Assignments are based on the courses PL 221 Psychology of Human Development-I and PL 231 Applied Psychology-I containing exercises on the study of the characteristics of the neonate and guidance and counseling.

PL 212 Psychology of Human Development-II 3-0-0-3

UNIT-I
Development during Infancy: PhysicalGrowth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

UNIT-II
Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

UNIT-III [9]
Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity.

UNIT-IV [8]
Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family.

UNIT-V [8]
Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues.

Text Book:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 222 Applied Psychology-II 3-0-0-3

UNIT-I

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

UNIT-II

Psychology and Health: Mental Health and General Health, Dimensions of Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

UNIT-III

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

UNIT-IV

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

UNIT-V

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. Industrial Psychology. Prentice Hall, Englewood Cliffs.
4. Misra, G. Psychological Perspective on Stress and Health. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. Social Psychology. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. Psychology in Sports: A Contemporary Perspective. Friends, New Delhi.

PL 232 Psychology Lab.-IV 0-0-2-1

Assignments are based on the courses PL 212 Psychology of Human Development-II and PL 222 Applied Psychology-II containing exercises on the study of developmental pattern of various stages of human life and stress management.

PL 311 Social Psychology - I 3-0-0-3

UNIT-I [3]
Social Psychology: Nature and Subject Matter; Relationship with other social sciences.

UNIT-II [5]
Methods: Experimental, Observation, and Sociometry.

UNIT-III
Socialization: Nature, Process and Agents of Socialization. [4]

UNIT-IV [8]
Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.

UNIT-V [5]
Social Norms: Meaning, Characteristics and Formation

UNIT-VI [6]
Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants

UNIT-VII [8]
Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional

Text Book:

1. Baron, R.A., Byrne, D. Social Psychology (10th Edn)-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E.The Handbook of Social Psychology (2nd Edn.), Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S. Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M.Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. Social Psychology (8th Edn.)-Tata McGraw Hill International Editions.
7. Penrod, S. Social Psychology (2nd Edn.) New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K.Samaj Manovigyan Ki Rooprekha (6th Edn), NewDelhi: MotiLal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O.Social Psychology (12th Edn) - Pearson Education

PL 321 Biological Basis of Behaviour 3-0-0-3

UNIT-I
Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical. [6]

UNIT-II
Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters. [7]

UNIT-III
Nervous System: Central nervous system and Peripheral nervous system – Structure and Functions. Endocrine system and its behavioral implications. [9]

UNIT-IV
Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention. [6]

UNIT-V
Motivation: Neural mechanism of Hunger, Thirst and Sex [5]

UNIT-VI
Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory. [6]

Text Book:

1. Carlson, N.Biology of Behavior. Boston : Allyn and Bacon.
2. Graham, R.B.Physiological Psychology. California :Wadsworth.

Reference Book

3. Grossman, S.P. A Text book of Physiological Psychology. New York :Siley.
4. Hoyenga, K.B. and Hoyenga, K.T.Psychobiology : The neuron and Behavior. California :Broks/Cole.
5. Kalat, J.N.Biological Psychology. California :Wadsworth.
6. Levinthal, C.R.Introduction of Physiological Psychology. New Jersey : Prentice Hall.
7. Pinel, Johan, P.J.Biopsychology.Boston : Allyn and Bacon.
8. Rosenzweig, M.R. and Liemen, A.L.Physiological Psychology. New York : Random House.

PL 331 Systems of Psychology 3-0-0-3

UNIT-I
Nature and scope of Psychology: Psychology as science; Historical Origins: Pre-experimental period- Science Among Greeks, British Empiricism, German Nativism. [4]

UNIT-II
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status [5]

UNIT-III
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner. [7]

UNIT-IV [6]

Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.

UNIT-V [6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).

UNIT-VI [5]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.

UNIT-VII [6]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.

Text Book

1. Chaplin, T. Kraweic, T.S. Systems and Theories of psychology. Holt Rinehart and Winston.
2. Schiffman, H.R. Sensation and Perception. New York: John Wiley and Sons.

Reference Book

3. Hilgard, E.H., and Bower, G.H. Theories of Learning. Englewood Cliffs : Prentice Hall.
4. Matlin, M.W. Cognition. Bangalore : Prism.
5. Mazur, J.E.Learning and Behaviour. Englewood Cliff's : Prentice Hall.
6. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology. London : Methuen and Co.
7. Marks, M.H. and William, A. Cronan – Hillix, Systems and Theories in psychology. McGraw Hill International Editions, Psychology Series.
8. Vygotsky, L.S. Thought and Language, Cambridge, mass. MIT Press.
9. Hall C.S. :Lindzey, G. Theories of Personlaity. New York : Wiley Eastern Limited.

PL 341 Psychopathology-I **3-0-0-3**

UNIT-I [3]
Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.

UNIT-II [7]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.

UNIT-III [3]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.

UNIT-IV [5]
Diagnostic Assessment: Case History, Interview, Projective Techniques

UNIT-V [12]
Anxiety Based Disorders: Nature, Symptoms and Etiology-Generalized Anxiety Disorders, Phobia, O.C.D, Conversion Hysteria and Dissociative Disorders

UNIT-VI [5]
Psycho physiological Disorders: Nature, Symptoms and Etiology – Asthma, Peptic Ulcer, CHD, Hypertension

UNIT-VII [4]
Mental Retardation: Nature, Types, Causes and its Management

Text Book:

1. Carson, R.C.; Butcher, J.N., et al. Abnormal Psychology ; New Delhi: Pearson Education.

Reference Book

2. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior ;New Delhi: PearsonEducation Inc.
3. Davison, G.C. & Neale, J.M. Abnormal Psychology ;New York: Willy.

PL 351 Industrial and Organizational Psychology-I 3-0-0-3

UNIT-I
Industrial/Organizational Psychology: Nature, historical development and scope. [5]

UNIT-II
Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing. [9]

UNIT-III [9]
Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme

UNIT-IV [10]
Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal

UNIT-V [6]
Work environment: Noise, atmospheric conditions. Illumination and performance

Text Book

1. Blumm M.L. abdNylor, J.C.Industrial Psychology. N.Y : Harper & Row.
2. Davis. K.Human Behaviour at Work. New Delhi : Tata McGraw Hill.
3. Dunnet, M.D.Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.

Reference Book

4. Ganguli, H.C.The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.
6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour,New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A.Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.

9. Mohanty G.Industrial and Organizational Psychology New Delhi: Oxford and IBH.

PL 361 Psychological Testing-I 3-0-0-3

UNIT-I [9]
Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.

UNIT-II [9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.

UNIT-III [9]
Validity: meaning, validation procedures, and special problems.

UNIT-IV [12]
Construction and Standardization of Psychological Tests
General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S.Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L. Psychological Testing : Design, Analysis and UseBoston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods. New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B.Clinical methods in psychology. New York : Wiley inter science publication.

PL 371 Psychology Lab.-V 0-0-4-2

Assignments to be based on the course PL 311 (Social Psychology), PL 341 (Psychopathology) AND PL 351 (Industrial and Organizational Psychology).

PL 312 Social Psychology-II 3-0-0-3

UNIT-I [6]
Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.

UNIT-II [6]
Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects.

UNIT-III [6]
Attribution process Nature and theories: Kelly and Weiner.

UNIT-IV [5]
Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies

UNIT-V [5]
Propaganda: Nature, Tools and Techniques

UNIT-VI [5]
Aggression and Violence: Nature, Determinants and Management.

UNIT-V [6]
Social Change: Nature, Factors and Theories.

Text Book

1. Baron, R.A., Byrne, D. Social Psychology-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E..The Handbook of Social Psychology, Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S .Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. .Social Psychology-Tata McGraw Hill International Editions.
7. Penrod, S.Social Psychology ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Taylor, S.E. Peplau, L.A. Sears, D.O. Social Psychology -Pearson Education.

PL 322 Guidance and Counseling **3-0-0-3**

UNIT-I
Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational. [5]

UNIT-II [5]
Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.

[9]

UNIT-III
Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.

[9]

UNIT-IV
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.

UNIT-V
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling. [7]

UNIT-VI [4]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.

Text Book

1. Bernard, H.W. and Fullmer, D.W.Principles of Guidance. New York : Crowell.
2. Burnard, Philips; Counseling skills for Health Professional. Madras: Chapman and Hall.

Reference Book

3. Crow, L.D. and Crow, A.; Introduction to Guidance. New Delhi: Imersia Pub.
4. Gelso, G. J. and Fretz B.R. ; Counseling psychology, Banglore : Prism.
5. Jones, J.F. ;Principles of Guidance. NY : McGraw Hill.
6. Lynn, S.J. and Garske, J.P. Contemporary Psychotherapies, and methods. Ohio, Bell and Howell.
7. Rao, S.N. Counselling and Guidance, New Delhi : Tata MC Grw Hill.

PL 332 Experimental Psychology 3-0-0-3

UNIT-I
Experimental Psychology: Nature and History, Experimental Method

[4]

UNIT-II
Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. Perception: Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.

[9]

UNIT-III
Psychophysics: Problems and Methods of Classical Psychophysics.

[8]

UNIT-IV
Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.

[6]

UNIT-V
Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning

[5]

UNIT-VI
Verbal Learning: Methods, Materials, Organizational Processes.

[3]

UNIT-VII [4]
Discrimination Learning: Phenomena, Procedures and paradigms

Text Book

1. Bourne, L.E. Jr., Dominowski, R.L., & Loftus, E.F.Cognitive Processes. New Jersey. Prentice Hall.
2. D' Amato, M.R. Experimental Psychology. New Delhi: Tata McGraw Hill.

Reference Book

3. Flaherty, C.F. et. Al. Learning and Memory. Chicago: Rn McNally Pub.Co.
4. Gordon, W.C. Learning and Memory. California: Brooks / Cole.
5. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology.London: Methuen & Co.
6. Mazur. Learning and Behavour, New Delhi: Prentice Hall of India.
7. Snodgrass, J.G., Berger, G.L., & Haydon, M. Human Experimental Psychology, New York: Oxford.
8. Solso, R.L.Cognitive Psychology Allyn& Bacon.

PL 342 Psychopathology-II 3-0-0-3

UNIT-I

Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation. [6]

UNIT-II [10]

Mood Disorders: Unipolar and Bipolar Symptoms and Etiology

UNIT-III [11]

Schizophrenia: Nature , Symptoms , Types and Etiology

UNIT-IV

Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT [12]

Text Book

1. Carson, R.C.; Butcher, J.N., et al.. Abnormal Psychology NewDelhi: Pearson Education.

Reference Book

2. Davison, G.C. & Neale, J.M. Abnormal Psychology New York: Willy
3. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior New Delhi: Pearson Education Inc.

PL 352 Industrial and Organizational Psychology-II 3-0-0-3

UNIT-I

Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory. [7]

UNIT-II

Job Satisfaction: Concept, determinants and measurement. [5]

[6]

UNIT-III

Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.

UNIT-IV

Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents. [6]

UNIT-V [6]
Human engineering: Man-machine system. Designs, displays, controls and action.

UNIT-VI
Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions. [9]

Text Book

1. Blumm M.L. and Nylor, J.C. Industrial Psychology. N.Y. : Harper & Row.
2. Davis. K. Human Behaviour at Work. New Delhi : Tata McGraw Hill.

Reference Book

3. Dunnet, M.D. (Ed.).Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.
4. Ganguli, H.C. The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.
6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour, New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A. Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
9. Mohanty G. Industrial and Organizational psychology New Delhi: Oxford and IBH.

PL 362 Psychological Testing-II **3-0-0-3**

UNIT-I [9]
Personality Tests: Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors.

UNIT-II [9]
Projective- Rorschach and TAT.

UNIT-III [8]
Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.

UNIT-IV [6]
Measurement of aptitude and Interest

UNIT-V [7]
Measurement of Creativity- Torrance Test
Anxiety and Depression,

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S. Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L.Psychological Testing : Design, Analysis and use Boston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods ,New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B. Clinical methods in psychology. New York : Wiley inter science publication.

PL 372 Psychology Lab.-VI **0-0-4-2**

Assignments to be based on the course PL332 (Experimental Psychology), PL342(Psychopathology) and PL362 (Psychological Testing-II).

BT 271 Food Technology **2-0-0-2**

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**
2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**
3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**
4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**
5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory **0-0-2-1**

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 **Plant and Animal Biotechnology** **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 **Tissue Culture Laboratory** **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 **Medical Biotechnology** **2-0-0-2**

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. **[8]**

Microbial degradation of xenobiotics. Sewage biodegradation.

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,
2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.
4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**

(a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

(b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: **[5]**

Staphylococcus aureus, Clostridium botulinum and mycotoxins; Indices of food sanitary quality and sanitizers.

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]
2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]
3. Natural Resources: Renewable and Nonrenewable resources. [**2**]
4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]
5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]
6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. [**3**]

Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of

Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION
B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome) [6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]
Porifera: Canal system; Endoskeleton, Reproduction. [3]
Coelenterata: Nematocysts, polymorphism. [3]
Ctenophora: Affinities. [1]
Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]
Annelida: Excretion in annelids. Type study – Earthworm. [6]
Mollusca: Respiration. [1]
Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]
Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]
Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing

exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals.

Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated

dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster [6]

management – Floods, Earthquakes, Cyclones and Landslides.

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: *Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.* [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson

and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 **Mathematics and Statistics for Biology** **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

Mody University of Science and Technology

College of Arts, Science and Humanities

BSc CBZ
2016-17

Department of Science

B.Sc. CZ Biotechnology/Biochemistry/Microbiology
Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	4	25	25	50
	ZO 121	Animal Diversity Laboratory-I	-	-	2	1	4	25	25	50
		Sub Total	15	1	9	20.5				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	BT 152	Genetics	3	1	-	4	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
	PH 112	Basic Physics	2	-	-	2	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	ZO 142	Animal Diversity Laboratory-II	-	-	2	1	4	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	21	2	11	28.5				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

CW: Course Work; MTE: Mid Term Examination; ETE: End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.# Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

B.**Sc. CZ Biotechnology/Biochemistry/Microbiology**
Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	Biotechnology									
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology lab	-	-	2	1	4	25	25	50
	Biochemistry									
	BC 231	Metabolism	2	-	-	2	3	25	25	50
	Microbiology									
	MB 211	Microbial Physiology and Genetics	2	-	-	2	3	25	25	50
	MB 221	Microbial Physiology and Genetics lab	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	17	1	9/7/9	22.5/21.5/22.5				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	Biotechnology									
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	4	25	25	50
	Biochemistry									
	BC 212	Plant Biochemistry	2	-	-	2	3	25	25	50
	Microbiology									
	MB 242	Food and Industrial Microbiology	2	-	-	2	3	25	25	50
	MB 252	Food and Industrial Microbiology lab	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Sub Total	18/17/17	1	9/7/9	22.5/21.5/22.5				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ Refer to the Foreign Languages Section

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B.Sc. CZ Biotechnology/Biochemistry/Microbiology
Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	**Compulsory Courses**									
	ZO 311	Ecology and Economic Biology	3	-	-	3	3	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	4	25	25	50
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	4	25	25	50
	Biotechnology									
	BT 391	Medical Biotechnology	2	-	-	2	3	25	25	50
	Biochemistry									
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
	BC 321	Nutritional and Clinical Biochemistry Lab	-	-	2	1	4	25	25	50
	Microbiology									
	MB 351	Medical Microbiology	2	-	-	2	3	25	25	50
	MB 361	Medical Microbiology Lab	-	-	2	1	4	25	25	50
		Sub Total	16/16/16	2/3/2	5/7/7	20.5/22.5/21.5	-			
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-			

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
0Spring Semester	**Compulsory Courses**									
	BT 352	Bioinformatics	3	-	-	3	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry–VI	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	4	25	25	50
	ZO 332	Zoology Laboratory	-	-	2	1	4	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	Biotechnology									
	BC 312	Enzyme and Industrial Biochemistry	3	-	-	3	3	25	25	50
	BC 322	Enzyme and Industrial Biochemistry Laboratory	-	-	2	1	4	25	25	50
	Biochemistry									
	BC 312	Enzyme and Industrial Biochemistry	3	-	-	3	3	25	25	50
	BC 322	Enzyme and Industrial Biochemistry Laboratory	-	-	2	1	4	25	25	50
	Microbiology									
	MB 312	Microbial Ecology	2	-	-	2	3	25	25	50
	MB 322	Microbial Ecology Lab	-	-	2	1	4	25	25	50
		Sub Total	15/15/14	0	9/9/9	19.5/19.5/18.5	-			

	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

Total Credits 130/130/130

CW: Course Work; MTE: Mid Term Examination; ETE: End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.# Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

SYLLABUS FOR NEW PAPERS OF BIOTECHNOLOGY

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 Plant and Animal Biotechnology 2-0-0-2

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its **[9]**

constituents; Sterilization

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Anianl Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 Tissue Culture Laboratory 0-0-2-1

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C.

Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,
2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.
4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and **[7]**

calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**

(a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

(b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid **[5]**

waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment.

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance **[2]**

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem **[2]**

3. Natural Resources: Renewable and Nonrenewable resources. **[2]**

4. Human Population and Environment: Population Growth, World and Indian scenario. **[2]**

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. **[2]**

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. **[3]**
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION
B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 Cell Biology 3-1-0-4

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of

eukaryotic chromosome, Giant chromosome) [6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 Animal Diversity-I **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave

equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.

2. The elements of Physical Chemistry, P.W. Atkins, 4th Edition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation,

electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 General Biochemistry **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs [6]

cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon

compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond

lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy [5]

Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis.

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt.

Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy. [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition - David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology 2-1-0-3

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New

Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. **[11]**

Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213	**Inorganic Chemistry-I**	**2-0-0-2**
	Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[6]**
	Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[5]**
	Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.	**[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization .

of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons, Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272	**Physical Chemistry-II**	**2-0-0-2**
	Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications.	**[10]**
	Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes.	**[12]**
	Chemical Equilibrium: Equilibrium constant and free	

energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare,

Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic **[6]**

acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk and hazard associated with their use; Potential uses and applications of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc. [12]

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory. [7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture. [8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement. [8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. [8]

Gene Transfer in Plants: Agrobactrium tumefaciens and

Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods. [8]

MB 331 General Microbiology 3-0-0-3

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters. [12]

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al*.; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New Delhi.
4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation.	[4]
Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium).	[5]
Biofuels: Bioethanol, Biodiesel, Methanogenesis.	[4]
Biopesticides: Bacterial, Fungal and Viral pesticides.	[4]
Biofertilizers: Nitrogen fixing microbes and their application in crop productions.	[5]
Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and pesticide biodegradation, Biobleaching of industrial effluents.	[6]
Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling.	[6]
Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process.	[5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells.	[8]
Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells.	[8]
Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures.	[8]
Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells	[8]
Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization.	[7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.
6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 Environmental Biotechnology Laboratory **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 Tissue Culture Laboratory

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 Internship **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 Genetic Engineering **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase. [6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors. [6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for [6]

selection of recombinant DNA molecules.

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing. [7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen. [6]

BT 352 Bioinformatics 3-0-0-3

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP) [5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized databanks). [7]

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X-ray crystallography), Algorithm for modeling protein folding. [5]

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 **Bioprocess Engineering** **3-0-0-3**

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation. [10]

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics. [10]

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.,), Bioprocess Engineering, Prentice Hall PTR, New Jersey.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.*
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York.

***latest edition**

BT 334 **Enzyme Technology** **3-0-0-3**

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity [12]

measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes.

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular emphasis on change in pH and hydrophobicty [8]

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of Biochemistry , MacMillian Worth Publishers, US.
2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.
3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.
4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.
5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.
6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory **0-0-2-1**

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory **0-0-2-1**

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory **0-0-2-1**

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory **0-0-2-1**

Assignments are based on the course BT 334 Enzyme Technology containing exercises on enzymes kinetics.

Mody University of Science & Technology

B.Sc. (Hons) Chemistry

Session 2016-2017

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B. Sc. (Hons.) Chemistry
(With Physics and Mathematics or Biotechnology and Zoology) Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
First Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	Compulsory Courses									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	Chemistry									
	CH 181	Physical and Inorganic Chemistry -I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry -I			3	1.5	4	25	25	50
						5.5				
	Optional Courses									
	For XII PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
	Physics									
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
						7				
	Mathematics									
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
						6				
	For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
	Biotechnology									
	BT 151	Cell Biology	3	1	-	4	3	25	25	50

	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
						9				
	Zoology									
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Laboratory-I	-	-	2	1	4	25	25	50
						4	-	-	-	-
	Total Credits					20.5*/20.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Chemistry with Physics and Maths
**Chemistry with Biotech and Zoology

First Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	Compulsory Courses									
	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
						9				
	Chemistry									
	CH 182	Physical and Inorganic Chemistry-II	2			2	3	25	25	50
	CH 192	Organic Chemistry-II	2			2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II			3	1.5	4	25	25	50
						5.5				
	Optional Courses									
	For XI PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
						7				
	Mathematics									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50

					6				
For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
Biotechnology									
BT 152	Genetics	3	1	-	4	3	25	25	50
MB 331	General Microbiology	3	-	-	3	3	25	25	50
MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
					8				
Zoology									
ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
ZO 142	Animal Diversity Laboratory-II	-	-	2	1	4	25	25	50
					4				
Total Credits					27.5*/26.5**				
GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Chemistry with Physics and Maths
**Chemistry with Biotech and Zoology

Second Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn	Compulsory Courses									
	Chemistry									
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
						7.5				
	Optional Courses									
	For XII PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
	Physics									
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
						8				
	Mathematics									
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
						7				
	For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
	Biotechnology									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology lab	-	-	2	1	4	25	25	50
	BC 221	Bio-Instrumentation Laboratory	-	-	2	1	4	25	25	50
						8				
	Zoology									
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50

					4				
Total Credits					22.5*/19.5**				
	Foreign Language-I‡ (Non-credit)	3	-	-	3	3	25	25	50
GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Foreign Language-I‡ Refer to the Foreign Languages Section
*Chemistry with Physics and Maths
**Chemistry with Biotech and
Zoology

Second Year-Spring Semester

Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
	Compulsory Courses									
	Chemistry									
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
						7.5				
	Optional Courses									
	For XII PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
		Physics								
	PH 212	Mathematical Physics and Special theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
						6				
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
						7				
	For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
		Biotechnology								
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	4	25	25	50

						8				
		Zoology								
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
						4				
	Total Credits					20.5*/19.5**				
		Foreign Language-II‡ (Non-credit)	3	-	-	3	3	25	25	50
	GE 202	Proficiency (Non-Credit) #	-	-	-	-	1	-		

: Foreign Language-II‡ Refer to the Foreign Languages Section
*Chemistry with Physics and Maths
**Chemistry with Biotech and Zoology

Third Year Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Semester Autumn	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 313	Instrumental Methods of Analysis	2	-	-	2	3	25	25	50
	CH 323	Chemistry of Polymers and Petrochemicals	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	3	25	25	50
	CH 333	Laboratory Course for Instrumental Methods of Analysis	-	-	3	1.5	3	25	25	50
	CH 343	Project$	-	-	-	5	-	100		
		Total Credits				18	-	-	-	-
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-	-	-

Total Credits: 18

$ Evaluation of project would comprise project report and viva-voce.

Third Year Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW ◄	MTE	ETE
Spring Semester	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry-VI	2	-	-	2	3	25	25	50
	CH 334	Green and Environmental Chemistry	2	-	-	2	3	25	25	50
	CH 344	Organic Reaction Dynamics, Reactive Intermediates and Photochemistry	2	-	-	2	3	25	25	50
	CH 354	Pharmaceutical Chemistry	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	3	25	25	50
	CH 364	Photochemistry and Green Chemistry Laboratory	-	-	3	1.5	3	25	25	50
	CH 374	Pharmaceutical Chemistry Laboratory	-	-	3	1.5	3	25	25	50
						16.5				

Total Credits: 16.5

Total Course Credits: 115.5*/121.5**

Sr No	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Chemistry with BT and Zoology**	20.5	22.5	19.5	19.5	18	16.5	116.5
Chemistry with Physics and Maths*	20.5	23.5	22.5	20.5			121.5

▲CW: Course Work; MTE: Mid Term Examination; ETE: End Term Examination
* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.
# Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

Detailed Syllabus
PTO.

COURSE DESCRIPTION
B. Sc. Honors Chemistry
Compulsory Courses

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 J$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int E.dr$. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 0-0-4-2

Physics Laboratory-I

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable [8]

energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for [7]

velocity of sound; Laplace's correction

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics

2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics

3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory

4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998

3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985

2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book

company, Inc.

3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics,

Waveland Press 2009

2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996

3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991

2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 **Basics of Nano-Science and Exotic Materials** **3-0-0-3**

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points. [8]

Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates. [8]

Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. [8]

Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes. [8]

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems. [7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix [13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership

project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure, Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised

Edition,Vikas Publishing House, 1992.
D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons

B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae.	[10]
Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula.	[8]
Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method.	[11]
Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods.	[10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, [9]

Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues.

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi
4. Achyut S Godbole, "Operating Systems", TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.
5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 **0-0-4-2**

Computational Numerical Analysis Laboratory

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava,

2011, RBD.

2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between **[6]**

configuration and conformation.

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and

deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics 2-0-0-2

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, [6]

Nuclear accidents and holocaust, Environmental Protection Laws in India.

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I 2-0-0-2

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors

influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 Inorganic Chemistry-I 2-0-0-2

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra **[6]**

of conjugated enes and enones.

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eu- [8]

karyotes – initiation, elongation and termination

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles **–** regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, [5]

Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-

metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U,

similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro

reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV 3-0-0-1.5

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.

4. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

7. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.

8. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.

9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.

10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.

11. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

12. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

2. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
5. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
6. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 General Biochemistry **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
4. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

7. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
8. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D.

Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.

11. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

12. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
4. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.

5. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.

6. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.

2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi

4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.

3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on

computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: *Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.* [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson
   and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith
   G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 Animal Physiology **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control [4]

mechanism, transport of gases, respiratory pigments.

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive [5]

Differentiation.

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal

gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

3. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
4. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

5. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
7. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New

Age International.

Reference Books:

3. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
4. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – [5]

Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair.

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic [5]

movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick).

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B- [5]

lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes.

Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.

4. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

5. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.

6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.

7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

8. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
7. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV 2-0-0-2

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

3. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005,

Prentice Hall.

4. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

Mody University of Science & Technology

B.Sc. (Hons) Food and Nutrition

Session 2016-2017

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	BC111	General Biochemistry	3	-	-	3	3	25	25	50
	FN 111	Principle of Nutrition	3	-	-	3	3	25	25	50
	FN 121	Nutrition through Life	3	-	-	3	3	25	25	50
	CH 113	Chemistry-I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Lab-I	-	-	2	1	3	25	25	50
		Sub Total	17	1	6	21				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MB 331	General Microbiology	3	1	-	4	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	3	25	25	50
	FN 112	Food Science	3	-	-	3	3	25	25	50
	FN 122	Food Science laboratory	-	-	2	1	3	25	25	50
	CH 114	Chemistry-II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Lab-II	-	-	2	1	3	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Sub Total	15	2	10	22				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	FN 211	Food Safety	3	-	-	3	3	25	25	50
	FN 221	Family Nutrition	3	-	-	3	3	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Lab	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	17	1	6	21				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN 212	Public Health Nutrition	3	-	-	3	3	25	25	50
	FN 222	Food Chemistry	3	-	-	3	4	25	25	50
	FN 232	Therapeutic Nutrition	3	-	-	3	2	25	25	50
	FN 242	Nutritional Laboratory-I	-	-	4	2	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total	15	-	6	18				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester										
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
	FN 311	Maternal and Child Nutrition	3	1		4	3	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocessing Engineering Lab	-	-	2	1	4	25	25	50
	FN 321	Nutrigenomics & Personalised Nutrition	3	1	-	4	3	25	25	50
	FN 331	Nutritional Laboratory-II	-	-	4	2	4	25	25	50
		Sub Total	13	4	6	20				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-			

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester										
	MB312	Microbial Ecology	2	-	-	2	3	25	25	50
	MB322	Microbial Ecology Lab	-	-	2	1	4	25	25	50
	FN 312	Dietetics	3	1	-	4	3	25	25	50
	FN 322	Food Services Management	3	-	-	3	3	25	25	50
	FN 332	Nutraceuticals and Health Foods	3	1	-	4	4	25	25	50
	FN 342	Food quality and sensory evaluation	3	1	-	4	3	25	25	50
	FN 352	Nutritional Lab-III	-	-	4	2	4	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	80
		Sub Total	16	3	6	22				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-			

FN 111 Principle of Nutrition 3-0-0-3

UNIT-I [7]
Indian foods - Food and culture, Traditional Indian Dietary patterns and Indian ethnic cuisines, Nutritional/medicinal quality of traditional foods - Traditional food beliefs, foods in Ayurveda. Food processing technologies

UNIT-II [6]
Nutrition and Food Science – Definition, history, RDA (Recent), factors affecting RDA – Methods used for deriving RDA, Basic four/five food groups and the functions of food, Food pyramid

UNIT-III [6]
Carbohydrates – classification, functions, digestion and absorption, Sources, deficiency diseases. Role fo fibre in human Nutrition

UNIT-IV [4]
Protein – classification – functions, sources digestion and absorption, sources and deficiency disorders.

UNIT-V [4]
Lipids – Classification, functions, digestion and absorption, sources, excess and deficiency disorder

UNIT-VI [6]
Vitamins – Fat soluble vitamins A, D, E & K, functions, sources, requirements deficiency diseases. Water soluble vitamins – B like thiamine, Riboflavin, Niacin, Phridoscin, Folic acid, B2 and Vitamin C and their functions sources requirements and deficiency diseases.

UNIT-VII [6]
Minerals – Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Flourine and their functions, sources requirements and deficiency diseases.

Text Book

1. Srilakshmi. B. (2010) Nutrition Science, V Edition, New Age International Publishers, New Delhi

References:

2. Chintapalli Vidya (2004) A Text book of Nutrition, New Delhi: Discovery Publishing House
3. Gopalan. C. Ramasastry, B.V. and Balasubramanian, S.C. (1976), Nutrition value of Indian Foods, Hyderabad: National Institute of Nutrition
4. 4. Swaminathan M. (1972), Essentials of Food and Nutrition, Philadelphia: Ganesh and Company

FN 121 Nutrition through life 3-0-0-3

UNIT-I [6]
Principles of meal planning: Balanced diet, Food groups, Food exchange list, Factors effecting meal planning and food related behavior, Dietary guidelines for Indians and food pyramid

UNIT-II [3]
Nutrient requirements: Dietary Concept, Overview of methods for assessment of

nutrient needs

UNIT-III [10]

Nutrition for adulthood and old age : Adult: Nutrient requirements for adult man and woman, RDA, nutritional guidelines, nutritional concerns, diet and lifestyle related diseases and their prevention, Elderly – Physiological changes in elderly, RDA, nutritional guidelines, nutritional and health concerns in old age and their management, factors contributing to longevity

UNIT-IV [10]

Nutrition during pregnancy and lactation: Pregnancy – Physiological changes in pregnancy, RDA, nutritional guidelines, nutritional needs, effect of nutritional status on pregnancy outcome, optimal weight gain and its components, nutrition related problems in pregnancy and ways to control them, Lactation – Physiology of lactation, RDA and nutritional needs of a nursing mother, nutritional guidelines

UNIT-V [10]

Nutrition during childhood: Growth and development, growth reference/ standards, RDA, nutritional guidelines, nutritional concerns and healthy food choices - Infants - Preschool children - School children – Adolescents

Text Book

1. Barrer. K. (2007) Basic Nutrition Counseling Skill Development Wadaworth Pub. Co.

References

2. Bendich. A. (1997) Preventive Nutrition Humana Press
3. Blackwell Scientific Publication. (1994). Manual Of Dietetic Practice.2nd ed.
4. British Nutrition Foundation. (1999). Obesity. Blackwell Science Pub.
5. Brown. J. (2002). Nutrition Through The Lifecycle. Wadsworth Pub Co.
6. Gable. J. (1997) Counselling skills for Dietitians, Blackwell Publishing House
7. Garrow .J.S (1993). Human Nutrition and Dietetics, 9th ed., Churchill Livingstone Pub.
8. Gibney, J. M. (2005). Clinical Nutrition. Blackwell Publishing House.
9. Gopalan .C.(2000). Nutritive Value of Indian Foods. NIN ICMR Pub.
10. ICMR Pub. (2000). Nutrient Requirement and Recommended Dietary Allowances for Indians

FN 112 Food Science 3-0-0-3

UNIT-I [10]

Cereals and Cereal Products: Structure Nutritive value of rice, wheat, maize and locally available millets, Enrichment and fortification. Batters and Doughs; Milling and parboiling; Malting of cereals. b. Pulses and Nuts : Composition and Nutritive value, factors affecting cooking quality of pulses, germination of whole grams.

UNIT-II [5]

Vegetables and Fruits – classification, Nutritive value, changes during cooking of vegetables, changes during ripening of fruits. Storage

UNIT-III [12]

Milk & Milk Products: Composition and Nutritive value, Different types of milk products; pasteurization of milk. b. Egg: Structure, Composition and Nutritive

value. Measure of quality, factors affecting foam formation, uses of egg in cookery. Home preservation and storage. c. Fleshy Foods: Composition and Nutritive value of meat, fish and poultry selection and storage – Effect of cooking on colour, texture and flavour. Factors affect tenderness.

UNIT-IV [12]

Fats & Oils : Composition and Nutritive value of common fats and oils, and reuse of oils, smoking temperature, rensidity of fat, absorption. b. Beverages : Classification, Nutritive value – Coffee, Tea, Cocoa, milk based fruit juices, aerated and alcoholic beverages. c. Spices and Condiments : Types, uses in Indian cookery

Text Book

1. Swaminathan, M. (6th Edition) Hand Book of Food Science and Experimental Food Text.

References:

2. Hughes and Benion, (1970), Introductory Foods.. McMillan Publishing Company.
3. Peckham, C.G. (1969) Foundation of Food Preparation, McMillan Publishing Company
4. Swaminathan, M. (1976) Essentials of Food and Nutritive Vol.I Bangalore Printing
5. 5. Potler, N. 5th Edition, Food Science. New York : Chapman & Hall

FN 122 Food Science laboratory 0-0-2-1

Experiments based on the contents of FN 112

CH 113 Chemistry - I 3-0-0-3

UNIT-I [6]

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

UNIT-II [8]

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. *Critical Phenomena:* PV isotherms of real gases; continuity of states, the isotherms of Van der Waals equation, relationship between cirtical constants and Vander-Waals constants, reduced equation of state.

UNIT-III [10]

Mechanism of Organic Reactions: homolytic and heterolytic bond cleavage. Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Mechanisms of nucleophilic substitution SN1 and SN2. Reactive intermediates - carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Methods of determination of reaction mechanism.

UNIT-IV [5]

Periodic Properties : Atomic and ionic radii, ionization energy, electron affinity

and electronegativity - definition, methods of determination of evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT-V [10]

Stereochemistry of Organic Compounds : Optical Isomerism- Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, chiral and achiral molecules with two stereogenic centres, diastereomers, resolution of enantiomers, inversion, retention. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature, geometric isomerism in oximes and alicylic compound. Conformational isomerism: Conformational analysis of ethane, propane and n-butane by the Newman projection.

Text Book:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI.

References

2. Malik, W.U., Tuli G.D. and Madan R.D. (2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
3. Puri, Sharma and Pathani (2013) Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
4. Stanley H Pine, Organic Chemistry, 5th Edition, Tata McGraw-Hill.
5. Mukherjee, S.M. and Singh, S.P. 3rd Edition; Reaction Mechanism in Organic Chemistry, Macmillan India Limited.

CH 123 Chemistry Laboratory-I 0-0-2-1

The laboratory experiment will be based on the theory paper CH 113

CH 114 Chemistry - II 3-0-0-3

UNIT-I [9]

Chemical Bonding: Covalent Bond: Valence bond Theory, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, concept of multicentric bonding, percentage ionic character. Ionic Solids: Ionic structures, radius ratio effect and coordination number, lattice energy and Born haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

UNIT-II **[9]**

S and p Block Elements: S-Block elements- Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies. P-Block Elements -Comparative study of groups 13-18 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron- diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride. Structure of Xenon compounds.

UNIT-III **[7]**

Chemical Kinetics and Catalysis: Chemical kinetics and its scope, rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half-life and Radioactive decay as a first order phenomenon. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, collision theory, transition state theory. Catalysis & types of catalysis,

Mechanism of catalysis, Enzyme catalysis

UNIT-IV **[6]**

Alkanes and Cycloalkanes: Classification of carbon atoms in alkanes, isomerism, sources, methods of formation (with special reference of Wurtz reaction, Kolbe reaction, Corey house reaction and decarboxylation of carboxylic acids). Physical properties and chemical reaction of alkanes.

[8]

UNIT-V

Alkenes and Alkynes: Nomenclature, preparation and reactions of alkenes, Saytzeff and Hofmann elimination, Mechanisms of hydrogentation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization. Chemical reaction of alkynes, mechanism of electrophilic and nucleophilic addition reaction, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.

Text Book

1. Bahl, A. and Bahl, B. S.: A Textbook of Organic Chemistry, S. Chand and Co. Ltd. New Delhi.

References

2. Puri, Sharma and Pathania (2013): Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
3. Malik, W.U., Tuli G.D. and Madan R.D.(2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
4. Morrison, R. T. and Boyd R. N. 6th Edition. Organic Chemistry, Prentice Hall, Englewood Cliffs, New Jersey.
5. R.K. Bansal; Organic Reaction Mechanisms, 3rd Ed., Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

CH 124 Chemistry Laboratory-II **0-0-2-1**

The laboratory experiment will be based on the theory paper CH 114

FN 221 Family Nutrition **3-0-0-3**

UNIT-I [7]

Principles of Nutrition - Nutrients and their functions. Food groups, meal planning, RDA, Over nutrition, under nutrition, malnutrition.

UNIT-II

Nutrition during Pregnancy and Lactation. Importance of Nutrition during pregnancy. Complications in pregnancy, food and nutritional requirements for lactating women. [8]

UNIT-III

Nutrition for Infants and Preschoolers Importance of breast milk, food and nutritional requirements for infants, weaning and supplementary foods for infants, food habits of preschoolers, nutritional requirements for preschool children. [8]

UNIT-IV

Nutrition for School Age and Adolescents. Nutritional requirements for school going children and adolescents, factors influencing food intake, nutritional disorders. [8]

UNIT-V

Nutrition during Adulthood and Old age. Food and nutritional requirements for adults. Importance of nutrition during old age, factors influencing food intake, nutritional requirements, nutritional problems and management of old age [8]

Text Book:

1. Gopalan, C. and Balasubramanian, B.C.Diet Atlas of India, NIN, Hyderabad, 1971.
2. Gopalan, C.Ramasastry, B.V. and Balasubramanian, S.C. Nutritive value of Indian foods, NIN, Hyderabad, 1976. 24

Reference:

3. Margaret Mc.Williams, "Food Fundamentals" John Wiley and Sons, London, 1974.
4. Swaminathan, M.Essentials of Food and Nutrition Vol.I& II BAPPCO., The Bangalore Printing and Publishing co., ltd., No.88, Mysore Road, Bangalore.

FN 211 Food Safety 3-0-0-3

UNIT-I [4]

Introduction to Food Safety

Definition, Types of hazards, biological, chemical, physical hazards Factors affecting Food Safety ,Importance of Safe Foods

UNIT-II [5]

Food Hazards of Physical and Chemical Origin

Introduction ,Physical Hazards with common examples ,Chemical Hazards(naturally occurring ,environmental and intentionally added , Packaging material as a threat ,Impact on health ,Control measures

UNIT-III [5]

Food Hazards of Biological Origin

Introduction ,Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes ,Seafood and Shell fish poisoning , Mycotoxins

UNIT-IV [4]

Management of hazards

Need ,Control of parameters ,Temperature control, Food storage

UNIT-V [5]

Hygiene and Sanitation in Food Service Establishments

Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal ,Pest and Rodent, Control Personnel Hygiene

UNIT-VI [4]

Food Safety Management Tools

Basic concept Prerequisites- GHPs, GMPs, HACCP ISO series TQM - concept and need for quality, components of TQM, Kaizen. Risk Analysis Accreditation and Auditing

UNIT-VII [5]

Microbiological criteria

Microbiological standards and limits (for processed food, water) Sampling Basic steps in detection of food borne pathogens Water Analysis

UNIT-VIII [3]

Food laws and Standards

Indian Food Regulatory Regime Global Scenario Other laws and standards related to food

UNIT-IX [4]

Recent concerns

New and Emerging Pathogens Genetically modified foods \ Transgenics Organic foods Newer approaches to food safety

Text Book

1. Lawley, R., Curtis L. and Davis,J. The Food Safety Hazard Guidebook , RSC publishing, 2004
2. De Vries. Food Safety and Toxicity, CRC, New York, 1997

Reference:

3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000
5. Forsythe,S.J.The Microbiology of Safe Food , second edition, Willey-Blackwell,U.K.,2010

FN 212 Public Health Nutrition 3-0-0-3

UNIT-I [8]

Concept of public health nutrition- relationship between health and nutrition, role of public health nutritionists in the health care delivery. Public health and nutrition policies- plan of action and programs.

UNIT-II [6]

Food and nutrition security- food production, distribution, access, availability and consumption. Socio cultural aspects and dietary patterns: their implication for nutrition and health.

UNIT-III [4]

Health care facility- primary health care of the community, health care delivery system.

UNIT-IV [10]

Determinants of nutrition and health status- socio cultural, biologic, environmental and economic factor, indicators of health and malnutrition. Economics of malnutrition- impact on productivity and national development. Socio demographic, health and nutrition transitions

UNIT-V [11]

Approaches and strategies for improving nutritional status and health: national and international contributions, role of government and non-government organizations. Case studies of selected strategies and programs: their rationale and context- health based, intervention, food based interventions including fortification, genetic improvement of foods, supplementary feeding, and nutrition education for behavior change

Text Book

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers

Reference:

2. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill..
3. Sethi P and lakra P Aahaarvigyaan ,Poshanevam Suruksha, Elite Publishing house, 2015
4. Khanna K et al. Textbook of Nutrition and Dietetics;2013; Phoenix Publisher.

FN 222 Food Chemistry 3-0-0-3

UNIT-I [9]

Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam.

UNIT-II [8]

Carbohydrates:Monosaccharides,Oligosaccharides,Polysaccharides,Starch,Cellulose,Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber

UNIT-III [7]

Lipids: Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids.

UNIT-V [7]

Amino Acids, Peptides and Proteins: Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein.

UNIT-VI [8]

Food colorants: pigments in animal and plant tissues. Flavors: Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances.

Text Book

1. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.

Reference:

2. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
3. Fennema, O.R, 2006, Food Chemistry, Academic Press.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. Food Chemistry. Marcel Dekker.

FN 232 Therapeutic Nutrition 3-0-0-3

UNIT-I

Diet in Cardiovascular diseases : Aetiology, Symptoms, Risk factors, pathophysiology, dietary management and prevention of Atherosclerosis, Coronary Artery Disease, Myocardial Infarction, Ischemic Heart Disease, Rheumatic Heart Disease(RHD), Congestive Cardiac Failure (CCF), Hypercholesterolemia, Hypertension – classification, sodium restricted diet, dangers of severe sodium restriction [16]

UNIT-II

Diet in Diseases of Liver and Gall Bladder: Aetiology, Symptoms, Dietary treatment in Jaundice, Hepatitis, Pancreatitis, Cirrhosis, Hepatic Coma. Role of food and alcohol in developing liver diseases. Biliary Tract Diseases- Cholecystitis Cholelithiasis and Choled ocholithiasis [8]

UNIT-III

Diet in Renal disease: Causes, Symptoms and dietary management in Nephritis, Nephrosis, Acute and chronic renal failure, Renal calculi, Acid and alkali producing foods, End Stage Renal Diseases (ESRD), Dialysis. [7]

UNIT-IV

Diet in Cancer: Tumor markers and their applications, Types of cancer, Risk factors, Symptoms, Metabolic alterations and Nutritional problems of cancer and cancer therapy, Medical Nutrition Therapy, Role of food in prevention of cancer. [8]

Text Book

1. Kumar .P. Clark M (2005) , Clinical Medicine, 6th Edition, Elsevier Saunders Publishing Co.

Reference:

2. Gibney M J., Elia.M, Lingqvist. O (2005),Clinical Nutrition, Blackwell Science publishing Co.
3. Guthrie, H.A and Picciano, M.F, (1995), Human Nutrition, Mosby Publishing Co, New York.
4. Kris Etherton.P and Burus J.H.(1998), Cardiovascular Nutrition, American Dietetic Association ,Chicago, Illinosis.

FN 242 Nutritional Laboratory-I 0-0-4-2

Experiments based on the contents of FN 212, FN 222 and FN 232

FN 311 Maternal And Child Nutrition 3-1-0-4

UNIT-I [13]

Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth outcome. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT-II [10]

Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and counselling

UNIT-III [10]

Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality, IMR and U5MR; link between mortality and malnutrition;

UNIT-IV [6]

Overview of maternal and child nutrition policies and programmes.

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s Banarasidas Bhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 321 Nutrigenomics & Personalised Nutrition 3-1-0-4

UNIT-I [6]

Introduction. Concept of functional genomics, systems biology, nutrigenomics, nutrigenetics, personalised nutrition

UNIT-II [13]

Molecular biology and genomics: Nutritional requirements and metabolic responses at cellular level, Impact of a changing nutrient environment, Introduction to molecular diagnostics: nutrients influences on genomes

UNIT-III [9]

Diet and gene expression: nutrients as regulators of activity and transcription factors. Nutrients as epigenetic exchange agents.

UNIT-IV [11]

Diet in early life and metabolic programming. V Diet as a possible risk or preventive factor in illnesses. Gene polymorphisms and responses to diet. Examples related to cardiovascular disease, cancer, osteoporosis. Risk/benefit biomarkers

Text Book

1. Principles and Applications by FransKok, Laura Bouwman, Frank Desiere, CRC press

R**eference**:

2. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition by Lynnette R. Ferguson, CRC press

FN 331 Nutritional Laboratory-II 0-0-4-2

Exercises based on Courses BC 311, FN 311 and FN 321

FN 312 Dietetics 3-1-0-3

UNIT-I [3]
Concept of Diet therapy: growth and source of dietetics, purpose and principles of therapeutic diets, modification of normal diet, classification of therapeutic diets.

UNIT-II [3]
Role of Dietician: Definition of nutritional care, interpersonal relationship with patient, planning and implementary dietary care, Team approach to nutritional care.

UNIT-III [6]
Diet in surgical conditions, burns and cancer.
Obesity and leanness- causes, complication and health effects, dietary treatment and other recommendation

UNIT-IV [3]
Diet in fever and infections- Types- metabolism in fever, general dietary consideration diet in influenza, typhoid fever, recurrent malaria and Tuberculosis.

UNIT-V [3]
Diet in gastritits, peptic ulcer- symptoms, clinical findings, treatment, dietary modification, adequate nutrition, amount of food, and intervals of feeding, Chemically and mechanically irrigating foods, four stage diet (Liquid, soft, convalescent, liberalized diet).

UNIT-VI [3]
Diet in disturbances of small intestine and color. Diarrhoea- (child and adult)- classification, modification of diet , fibre, residue. Fluids & nutritional adequacy. Constipation- flatulence - dietary considerations. Ulcerative colitis (adults) - symptoms, dietary treatment. Spruce, coeliac disease- disaccharide intolerance, dietary treatment.

UNIT-VII [6]
Diet in diseases of the liver, gall bladder and pancreas, a) Etiology, symptoms and dietary treatment in - Jaundice, hepatitis, cirrhosis and hepatic coma. b) Role of alcohol in liver diseases. c) Dietary treatment in cholecystitis, cholelithiasis and pancreatitis. Gout- Nature and occurrence of uric acid, causes, symptoms and diet.

UNIT-VIII [3]
Diet in allergy and skin disturbances: Definition, classification, manifestations, common food allergies and test and dieteric treatment.

UNIT-IX [3]
Diet in Diabetes mellitus: a) Incidence and predisposing factors. b) Symptoms-types and tests for detection. c) Metabolism in diabetes d) Dietary treatment & meal management e) Hypoglycemic agent, insulin and its types. f) Complication of diabetes.

UNIT-X [3]
Diet in Renal diseases: Basic renal function, symptoms and dietary treatment in acute and chronic glomerulonephritis, Nephrosis, renal failure, dialysis. Urinary calculi-causes & treatment, acid and alkali producing and neutral foods and dietary treatment.

UNIT-XI [3]
Diet in Cardiovascular diseases: Role of nutrition in cardiac efficiency, incidence of Atherosclerosis, dietary principles, Hyperlipidenmia, Hypertension- causes and dietary treatment, Sodium restricted diet, level of sodium restriction, sources of sodium, danger of severe sodium restriction.

Text Book

1. Antia P. Clinical Dietetics and Nutrition, 2nd edition, Oxford University press.

Reference:

2. Garrrow J.S, James W. P.T, Ralph A, (2000), Human Nutrition and Dietetics, 10th edition, Churchill Livingston, London.
3. Guthrie H. A, Picciano M. F (1995), Human Nutrition, Mosby, St. Louis Missorie.

FN 322 Food Service Management 3-0-0-3

UNIT-I [6]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel

UNIT-II [6]

Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules. Theories about approaches to food service management

UNIT-III [10]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-IV [9]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance. Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of Kitchen records.

UNIT-V [8]

Financial management – Budgeting, costing and cost control, accounting. 8. Hygiene and sanitation in preparation and serving area – Personal hygiene, types and sources of contamination, prevention and safety measures. Methods of controlling infestation. Methods of dish washing.

Text Book:

1. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.

Reference:

2. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.
3. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.

FN 332 Neutraceuticals and Health Foods 3-1-0-3

UNIT-I

Nutraceuticals: (a) Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases (b) Definition, Classification, food and non-food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [13]

UNIT-II

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [8]

UNIT-III

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [9]

UNIT-IV

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India [9]

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s BanarasidasBhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 342 Food Quality And Sensory Evaluation 3-1-0-3

UNIT-I [4]

Introduction to quality attributes of food, Appearance, flavour, textural factors and additional quality factors

UNIT-II [10]

Gustation: introduction and importance of gustation, Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands. Mechanism of taste perception Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami, Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold, Taste measurement- Electronic Tongue, Taste abnormalities

UNIT-III [10]

Olfaction: Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Theories of odour classification, chemical specificity of odour. Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc. Olfactory abnormalities

UNIT-IV [5]

Colour: Introduction and importance of colour, Dimensions of colour and attributes of colour; gloss etc. Perception of colour. Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, etc. Colour abnormalities

UNIT-V [10]

Texture: Introduction, definition and importance of texture, Phases of oral processing, Texture perception, receptors involved in texture perception, Rheology of foods Texture classification, Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation. Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products

Text Book

1. Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.

Reference:

2. Rao E. S. (2013). Food Quality Evaluation. Variety Books.
3. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.

FN 352 Nutritional Lab-III **0-0-4-2**

Exercises based on Courses FN 312,FN 322, FN 332 and FN 342

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT-I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT-II

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital [8]

UNIT-III

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports [8]

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference:

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

Mody University of Science & Technology

B.Sc. (Hons) Physics
Session 2016-2017

Curriculum Structure

B. Sc. (Hons.) Physics

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)

No. of Seats: 20

Objectives:

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The programme offers core skills in physics as well as maths, which instills in the knowledge about the fundamental aspects of physics. With this course, Mody University aims to open many doors for their students by offering Courses in Atomic and Molecular Physics, Electronics, Applied Electronics, Nuclear Physics, Nano sciences, etc. The student will be able to select various options for higher studies like M.Sc. in Physics, Applied Physics, and Electronics. In addition, the programme provides good combinations to create interest of undergraduate students towards M. Tech. in Allied Sciences including Electronics, Astrophysics, Material Science, Laser Technology, Nuclear Science, Opto- electronics and Nanoscience. Further, they have scope for absorption in research Labs.

The first batch of this programme in MUST/ Mody University proposed to be admitted in the session 2015-16.

Input Qualification:

A pass in 10+2 examination of CBSE, or its equivalent from any Board, in Science stream with Physics and Mathematics as subjects and adequate proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of MUST/ Mody University shall be followed.

B. Sc.(Hons.) Physics

Three-Year Programme

Academic Curriculum (2015 – 16 onwards)

First Year

First Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total	**20/19**	**-**	**7/8**	**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

Second Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total	**15/17**	**-**	**11/ 12**	**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

Third Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total	**21/21**	**1/1**	**7/8**	**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

Fourth Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special Theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢	**16/15**	**2/2**	**7/8**	**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry****<u>Or</u>* ***Computer Science*** *may only be opted in first four semesters.*

B.Sc. (H) Physics
Batch 2016-17 and onwards
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 323	**Statistical Mechanics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 333	**Fiber Optics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 343	**Computational Physics**	**2**			**2**	3	25	25	50
	PH 321	**Physics Laboratory V**			**4**	**2**	4	25	25	50
	PH 353	**Computational Laboratory**			**4**	**2**	4	25	25	50
	PH 363	**Project (Minor)**				**2**				
		Total Credits				**20**				
	GE 301	Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	**Elements of Nuclear Physics**	**2**	**-**	**-**	**2**	3	25	25	50
	PH 334	**Microwaves**	**4**	**-**	**-**	**4**	3	25	25	50
	PH 372	Basics of Nanoscience and Exotic Materials	3	-	-	3	3	25	25	50
	PH 332	**Physics Laboratory VI**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 344	**Electronic Laboratory**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 354	**Project (Major)**				**4**				
		Sub Total	**14**	**-**	**8**	**20**				
	GE 302	Proficiency (Non-Credit) #				**1**				

Course Description

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata

McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)
2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields
2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics

3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions

using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable [13]

coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application)

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:

4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation [4]

(Basic Concepts only).

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic [6]

Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.

2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension [12]

Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis. [10]

Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces. [9]

Inner Product Space: Inner produt space, norm of a vector, Orthogality. [8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant [14]

coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems

and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as [8]

Traversal, Insertion, Deletion, Searching.

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, “Operating Systems”, New Delhi
2. Ritchie, “Operating System”, BPB Publication , New Delhi
3. Dhamdhere D. M. “System Programming and Operating System”, TMH New Delhi
4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi

3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of

corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint

2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in

crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.

3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population [5]

growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their

differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid

and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

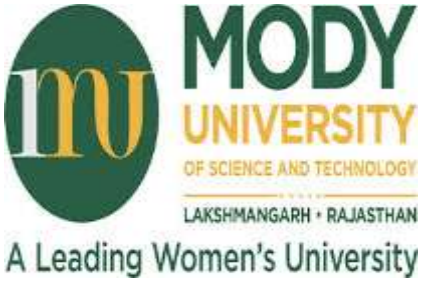
CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

Mody University of Science & Technology

M.Sc. Biotechnology
Session 2016-2017

Curriculum Structure



M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2013 –14 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 511	Cytogenetics	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 531	General Microbiology	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 551	Microbiology and Cytogenetics Laboratory	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	1	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 512	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 522	Animal Biotechnology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3		-	3	3	25	25	50
	MB 532	Immunology	3		-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 552	Seminar	-	-	-	1	-	100		
	BT 514	Plant, Animal Biotechnology and Food Technology Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2013 – 14 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 621	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 641	Bioprocess Engineering	3	1	-	4	3	25	25	50
	BC611	Enzymology	3	-	-	3	3	25	25	50
	BT 661	Genetic Engineering and Environmental Biotechnology Laboratory	-	-	4	2	4	100		
	BT 613	Enzymology and Bioprocess Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**2**	**8**	**18**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				

Total Credits **83**

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Biotechnology)

BT 511 Cytogenetics 3-0-0-3

Cell Diversity: Cell as a basic unit of life, Cell theory, Cell size and shape.	[2]
Cytology: Introduction to cell organelles (Structure and functions), Self-assembly and dynamic structure of cytoskeletal filaments and their cellular regulation, Molecular motors and cell behaviour, Microtubules motors and movement, Cell-cell interactions, Cell adhesion, Tight and gap junction, Plant cell adhesion and plasmodesmeta.	[8]
Energy Metabolism: Chemotropic (mitochondria) and phototropic (chloroplast) energy metabolism of cell, Electron transport chain and proton pump, Evolution of electron transport chain.	[5]
Membrane Biology: Structure, Chemistry and function of biological membrane, Transport across membrane- simple diffusion, facilitated diffusion, active transport, Energetics of transport, Signal transduction mechanism of cell-membrane potential, Action potential, Synaptic transmission, Messengers and receptors of signal transduction mechanism.	[7]
Cellular Oncology: Cell cycle and its control, Molecular mechanism, Check points and cancer.	[6]
Principles of Genetics: Introduction toMendelian and non-Mendelian genetics, Chromosomal theory of inheritance. Extra chromosomal inheritance.	[4]
Linkage: Concept of linkage and crossing over, basic eukaryotic chromosome mapping, recombination of genes, two-point and three-point test cross, tetrad analysis, linkage maps, Interference.	[4]
Mutation: Spontaneous and induced mutations, chromosomal aberrations, Cytological behavior and molecular basis.	[4]
Population Genetics: The Sources of variation, Hardy Weinberg's Law, Genetic drift and change in gene frequency.	[2]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean,median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean	[6]
Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures	[6]
Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient,	[9]

Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 531 General Microbiology 3-0-0-3

History and Scope of Microbiology: Spontaneous Generation vs. Biogenesis, Contributions of various scientists to the field of microbiology and development of microbiology as a scientific discipline. Avenues for microbiologists. [6]

Classification: Microorganisms and place of microbes in Whittakers' five kingdom classification, Eight kingdom classification, Phenetic and phylogenetic classification. Bergeys' manual for classification of bacteria, Structure and organization of Prokaryotic and Eukaryotic cells. Structure of bacterial cell wall-difference between Gram positive, Gram negative and archaebacteria, Cell membrane, Flagella, Pilli, Capsule, Endospore, Mesosome, Reserve food material. [10]

Microbial Growth: Bacterial growth curve, Factors affecting the microbial growth, One step growth curve of bacteriophages, Concepts of batch culture, Continuous culture, fed batch culture, synchronous growth and measurement of growth. [8]

Recombination in Bacteria and Viruses: Transformation, Conjugation and Transduction. [5]

Methods of Studying microorganisms: Microscopy- light microscopy (bright field, dark field, phase contrast, fluorescent) and electron microscopy (SEM & TEM), Pure culture techniques, Microbiological media (Liquid, solid, semi solid, defined, selective, maintenance, enrichment & differential), Sterilization, Disinfection, Aseptic techniques. [6]

General Properties of Microorganisms: Brief study of characteristics of viruses, algae, protozoa and fungi. Economic importance of microorganisms, Microbes as agents of diseases. [4]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates, [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, MichelisMenten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary electrophoresis. [6]

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 551 Microbiology and Cytogenetics Laboratory 0-0-4-2

Assignments based on BT 511 and MB 531 containing exercises on study of cell and its various structures and functions and general characteristics of microorganisms will be conducted.

BC 541 Biochemistry and Instrumentation Laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

BC 531 Biomolecules 3-0-0-3

Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [5]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates.Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway [8]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis,Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis. [7]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $–NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids.Classification of enzymes, MichelisMenten equation Km value, Linweaver-Burk equation. [8]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [6]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

BT 512 Plant Biotechnology 3-0-0-3

Plant Tissue Culture: Historical perspective, Tissue culture media, Totipotency, Organogenesis, Somatic embryogenesis- regulation and application, Artificial seed production, Micropropagation, Somaclonal variation, Androgenesis and its applications in genetics and plant breeding, Germplasm conservation and Cryopreservation. [5]

Protoplast Culture and Somatic Hybridization: Protoplast isolation, Culture and usage, Somatic hybridization-methods and applications, Cybrids and somatic cell genetics [6]

Agrobiology: *Agrobacterium*-plant interaction, Organization of virulence genes, Ti and Ri plasmids, Opines and their significance, T-DNA transfer mechanism, Disarming the Ti plasmid, *Agrobacterium* based vectors, Binary and shuttle vectors. [5]

Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co - integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Transgene stability and Gene silencing. [7]

Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance Plants as Biofactories. [8]

Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection. [8]

BT 522 Animal Biotechnology 3-0-0-3

Introduction: Brief account of animal tissue culture, Brief history and some established normal and transformed cell lines. [5]

Media formulations: Balanced salt solution, Semi-synthetic and synthetic media, Serum as a media supplement, Serum-free media, Feeder layers, Medium sterilization. [8]

Cell culture Methods: Disaggregation (mechanical, chemical and enzymatic), Primary culture, Secondary culture, Suspension and monolayer cultures, Immobilized cultures. [8]

Growth Characteristics of Animal Cells: Growth curve, Growth kinetics, Synchronization of cells, Differentiation of cells, Transformation, Bioreactors. [8]

Application of Animal Biotechnology: Tissue engineering, Production of monoclonal antibodies, Transgenic animals, Embryo culture and IVF, Gene therapy, Production of interferons and vaccines, Diagnostics. [10]

BT 592 Bioinformatics , Scientific Communication & Intellectual 3-1-0-4

Property Rights

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management.	6
Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions.	8
Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins.	8
Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index.	3
Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International)	7
Biotechnology and Intellectual Property Rights. Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy	7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 **Molecular Biology** **3-0-0-3**

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of

constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity**.** [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and

regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli*O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori* [10]
Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 552 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver

seminar on it.

BT 514 Plant, Animal Biotechnology and Food Technology Laboratory **0-0-4-2**

Assignments based on BT 514, BT 512 and BT 522 containing exercises on application of food microbiology and biotechnological techniques in animals and plants will be conducted.

BT 572 Molecular Biology and Immunology Laboratory **0-0-4-2**

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication **0-0-2-1**

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomycescereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

BT 621 Environmental Biotechnology 3-0-0-3

Agricultural Microbiology: Types of soils-physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere- general account, Microbial interactions- Study of positive and negative interactions among microbial populations, Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic (Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications, Biofertilizers, Biopesticides. [12]

Water Microbiology: Assessment of water quality- water purification, Potability standards, Major water borne diseases. [6]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles, Role of microbes in biodeterioration- Metal corrosion, Paper, Metal detoxification. [10]

Waste Treatment: Types of wastes-Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and Tertiary treatment), Trickling filter, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [10]

BT 641 Bioprocess Engineering 3-1-0-4

Microbial Growth and Product Kinetics: Microbial biomass, Enzymes and metabolites, Batch and Continuous culture, Feed back system, Comparison of batch and continuous culture, Fed batch system and its applications. [7]

Isolation, Preservation and Improvement of Industrially important Microorganisms: Enrichment culture technique, Storage at low temperature, Storage in Liquid nitrogen, Lyophlization, Strain improvement by mutation, Feed back inhibition and repression, Strain improvement by modifying the characteristics of inhibitor metabolite, Isolation of auxotrophic mutants, Resistant mutants, Revertant mutants, Use of Recombination methods and Improvement by modifying properties other than yield. [8]

Sterilization: Design of batch sterilization process, Calculation of Del factor, Holding time, Richard's rapid method for design of sterilization, scale up of batch sterilization process, Design of continuous sterilization process, Sterilization of air, Theory and design of depth filter. [5]

Mass Transfer in Microbial System: Fluid and its properties, Mass transfer co-efficient and its determination, Factor affecting mass transfer coefficient, Scale up and scale down. [7]

Downstream Processing: Introduction, Filtration, Product isolation and extraction– centrifugation, precipitation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, Drying, Crystallization and whole broth processing. [7]

Bioreactor and Control: Basic design of fermenter and control system: automatic and manual, off line and on line, Bioreactor– Packed bed, Fluidized bed, Tickle bed, CSTR, Plug flow reactor, Scale up of bioreactor. [5]

BC 611 Enzymology 3-0-0-3

Introduction: Units of activity, Specific activity of enzymes and methods of enzyme assay, Enzyme specificity, Uni substrate enzyme kinetics, Factors affecting the rate of enzyme catalyzed reaction, Derivation of Michelis-Menten equation, Significance of $V_{max}$and K_m, Enzyme inhibition- type of inhibition, Competitive non Competitive and uncompetitive kinetics. [5]

Enzyme Catalytic Efficiency: Factors associated with catalytic efficiency such as proximity, Orientation-distortion of strain, base nucleophilic catalysis with equation, Protein ligand binding co-operativity, Hill and Sat Chard plot protein sequencing. [6]

Immobilization: Immobilized enzymes and their industrial applications, Effect of partition on kinetics and performance with particular emphasis on change in pH and hydrophobicty. [6]

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

BT 661 Genetic Engineering and Environmental Biotechnology Laboratory 0-0-4-2

Assignments based on BT 611 and BT 621 containing exercises on genetic engineering and role of biotechnology in environment will be conducted.

BT 613 Enzymology and Bioprocess Laboratory 0-0-4-2

Assignments based on BC 611 and BT 641containing exercises on fermentation process and production of metabolites and role of enzymes in biotechnology will be conducted.

Mody University of Science & Technology

MSc Maths

Session 2016-2017

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M. Sc. Mathematics

(Session 2016-2017 Onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20

Objectives: The proposed PG programme in Mathematics is a highly interesting and promising with broader opportunity for absorption in teaching, research and industry for students. The M.Sc. Mathematics programme offers core fundamental skills in Mathematics which incorporate the ideas of applied mathematical knowledge as well as provide platform to the student's regarding research oriented programmes in various interdisciplinary areas of mathematics.

Scope: The programme will generate interest of students towards fundamental mathematical research and will be able to qualify eligibility test for various fellowships.. Student will be able to select various options for higher studies like doctoral programmes in Computational numerical analysis, Advanced graph and pebbling theory, Algebraic and numerical topology, Approximation theory, Optimization techniques , Economics Fluid dynamics, Financial mathematics, Theory of computation and artificial intelligence, Mathematical modeling and simulation etc. Further, they have scope for absorption in research Labs in India like BARC, IISc, TIFR, IITs, ISRO, DRDO etc. as well as may get opportunity for doctoral or post doctoral research in India and abroad.

Input Qualification:

Bachelor's Degree in Science from any recognized university with Mathematics as a core subject for three years/six semesters, with 50% of aggregate marks and adequate proficiency in English.

Evaluation Procedure: All the Rules and Regulations as a provided in the Ordinance and regulations of the Undergraduate/postgraduate programmes of Mody University shall be followed. The first batch of this programme is proposed to be admitted in the session 2016-2017.

	M.Sc. Mathematics									
	Two-Year Programme									
	Academic Curriculum(Session 2016-2017 onwards)									
	First Year									
Autumn Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 511	Computer Based Advanced Numerical Analysis	3	1	-	4	3	25	25	50
	MS 521	Discrete Mathematics	3	1	-	4	3	25	25	50
	MS 531	General Topology	3	1	-	4	3	25	25	50
	MS 541	Operations Research	3	1	-	4	3	25	25	50
	MS 551	Statistics and Probability -I	3	1	-	4	3	25	25	50
	MS 561	Ordinary Differential Equations	3	1	-	4	3	25	25	50
		Sub Total	**18**	**6**	**-**	**24**				
		Foreign Language-I** (Non-Credit)	3	-	-	3	3	25	25	50
Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 512	Advanced Abstract Algebra	3	1	-	4	3	25	25	50
	MS 522	Complex Analysis and Integral Transform	3	1	-	4	3	25	25	50
	MS 532	Mathematical Modeling and Simulation	3	1	-	4	3	25	25	50
	MS 542	Partial Differential Equations	3	1	-	4	3	25	25	50
	MS 552	Statistics and Probability - II	3	1	-	4	3	25	25	50
	MS 562	Modeling and Simulation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**5**	**4**	**22**				
		Foreign Language-II **(Non-Credit)	3	-	-	3	3	25	25	50

** Refer to Foreign Language Section.

M.Sc.(Mathematics)

Two-Year Programme (2016- 17 and onwards)

Second Year

Autumn Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 611	Advanced Linear Algebra	3	1	-	4	3	25	25	50
MS 621	Advanced Graph Theory and Combinatorics	3	1	-	4	3	25	25	50
MS 631	Real Analysis and Measure Theory	3	1	-	4	3	25	25	50
MS 641	Special Functions and Integral Equations	3	1	-	4	3	25	25	50
	Elective-I	3	1	-	4	3	25	25	50
	Sub Total	**15**	**5**	**-**	**20**				

Spring Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 612	Functional Analysis	3	1	-	4	3	25	25	50
MS 622	Inequality and Continued Fractions	3	1	-	4	3	25	25	50
MS 632	Basics of MATLAB	-	-	4	2	4	100		
	Elective-II	3	1	-	4	3	25	25	50
MS 642	Dissertation	-	-	-	8		100		
	Sub Total	**9**	**3**	**4**	**22**				

Total Credits: 88 (I Year +II year)

Elective- I	**Elective- II**
MS 651 Magneto Hydrodynamics	MS 652 Viscous Fluid Dynamics
MS 661 Sequence and Series	MS 662 Summability and Approximation Theory
MS 671 Tensor Analysis	MS 672 Mechanics and Calculus of Variations
MS 681 Reliability Theories	MS 682 Fourier Analysis
MS 691 Advanced Number Theory	MS 692 Differential Geometry

* CW (Course work): It would include attendance, assignments, class /quiz test.

Note: Combinations of electives are: MS 651 & MS 652; MS 661 & MS 662; MS 671 & MS 672; MS 681 & MS 682; MS 691 & MS 692.

(Above II year is taken from AC 30, syllabus in AC 30 minutes)

MS 511 Computer Based Advanced Numerical Analysis 3-1-0-4

1. Algebraic and Transcendental Equations: General iterative methods, Newton-Raphson method for finding multiple roots, system of non linear equations, convergence of Newton-Raphson method, Graeffe's root squaring method, Muller's method , Bairstow iterative method. **[08]**

2. System of Linear Equations: Existence of solution, ill-conditioned system, Gauss elimination with pivoting, Gauss-Jordan method, triangular factorization method, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. **[08]**

3. Boundary Value and Eigen Value Problems: Solution of Eigen values problems by power method, Jacobi method, finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method. **[08]**

4. Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations. **[09]**

5. Difference Equations and Curve Fitting: Homogeneous difference equations with constant coefficients, particular solutions of a difference equations, curve fitting and regression, least square method, fitting of straight line and second order polynomials. **[06]**

Text Books:

1. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
2. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.
3. Jain M.K. and Iyenger S.R.K.(2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.

MS 521 **Discrete Mathematics** **3-1-0-4**

1. Relation and Function: Definition of set, different forms, properties and operations, principle of inclusion and exclusion, partition of a set, definition and types of a relation, composition, properties, graphical representation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice, different forms, properties, definition and kinds of a function, composition and properties of functions, recursively defined functions. **[10]**

2. Logics and Proofs: Propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, notion of a proof and methods for constructing proofs, normal forms (disjunctive and conjunctive), proof methods and strategy, statements of Fermat's last theorem, the $(3x + 1)$ conjecture and Godel's incompleteness theorem, program correctness. **[10]**

3. Induction and Counting: Mathematical induction, strong induction and well-ordering, recursive definitions and structural induction, recursive algorithms, basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

4. Graphs and Finite Automata: Graph and digraphs,, Konigsberg bridge problem, finite and infinite graphs, incidence and degree, isolated vertex, pendant vertex, and null graph, isomorphism, sub graphs, walk, path and circuits, connected graphs, disconnected graphs and components, Euler graphs, operation on graphs, Hamiltonian paths and circuits, traveling salesman problem, types and properties of tree, matrix representation of graphs; deterministic and non-deterministic finite automata, transition table and transition diagram, Mealy and Moore machines, minimization of finite automation. **[10]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International.

Reference Books:

1. Tremblay(1997), Discrete Mathematical Structures with Application to Computer Science, 35th reprint 2008,Mc Graw Hill Education,
2. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd ed., Mc Graw Hill Education, New Delhi.
3. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.

MS 531 **General Topology** **3-1-0-4**

1. Metric and Topological Spaces: Definition and examples of metric spaces, open sets, closed sets, convergence, completeness and Baire's theorem, continuous mappings, spaces of continuous functions, Euclidean and unitary spaces, definition and examples of topological spaces, elementary concepts, open bases and open subbases, weak topologies, function algebras. **[08]**

2. Compactness: Compact spaces, products of spaces, Tychonoff's theorem and locally compact spaces, compactness for metric spaces, Ascoli's theorem. **[08]**

3. Separation: T_1 – spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohn's lemma and the Tietze extension theorem, Urysohn's imbedding theorem, Stone – Cech compactification. **[08]**

4. Connectedness: Connected spaces, the component of spaces, totally disconnected spaces, locally connected spaces. **[08]**

5. Approximation: Weierstrass approximation theorem, Stone-Weierstrass theorems locally compact Hausdrorff spaces, extended Stone-Weierstrass theorems. **[07]**

Text Books:

1. George F. Simmons (2015), Topology and Modern Analysis, reprint ed., McGraw Hill Education, New Delhi
2. Sharma J. N. and Vashistha A. R.(2010), Topology, 37th ed., Krishna Prakashan Media, Meerut.
3. Adams (2008), Introduction to Topology: Pure and Applied, 3rd reprint ed., Pearson.

Reference Books:

1. Cain L.(2012), Introduction to General Topology,1st impression. Pearson.
2. Armstrong (2014), Basic Topology, reprint ed., CBS Publication.
3. Seymour Lipschutz(1965), Schaum's Outline of Theory and Problems of General Topology, 1st ed.,McGraw Hill Education.

MS 541 **Operations Research** **3-1-0-4**

1. Linear Programming: Dual simplex method, parametric linear programming, game theory, two person zero sum game, game with mixed strategies, graphical solution, solution by linear programming. **[10]**

2. Inventory and Replacement Models: Deterministic models purchase and manufacturing models, probabilistic models, replacement of items that deteriorate and whose maintenance and repair costs increases with time. **[10]**

3. Job Sequencing and Queuing Theory: N jobs two machines, N jobs three machines, two jobs N machines; elements of a queuing system, Kendall's notation, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞) models. **[10]**

4. Dynamic Programming and PERT-CPM: Bellman's principal, employment smoothing problem, cargo loading problem; project planning and scheduling using PERT-CPM. **[09]**

Text Books:

1. Gupta Prem Kumar and Hira D.S.(2007), Operations Research,4th ed., S. Chand & Company Ltd., New Delhi.
2. Kanti Swarup, Gupta P.K. and Man Mohan (2006), Operations Research, 3rd ed., Sultan Chand & Sons, New Delhi.
3. Hillier F.S. and Lieberman G.J. (2005), Introduction to Operations Research, 8th ed., McGraw Hill, New Delhi.

Reference Books:

1. Taha H.A. (2010),Operations Research-An Introduction, 9th ed., Macmillan Publishing Co., Inc., New York.
2. Hadly G.(1964), Nonlinear and Dynamic Programming , 2nd ed., Addison-Wesley, Reading Mass.

MS 551 **Statistics and Probability - I** **3-1-0-4**

1. Introductory Ideas: Recapitulation of basic probability theory, law of addition and multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[06]**

2. Random Variables: Theorems on random variables, distribution function, properties of distribution, discrete random variable, probability mass function (pmf), discrete distribution function, continuous random variable, probability density function (pdf), cumulative distribution function(cdf), moments, covariance, moments generating function, two-dimensional random variables (discrete and continuous), transformation of random variables. **[12]**

3. Distributions: Discrete-binomial, Poisson, geometric, uniform distributions, continuous-uniform, exponential, gamma, weibull, normal distributions. **[12]**

4. Correlation and Regression: Simple and partial correlations, linear and non-linear regressions, regression coefficients, properties, angle between two lines of regression, standard error of estimate rank, regression curve correlation. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
4. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
4. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

1. Second Order Differential Equations: Review of the general solution of the second order homogeneous differential equations, use of a known solution to find another solution, homogeneous equations with constant coefficients, method of undetermined coefficient and method of variation of parameters. **[08]**

2. Non-Linear Ordinary Differential Equations: Two dimensional autonomous systems and phase space analysis- critical points, proper and improper nodes, spiral points and saddle points, definition of stability, Lyapunov function, stable, unstable and center subspaces, Riccati's equation-general solution and the solution when one, two or three particular solutions are known. **[10]**

3. Total Differential Equations: Different forms and solutions, necessary and sufficient condition, geometrical meaning of equation containing three and four variables, total differential equations of second degree. **[07]**

4. Power Series Solutions: Review of power series, series solutions of first order equations (Taylor series method), second order linear equations, solution near a regular singular point (method of Forbenius) for different cases, particular integral and the point at infinity. **[08]**

5. Existence and Uniqueness of Initial Value Problems: The existence and uniqueness of solutions, method of successive approximations, Picard's theorem, solution of initial-value problems by Picard method. **[06]**

Text Books:

1. Deo S. C., Lakshmikantham and Raghvendra V.(2000), Text book of Ordinary Differential Equations, 2nd ed.,Tata Mc-Graw Hill.
2. Dennis G. Zill, Michael R Cullen (2009), Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.
3. M. Rama Mohana Rao (1980), Ordinary Differential Equations: Theory and Applications, 2nd ed., Affiliated East-West Press Pvt. Ltd., New Delhi.

Reference Books:

1. Birkhoff and Rota G., G.C. (1978) , Ordinary Differential Equations , 4th ed., John Wiley and Sons Inc., NY.
2. Boyce, W.E. and Diprima, R.C.(1986), Elementary Differential Equations and Boundary Value Problems ,4th ed., John Wiley and Sons Inc., NY.
3. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations , 18th ed.,S. Chand Limited.

MS 512 **Advanced Abstract Algebra** **3-1-0-4**

1. Groups: Introduction and preliminaries (equivalence relation, integers modulo n), group definition and basic axioms, examples (dihedral, symmetric, matrix, quaternion groups), subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, centralizers and normalizers, nilpotent groups, direct products. **[10]**

2. Homomorphism and Group Actions: Definition and examples, isomorphism theorems, groups acting on themselves by left multiplication (Cayley's theorem), groups acting on themselves by conjugation (the class equation), automorphisms, Sylow p-groups and Sylow theorem. **[10]**

3. Ring: Basic definitions, examples (polynomial rings, matrix rings, group rings), ideals, ring homomorphism, integral domains and fields, maximal and prime ideals, Euclidean domain, principal ideal domains, unique factorization domains, polynomial rings over fields, introduction to modules (vector space as a special case). **[10]**

4. Field: Basic theory of field extensions, algebraic extensions, splitting fields and algebraic closures, separable and inseparable extensions, finite fields, field automorphisms, fundamental theorem of Galois theory, Galois groups of polynomials, cyclotomic extension. **[09]**

Text Books:

1. Fraleigh J. B. (2003), Abstract Algebra, 7th Edition, Pearson.
2. Dummit and Foote(1991), Abstract Algebra,3rd ed., John Wiley & Sons, Inc.
3. Khanna and Bhambri (2009), A Course in Abstract Algebra , 3rd ed., Vikas Publishing.
4. Herstein I. N.(1996), Topics in Algebra, 3rd Edition, Wiley India.

Reference Books:

1. Thomas W. Hungerford (2012), AbstractAlgebra, 4th Edition, Springer.
2. Vashistha, Modern Algebra(2011), 4th ed., Krishna Prakashan Mandir, Meerut.
3. Artin(2012), Algebra, 7th Edition, PHI.

MS 522 **Complex Analysis and Integral Transform** **3-1-0-4**

1. Basics of Complex Analysis: Complex numbers, complex function and its derivative, basic transcendental functions, power series of functions, integration in the complex plane, residues and their use in integration. **[10]**

2. Laplace Transforms and Stability of Systems: Laplace transform and their inversion, introduction of stability, Nyquist stability criterion, generalized functions, Laplace transforms and stability. **[10]**

3. Mellin Transform: Definition and properties of Mellin transform, evaluation of Mellin transform complex variable method and applications. **[09]**

4. Hankel Transform: Elementary properties, inversion theorem, transform of derivatives of functions, transform of elementary functions, Parseval's relation, relation between Fourier and Hankel transforms, use of Hankel transform in the solution of partial differential equations, dual integral equations and mixed boundary value problems. **[10]**

Text Books:

1. David Wunsch A.(2009), Complex Variables with Applications, 3rd Edition, Pearson.
2. H.K. Pathak(2004), Complex Analysis , 3rd ed., Shiksha Sahitya Prakashan, Meerut.
3. Gupta and Vashistha(2010), Integral Transform,4th ed., Krishna publication Media, Meerut.
4. Ian N. Sneddon(1972), The Use of Integral transforms by, 2nd Printing Edition, McGraw Hill.

Reference Books:

1. Ahlfors(1987), Complex Analysis,3rd ed., McGraw Hill Education.
2. Rudin(2006), Real and Complex Analysis,2nd reprint , McGraw Hill Education.
3. Andrews & Shivamoggi(2007) , Integral Transforms for Engineers,3rd ed., PHI Learning.

MS 532 **Mathematical Modeling and Simulation** **3-1-0-4**

1. Introduction to Simulation and Modeling: System concepts and theories, attributes and types of systems, discrete and continuous, deterministic and stochastic, open and closed, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, developing system dynamic equations - first order (+ve, -ve) systems, pure second order (+ve, -ve) systems and general feedback systems, simulation of equations for different systems. **[14]**

2. Random Numbers and Random Variates: Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods. **[10]**

3. Discrete Event Simulation: Concepts, event scheduling versus time advance scheduling, list processing. **[05]**

4. Verification and Validation of Simulation Models: Introduction, input modeling, identifying the distribution of data, parameter estimation, goodness of fit tests, model building, , verification calibration and validation of models, output analysis- measures of performance and their estimation. **[10]**

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2013), Discrete- Event System Simulation , 5th ed.,, Pearson, 2013.
2. Averill M. Law(2006), Simulation Modeling and Analysis, 4th ed., McGraw Hill Education.
3. V.P. Singh (2009), System Modeling and Simulation, 3rd ed., New Age International Publishers.
4. Frank L. Severance (2009) System Modeling and Simulation: An Introduction , 4th ed., Wiley.

Reference Books:

1. Taha(2012), Operations Research: An Introduction, 15th Indian reprint, PHI.
2. Geoffrey Gordon (2012), System Simulation, 2nd ed.,, PHI.
3. J.N. Kapoor (1994), Mathematical Modeling, 2nd ed.,Wiley Eastern Limited, Fourth reprint.

MS 542 **Partial Differential Equations** **3-1-0-4**

1. Second Order Partial Differential Equations: Preliminaries of partial differential equations, review of the classification of second order partial differential equations to hyperbolic, elliptic and parabolic forms, reduction of linear and quasi-linear equations in two independent variables to their canonical forms, characteristic curves. **[06]**

2. Laplace equation: Solution by method of separation of variables, mean value property, weak and strong maximum principle, Poisson's formula, Dirichlet's principle, solution of Laplace equation in cylindrical and spherical polar coordinates. **[06]**

3. Heat Equation: Solution by method of separation of variables, initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results. **[06]**

4. Wave Equation: Solution by method of separation of variables, uniqueness, D'Alembert's method, solution by spherical means and Riemann method of solution. **[06]**

5. Green's Functions: Introduction, Green's function for Laplace equation, method of images, eigenfunction method, Green's function for the wave and diffusion equations, Helmholtz theorem. **[08]**

6. Laplace and Fourier Transforms: Basics of Laplace transform solutions of diffusion and wave equations, basics of Fourier transform solution of diffusion, wave and Laplace equations. **[07]**

Text Books:

1. Sankara Rao K. (2003), Introduction to Partial Differential Equations , 4th ed., PHI Pvt. Ltd.
2. Asmar(2010), Partial Differential Equations and Boundary Value Problems with Fourier series, 2nd ed., Pearson.
3. Sundarapandian(2012), Ordinary and Partial Differential Equations, 3rd ed.,McGraw Hill Education, New Delhi.
4. Bhamra (2013), Partial Differential Equations: An Introductory Treatment with Applications ,4th ed., PHI Learning.

Reference Books:

1. Raisinghaniya M.D. (2008) , Ordinary and Partial Differential Equations , 3rd ed.,S. Chand Limited.
2. Zauderer(E. 1989), Partial Differential Equations of Applied Mathematics , 2nd ed., John Wiley and Sons, New York.
3. L Debnath(2007), Nonlinear PDE's for Scientists and Engineers , Birkhauser, Boston.
4. Sneddon I.N. (1957) , Elements of Partial Differential Equations, 2nd ed., McGraw Hill Book Company.

MS 552 **Statistics and Probability -II** **3-1-0-4**

1. Tests of Hypotheses: Simple hypothesis versus simple alternative, composite hypotheses, sampling from the normal distribution, tests on the mean and variance, tests on several means and variances, Chi-square tests, tests of hypotheses and confidence intervals, sequential tests of hypotheses. **[10]**

2. Sampling and Sampling Distributions: Sampling-inductive inference, populations and samples, distribution of samples, statistics and sample moments, sample mean and variance, law of large numbers, central limit theorem and its applications, sampling from the normal distributions, role of the normal distribution in statistics, sample mean, Chi-square distribution, F distribution, student's t distribution. **[10]**

3. Random Processes: Basics of random process, random process concept, continuous and discrete, statistics of random process, classification of random process, stationary and evolutionary random processes, cross-correlation, Markov process and Markov chain, binomial, Poisson, normal, Ergodic, random telegraph , sine wave random processes. **[11]**

4. Time Series Analysis: Introduction, characteristics movements in a time series, time series models, measurement of trends, secular trend, seasonal movements, cyclical movement, irregular movements, long cycles and applications. **[08]**

Text Books:

5. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
6. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
7. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
8. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

5. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
6. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
7. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
8. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

MS 562 **Modeling and Simulation Laboratory** **0-0-4-2**

Modeling and Simulation Laboratory related to Course Code MS 532 (Mathematical Modeling and Simulation).

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MS 611 **Advanced Linear Algebra** **3-1-0-4**

1. Vector Spaces and Linear Equations: Fields, vector spaces, subspaces, bases, dimension, span, coordinates, row reduced echelon matrices, invertible matrices, row and column space, system of linear equations, direct sum, determinants. **[08]**

2. Linear Transformations: Definition of linear transformations, kernel, range, rank-nullity theorem, algebra of linear transformations, representation of transformations by matrices, eigenvalues, eigenvectors, diagonalization, invariant subspaces, invertibility and isomorphisms, linear functional, transpose of a linear transformation, dual spaces. **[08]**

3. Inner Product Space and Norms: Definition of an inner product and its properties, (including the Cauchy Schwartz inequality), orthogonality, Gram-Schmidt orthogonalization process, orthogonal projections, minimization problem (least squares), adjoints. **[08]**

4. Operators on Inner Product Spaces: Unitary and orthogonal operators and their matrices, normal and self-adjoint operators, bilinear and quadratic forms on inner product spaces, spectral theory. **[08]**

5. Rational and Jordan Forms: Cyclic subspaces and annihiliators, Jordon canonical form, minimal polynomial, block matrices and matrix factorization, SVD and pseudoinverse. **[07]**

Text Books:

1. Friedbeg, Insel, Spence (2011) Linear Algebra, 4th Edition, PHI.
2. David C. L. (2002) Linear Algebra and its Applications, 3rd Edition, Pearson.

Reference Books:

1. Kumaresan S. (2000) Linear Algebra: A Geometric Approach, PHI.
2. Charles. W. C. (2012) Linear Algebra: An Introductory Approach, 3rd Edition, Springer.
3. RomanS. (2008) Advanced Linear Algebra, 3rd Edition, Springer.
4. Cheney, Kincaid (2012) Linear Algebra: Theory and Applications, 2nd Edition, Jones and Bartlet.

MA 621 Advanced Graph Theory and Combinatorics 3-1-0-4

1.Preliminaries: Graphs(undirected and directed), sub graphs, degree-sum formula, graphic sequences, matrix representations of a graph, path and circuits, bipartite graphs, graph isomorphism, decomposition,Euler graph and its properties,operations on graphs, Hamiltonian paths and circuits, traveling –salesman problem. **[08]**

2. Trees, Cut-Sets and Cut-Vertices: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's and Prim's algorithms, cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism. **[08]**

3. Planarity, Matching, Coloring and Covering: Combinatorial versus geometric graphs, geometric and combinatorial duals of a graph, planar embeddings, Euler's formula, triangulation, Kuratowski's theorem, dual graphs, factors and matching (in bipartite and non-bipartite graphs), Hall's matching theorem, chromatic number, chromating partitioning, chromatic polynomial, matching, coverings, the four color problem. **[08]**

4.Pebbling on Graph: Pebbling on undirected graph with properties, pebbling number, cover pebbling, the staching theorem, pebbling on directed graph with properties, pebbling on isomorphic graphs, pebbling of cyclic graph, alternating wheel graph, alternating fan graph and alternating complete graph with their properties, extension of graph pebbling. **[08]**

5**. Advance Counting Techniques:** Recurrence relations, solving linear recurrence relations, divide-and-conquer algorithms and recurrence relations, generating function, inclusion-exclusion with applications. **[07]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science, PHI.
2. Chartland G., Zhang P. (2006)Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. Yerger C.R.(2005) Extensions of Graph Pebbling, Thesis.
4. Ore O. (1991) Theory of Graphs, Volume 38, American Mathematical Society, Colloquium Publications.
5. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.
6. Kenneth H R. (2007) Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7thEdition, Mc Graw Hill Education.

MS 631 **Real Analysis and Measure Theory** **3-1-0-4**

1. Metric Spaces: Review of the real number system (supremum, infimum, field, order and completeness axioms, extended real number system, basic notions of sets, relation and functions), finite, countable and uncountable sets, open and closed sets, adherent and accumulation points, Bolzano-Weistrass theorem, Heine-Borel covering theorem, compactness in R^n and in general metric spaces, connectedness. **[08]**

2. Limits and Continuity: Convergent sequences, Cauchy sequences, complete metric spaces, limit of a function, continuous functions, uniform continuity, convergence of series, rearrangements, Abel's and Dirichlet's theorem, sequence of functions, point wise and uniform convergence, sequential compactness, Ascoli-Arzela theorem, real power series, Weistrass theorem. **[08]**

3. Differentiation and Riemann Integration: Algebra of derivatives, the chain rule, differentiation of monotone functions (leading to the mean value theorem and intermediate value theorem), upper and lower integrals, oscillations, integrality of continuous functions, fundamental theorem of calculus, interchange of limit and integration operations, vector valued differentiation and integration. **[08]**

4. Measure Theory: Indicator functions, fields and σ-fields, definition and fundamental properties of a non-negative measure, measurable sets, measure zero sets, positive Borel measures,Lebesgue measure,algebra of measurable functions, almost everywhere convergence, convergence in measure. **[08]**

5. Integration Theory on General Measure Spaces: The Lebesgue integral, Fatou's Lemma, the monotone and dominated convergence theorems, continuous functions with compact support, Tonelli and Fubini's theorems, comparison of proper and improper Lebesgue and Riemann integrals. **[07]**

Text Books:

1. Rudin W.(1976)Principles of Mathematical Analysis, 3rd Edition, TMH.
2. Bartle R. G., Donald R. S. (2011)Introduction to Analysis, 2nd Edition, Wiley and Sons.

Reference Books:

1. Royden H.L. (2017)Real Analysis , 2nd Edition, PHI
2. Apostle (1997)Mathematical Analysis , 2nd Edition, Narosa Publishing House,
3. Carothers N. L. (2000) Real Analysis, 2nd Edition, Cambridge University Press.
4. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.

MS 641 **Special Functions and Integral Equations** **3-1-0-4**

1. Hypergeometric Functions: Definition, convergence, gamma and beta functions, Gauss hypergeometric function and its properties, series solution of Gauss hypergeometric equation, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, Kummer's confluent hyper geometric function and its properties, integral representation. **[10]**

2.Bessel and Legendre Functions: Definition, connection with hypergeometric function, differential and pure recurrence relations, generating function, integral representation, orthogonal properties. **[10]**

3.Linear Integral Equations: Definition and classification, conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions, solution of homogeneous and general Fredholm integral equations of second kind with separable kernels. **[10]**

4.Solution of Integral Equations: Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations, Resolvent kernel and its results, conditions of uniform convergence and uniqueness of series solution, solution of Volterra integral equations of second kind with convolution type kernels by Laplace transform. **[09]**

Text Books:

1. Kanwal R.P. (1971)Linear Integral Equations: Theory and Techniques,Academic Press, New York.
2. Miller LieW. Jr. (1968)Theory and Special Functions,Academic Press, New York and London.

Reference Books:

1. Rainville E.D. (1960) Special Functions, Macmillan Company, New York.
2. Wazwaz A. M. (2011)Linear and Non Linear Integral Equations: Methods and Applications,Higher Education Press, Springer.
3. Banerjee P.K., Goyal M.C. (2003) Special Functions and Calculus of Variations, Ramesh Book Depot. Jaipur, India.
4. Swarup S., Singh S. J. (2014) Integral Equation, 22nd Edition, Krishna Prakashan Meerut.

MS 612 **Functional Analysis** **3-1-0-4**

1. General Theory: Introduction of topological vector spaces, separation properties, linear mappings, finite-dimensional spaces, metrization, boundedness and continuity, seminorms and local convexity, quotient spaces, completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

2. Completeness and Compactness: Completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

3.Duality in Banach Spaces and Applications I: The normed dual of a normal space, adjoints, compact operators, continuity theorem, closed subspaces of Lp-spaces, the range of a vector-valued measure, **[10]**

4.Duality in Banach Spaces and Applications II: Generalized Stone-Weierstrass theorem, two interpolation theorems, Kakutani's fixed point theorem, Haar measure on compact groups, uncomplemented subspaces, sum of Poisson kernels, two more fixed point theorems. **[09]**

Text Books:

1. Rudin W. (2006) Functional Analysis, McGraw Hill Education (India).
2. Limaye B.V.(2013)Functional Analysis, 3rd Edition, New Age International.

Reference Books:

3. Somasundaram D. (2014) First Course in Functional Analysis, 1 Edition, Narosa Book Distribution Pvt. Ltd.
4. Corlson, Robert (2006) Concrete Introduction to Real Analysis, Vikas publishing House Pvt. Ltd.
5. Kreyszig E. (2007) Introductory Functional Analysis with Applications John Wiley & Sons.

MS 622 **Inequality and Continued Fractions** **3-1-0-4**

1. Inequalities: Definition and important properties**,** maximum and minimum values of algebraic functions and expressions with and without constraints, some important inequalities, Weirstrass inequality, Schwarz's or Cauchy's inequality,Tchebychef's inequality, important proofs and theorems. **[10]**

2. Continued Fractions I: Definition and different form of continued fractions, simple, infinite or non terminating and terminating continued fractions, continued fractions with positive quotients, conversion of fraction into continued fraction, successive convergent, law of formation of successive convergent of simple continued fraction. **[10]**

3. Continued Fractions II: Difference between the fraction and its convergent, equivalent numbers and periodic continued fractions, some special quadratic surds, recurring continued fraction. **[10]**

4. Continued Fractions III: Different theorems based on odd and even convergent, limits to error in convergent for the continued fraction, series of fractions and approximation. **[09]**

Text Books:

1. Hardy G. H., Littlewood J. E., Polya G. (1952) Inequalities, Cambridge University Press.
2. Hardy G. H., Wrihgt E.M. (1979) An Introduction to Theory of Numbers, 5th Edition, Oxford, University Press.

Reference Books:

1. Niven, Zuckerman H. S., Montgomery H. L. (2004) An Introduction to the Theory of Numbers, 5th Edition, John Wiley and Sons, Inc., New York.
2. Bruce C. B. (2005)Ramanujan's Note Books Volume-1 to 5, Springer.
3. ApostolT. M. (2013)Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi.

MS 632 **Basics of MATLAB** **0-0-4-2**

1. Introduction: MATLAB interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. **[08]**

2. Functions and Files: Elementary mathematical functions, user defined functions, additional functions, working with data files. **[06]**

3. Decision-Making Programs: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[06]**

4. Advanced Plotting and Model Building: *xy* Plotting functions, additional commands and plot types, interactive plotting, function discovery, regression, basic fitting interface, three dimensional plots. **[06]**

Text Books:

1. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.
2. William J. Palm III (2012), A Concise Introduction to MATLAB, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.
2. Stormy A. (Edition 4), MATLAB: A Practical Introduction to Programming and Problem Solving, BH Publication.

MS 651 **Magneto Hydrodynamics** **3-1-0-4**

1. Fundamental Equations of MFD: Electromagnetic field equations(charge conservation equation, constitutive equations, Maxwell's equations, generalized Ohm's law),fluid dynamics field equations(equation of state, equation of motion, equation of energy), MFD approximation, magnetic field equation, magnetic Reynolds number, Alfven's theorem, magnetic energy, electromagnetic stresses, force free magnetic fields. **[10]**

2. Basic Equations of MHD Flow: Boundary conditions, flow between parallel plates, Hartmann flow, Couette flow with velocity and temperature distributions, flowin a tube of rectangular cross section, pipe flow, flow in a annular channel, flow between two rotating coaxial cylinder. **[10]**

3. Boundary Layer Approximation: Two dimensional boundary layer equations for flow over a plane surface for fluids of large electrical conductivity, flow past a semi infinite rigid flate plate in an aligned and transverse magnetic field, two dimensional thermal boundary layer equations for flow over a plane surface, heat transfer in MHD boundary layer flow past a flate plate in an aligned magnetic field. **[10]**

4. Magneto Hydrodynamics Waves: Waves in an infinite fluid of infinite electrical conductivity, Alfven waves, waves in a compressible fluid, waves in the presence of dissipative effects, stationary plane shock waves in absence of magnetic field. **[09]**

Text Books:

1. Cramer R.K., Pai S.I.(1973) Magnetofluid Dynamics for Engineers and Physicists, Scripta Publishing Company, Washington D. C.
2. Charlton P.(1985) Text Book on Fluid Dynamics, CBS Publications, Delhi.

Reference Books:

1. Shereliff J.A. (1965) Magneto Hhydrodynamics, Pergamon Press, London.
2. Rathy R.K. (1976)an Introduction to Fluid Dynamics Oxford and IBH Publishing Company, New Delhi.

MS 652 **Viscous Fluid Dynamics** **3-1-0-4**

1. Fluid Motion: Introduction and continuum hypothesis, constitutive equations for Newtonian fluids, viscosity, Navier Stoke's equation for viscous compressible flow, vorticity and circulation, equation of energy, flow between two concentric rotating cylinders, stagnation point it two dimensional flow, flow due to plane wall suddenly set in motion(Stoke's first problem). **[10]**

2. Temperature Distribution: Physical importance of non-dimensional parameters. Renold's number, Prandtl number, Mach number, Froude Number, Nusselt number , plane couette flow, plane poisseullecouette flow, plane poissuille flow, Haigen poissuille flow in a circular pipe, Stoke's equation of very slow motion, Stoke's stream function, flow past a sphere. **[10]**

3. Laminar Flow: Two dimensionalincompressible boundary layer equation, Blasuis Topfer solution of boundary layer on a flat plate, wedge flow, flow in a convergent channel, flow in the wake of flat plate, two dimensional plane jet flow. **[10]**

4. Boundary Layer Theory: Thermal boundary layer in two dimensional incompressible flows, Crocco's integrals, forced convection in laminar boundary layer on a flat plate, free convection from a heated vertical plate, Karman momentum and kinetic energy integral equations. **[09]**

Text Books:

1. Schliching H., Boundary Layer Theory, McGraw Hill.
2. Pai, S.I, Nostrand D.V. (1956) Viscous Flow Theory, Vol.I, Laminar Flow, Company, New York.

Reference Books:

1. BansalJ.L. (2004)Viscous Fluid Dynamics, Oxford and IBH.
2. Frank M. W. (1991)Viscous Fluid Flow,2nd edition, McGraw Hill.

MS 661 **Sequence and Series** **3-1-0-4**

1. **Real and Complex Numbers:**Introduction, field and order structures, bounded and unbounded sets with supremum and infimum, completeness, absolute value, limit points, closure, countable and uncountable sets,complex number system, triangle inequality, functions of single variable. **[12]**

2. Sequences: Sequences of real and complex numbers, limit points, limits, convergence and non-convergence, Cauchy's general principle of convergence, algebra of sequences, monotonic, point wise convergence, uniform convergence on an interval, tests for convergence, properties, Weierstrass approximation theorem. **[11]**

3.Infinite Series I: Introduction, series of real and complex numbers, positive term series, comparison, Cauchy's root, D'Alembert's ratio, Raabe's, Logarithmic, integral, Gauss's tests, series with arbitrary terms, rearrangement of terms. **[08]**

4.Infinite Series II: Properties of uniform convergent series, power series, properties of functions expressible as power series, Abel's theorem, Taylor's and Lauren's series with convergence. **[08]**

Text Books:

1. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.
2. Rudin W.(1976) Principles of Mathematical Analysis, 3rd Edition, TMH.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trignometric Series, Vol. 1, Cambridge University Press.
3. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.
4. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
5. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 662 **Summability and Approximation Theory** **3-1-0-4**

1. Transformation and Summability Means: Matrix and linear transformation, definition of summability, Norlund means and its regularity condition, Cesaro means (C, 1) means, Cesaro and holders matrices, consistency of methods, examples and related theorems. **[15]**

2.Convergence of Fourier Series: Convergence of Fourier series, Dirichlet's integral, Riemann-Lebesgue theorem, (C, 1) summability of Fourier series, Fejer theorem, Fejer-Lebesgue theorem. **[08]**

3. L_p Space: Definition of L_2space, L_p space, Bessel's inequality, Holders inequality and Minkowski inequality. **[08]**

4.Approximation Theory: Best approximation in normed space, linear operators, Weierstrass's approximation theorem, Stone Weierstrass theorem, Chebyshev polynomials, trigonometric polynomials, error approximation function, Bernstein polynomial. **[08]**

Text Books:

1. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
2. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trigonometric Series, Vol. 1, Cambridge University Press.
3. PetersonG. M (1966) Regular Matrix Transformation, Mc-Graw Hill.
4. Boss J. (2000) Classical and Modern Methods in Summability, Oxford University Press.
5. Mursaleen M. (2014) Applied Summability Methods, Springer.
6. Hrushikesh N., Haskar M, Pai D.V. (2000) Fundamentals of Approximation Theory, Narosa Publishing House.
7. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 671 **Tensor Analysis** **3-1-0-4**

1. Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors. **[10]**

2. The Tensor Concept: Zeroth-order tensors, first-order tensors, second-order tensors, higher-order tensors, transformation of tensors under rotation about a coordinate axis, invariance of tensor equations, curvilinear coordinates, tensors in generalized coordinate systems. **[10]**

3. Tensor Algebra: Addition of tensors, multiplication of tensors, contraction of tensors, symmetry properties of tensors, reduction of tensors to principal axes, invariants of tensors, pseudotensors. **[10]**

4. Vector and Tensor Analysis: Field concept, Gauss, Green And Stokes theorem, scalar fields, vector fields, second-order tensors fields, the operator ∇ and related differential operators. **[09]**

Text Books:

1. Vector and Tensor Analysis by A. I. Borisenko and I. E. Tarapov, Dover, 1979.
2. Introduction to Vector and Tensor Analysis by R. C. Wrede, Dover, 1972.

Reference Books:

1. DavisH. F., SniderA. D. (1995) Introduction to Vector Analysis, 7thEdition, Brown Publishers.
2. Schey H.M. (1997) Div, Grad, Curl and All That: An Informal Text on Vector Calculus, 2nd edition, W.W. Norton.
3. Bourne D.E., KendallP.C. (1977) Vector Analysis and Cartesian Tensors, Nelson.
4. Tensor Calculus by J. L. Synge and A. Schild, Dover, 1978.

MS 672 **Mechanics and Calculus of Variation** **3-1-0-4**

1. Generalized Coordinates: Holonomic and non holonomic systems, Scleronomic and Reonomic systems, generalized potential, Lagrange's equations of first kind, Lagrange's equations of second kind, uniqueness of solution, and energy equation of conservative fields. **[10]**

2. Hamilton's Variables: Donkin's theorem, Hamilton canonical equations, cyclic coordinates, Routh's equation, Poisson's bracket, Poisson's identity, Jacobi- Poisson theorem. **[10]**

3. Calculus of Variations: Motivating problems of calculus of variations, Brachistochrone problem, isoperimetric problem, geodesic, fundamentals lemma of calculus of variations, Euler's equation of one dependent function and its generalization to (i) 'n' dependent functions, (ii) higher order derivatives, conditional extremum under geometric constraints and integral constraints. **[10]**

4. Hamilton-Jacobi Theory: Hamilton's principal, principal of least action, Poincare Cartan integral invariant, Whittaker's equations, Jacobi's equations, statement of Lee Hwa Chung's theorem, Hamilton-Jacobi's equation, Jacobi's theorem, method of separation of variables. Lagrange's bracket and Poisson brackets, invariance of Lagrange's bracket and Poisson brackets under canonical transformations. **[09]**

Text Books

1. Ramsey A.S.(1941)Dynamics Part II, Cambridge University Press.
2. Goldstein H. (2002) Classical Mechanics, 3rd edition, Narosa Publishing House.

Reference Books:

1. Loney S.L. (2016) An Elementary Treatise on Statics, First paperback edition, Cambridge University Press.
2. Louis N. H., Janet D. F.(1999)Analytical Mechanics, Cambridge University Press.
3. Gelfand I M., Fomin S.V., Richard A. S. (2000) Calculus of Variations PHI.
4. Tiwari R.N., Takhur B.S. (2007) Classical Mechanics: Analytical Dynamics, PHI.

MS 681 **Reliability Theory** **3-1-0-4**

1. Basic Concepts of Reliability: Introduction, reliability and quality, failure and failure modes, causes of failures and unreliability, maintainability and availability, reliability analysis, mathematical models and numerical evaluation, designing for higher reliability, redundancy techniques, equipment hierarchy, reliability and cost. **[07]**

2. Reliability Mathematics: Random experiments and probability, random variables, discrete distribution (Binomial and Poisson) and Continuous distributions (uniform, exponential, Rayleigh, Weibull, gamma, normal, log normal, truncated normal, inverse Gaussian), numerical characteristics of random variables and Laplace transform. **[08]**

3. System Reliability and Hazard Models: Component reliability from test data, mean time to failure, time-dependent hazard models, stress-dependent hazard models, derivation of reliability function using Markov model, treatment of field data, system with components in series and parallel, k-out-of-m systems,non series-parallel systems, system with mixed-mode failures, fault-tree technique. **[08]**

4. System Design and Reliability Redundancy: Component versus unit redundancy, weakest-link technique, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy, maintainability and availability concepts with two-unit parallel system with repair, preventive maintenance. **[08]**

5. Reliability Testing Demonstration and Acceptance: Problem of life testing, estimation of parameters and reliability using standard probability models using complete and censored samples, properties of these estimators, probability plotting and graphical procedures for estimating the parameter and testing validity of model by some standard statistical tests, life test acceptance sampling plans in exponential case, sequential life test in exponential case, accelerated life tests. **[08]**

Text Books:

1. Ebeling C. E. (2015), An Introduction to Reliability and Maintainability Engineering, Eighteenth reprint, McGraw Hill Education.

Reference Books:

1. Balagurusamy E. (2008) Reliability Engineering, Sixth reprint, TMH.
2. Srinath L.S., Reliability Engineering, Fourth Edition, EWP.

MS 682 **Fourier Analysis** **3-1-0-4**

1. Fourier Series: Recapitulation about piecewise continuous functions, odd and even functions, periodic and non-periodic functions, orthogonal and orthonormal functions, orthonormal sets, Dirichlet's conditions, Fourier series, change of interval, Fourier cosine series, Fourier sine series, complex form of Fourier series, convergence of Fourier series, generalized Fourier series, practical harmonic analysis,Fourier–Bessel series, Fourier – Legendre series. **[10]**

2. Fourier Integral and Applications: The Fourier integral formula, Dirichlet's integral, Fourier integral theorem, cosine and sine integrals, Eigen value problems on unbounded intervals, superposition of solutions, steady temperature in a semi-infinite strip, temperature in a semi-infinite solid, temperature in an unlimited medium. **[10]**

3.Fourier Transform and Applications I: Definition and properties of Fourier transform, Fourier cosine and sine transforms, complex Fourier transform, convolution theorem, Parseval's identities, finite Fourier transforms, solution of some partial differential equations. **[10]**

4. Fourier Transform and Applications II: Discrete Fourier Transform (DFT), approximation of Fourier coefficients of a periodic function, inverse DFT, properties of DFT, cyclical convolution and convolution theorem for DFT, Parseval's theorem for DFT, matrix form, N-point inverse DFT, fast Fourier transform(FFT). **[09]**

Text Books:

1. Ward Brown J., ChurchillR. V. (2015) Fourier Series and Boundary Value Problems, McGraw Hill Education.
2. Davis H.F. (1989) Fourier series and Orthogonal Functions, Dover Books on Mathematics.

Reference Books:

1. Spiegel (2015) Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series), McGraw Hill Education.
2. Jain R.K., Iyengar S.R.K. (2003) Advanced Engineering Mathematics, Narosa Publishing House.
3. Tolstov G.P. (1976) Fourier series, Dover Books on Mathematics.
4. JamesI.F. (2002) A Student's Guide to Fourier Transform with Applications in Physics and Engineering, 3rd edition, Cambridge.

MS 691 **Advanced Number Theory** **3-1-0-4**

1. Divisibility Theory and Factorization: Prime numbers and their distribution, greatest common divisor and the Euclidian algorithm, linear Diophantine equation, sieve of Eratosthenes, Mersenne primes and perfect numbers, sums of two squares. **[08]**

2. Theory of Congruences: Basic properties of congruences, linear congruences and the Chinese remainder theorem, Fermat's little theorem and pseudoprimes, $\varphi(n)$ (Euler's phi function), Euler generalization of Fermat's theorem, Wilson's theorem. **[08]**

3. Primitive Roots and Quadratic Reciprocity: Multiplicative orders of integers modulo$n$, primitive roots of primes and composites, Legendre and Jacobi symbols, quadratic reciprocity and quadratic congruences with multiple moduli. **[08]**

4. Special Functions and Recent Applications: Fermat numbers, amicable numbers, the Mobius inversion formula, sums of more than two squares, public key cryptosystems, primalty testing and factorization, Diffie-Helman key exchange, finite fields, cyclotomic polynomials, Gaussian integers, continued fractions, Pells equations, valuations, Deedkind domain, the Riemann zeta(ζ) function, modular (quadratic) forms, quadratic number fields. **[15]**

Text Books:

1. BurtonD.M. (2011) Elementary Number Theory, 2nd Edition, Tata Mc Graw Hills.
2. Telang S.G. (1996) Number Theory, 6th Edition, Tata Mc Graw Hills.

Reference Books:

1. Murty V. K. (1998) Contemporary Mathematics (Number Theory), Wald Schmidt AMS Society.
2. Lang S. (1994) Algebraic Number Theory, 2ndEdition, Springer Textbooks.
3. LandauE. (1966)Elementary Number Theory, 2nd Edition, AMS.
4. Frohlich, Taylor, Taylor (1991) Algebraic Number Theory, 2nd Edition, Cambridge University Press.
5. Niven I., Zuckerman (1991) Introduction to Theory of Numbers, 5th Edition Montgomery, Wiley.

MS 692 **Differential Geometry** **3-1-0-4**

1. Space Curves I: Definition of space curves, arc length, natural equation of a line, and intersection of curves, intersection of curve and surface, order of contact, tangent, normal, osculating plane. **[10]**

2. Space Curves II: Principal normal and binormal at a point of a curve, curvature, torsion, Frenet – Serret formulae, plane curves, osculating circle and osculating sphere, fundamental theorem for space curves, helices, evolutes and involutes. **[10]**

3. Surfaces I: Definition of a surface, tangent plane and normal at a point of a surface, surfaces of revolution, conicoids and helicoids, envelopes and developable surfaces, ruled surfaces. **[10]**

4. Surfaces II: First fundamental form(metric), metric potentials, direction coefficients and angle between two curves on a surface, second fundamental form, lines of curvatures, principal curvatures, Meusnier's theorem, Euler's theorem, Dupin's indicatrix, means curvature, Gaussian curvature. **[09]**

Text Books:

1. Hsiung C. C. (1997) A First Course in Differential Geometry, International Press, and Cambridge, MA.
2. Willmore T.J. (1964) An Introduction to Differential Geometry, Oxford University Press,

Reference Books:

1. Carmo M. P. D. (1976) Differential Geometry of Curves and Surfaces, Prentice-Hall, Englewood, NJ.
2. Abate M., Tovena F. (2012) Curves and Surfaces, Springer.
3. PetersA. K. (2010) Differential Geometry of Curves and Surfaces, Ltd., Natick, Mass.
4. Struik D.J. (1988) Lectures on Classical Differential Geometry, 2nd Edition, Addison-Wesley.

Mody University of Science & Technology

MSc Microbiology
Session 2016-2017

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.- Microbiology

Two-Year Programme

Academic Curriculum (2013 – 14 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Autumn Semester	MB 511	Bacteriology and Phycology	3	-	-	3	3	25	25	50
	MB 521	Virology and Mycology	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 541	Laboratory Course in Study of Microorganisms	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**1**	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Spring Semester	MB 512	Microbial Physiology and Metabolism	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3	-	-	3	3	25	25	50
	MB 532	Immunology	3	-	-	3	3	25	25	50
	MB 631	Microbial Genetics	3	-		3	3	25	25	50
	MB 542	Seminar	-	-	-	1	-	100		
	MB 524	Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section.

M.Sc.-Microbiology
Two-Year Programme
Academic Curriculum (2013 – 14 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	MB 611	Medical Microbiology	3	1	-	4	3	25	25	50
	MB 681	Environmental and Agricultural Microbiology	3	1	-	4	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	MB 651	Medical, Environmental and Agricultural Microbiology Laboratory	-	-	4	2	4	100		
	MB 671	Genetic Engineering and Fermentation Technology Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**3**	**8**	**19**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	MB 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				
		Total Credits				**84**				

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Microbiology)

MB 511 Bacteriology and Phycology 3-0-0-3

General Concepts of Microbiology: History and development of Microbiology as a discipline of science, spontaneous generation vs biogenesis, Koch's postulates Basic features of microscopy-Compound, fluorescence, dark field, phase contrast, SEM and TEM, Staining methods-simple, differential and sample preparation for electron microscopy. [6]

Morphology and Ultrastructure of Bacteria: Basic ultrastructure, morphological types, cell walls of gram positive, gram negative and archeobacteria, cell wall biosynthesis, cytoplasmic membrane-structure, composition and functions, L-forms, Ultrastructure and types of flagella, capsule and its function, pilli. [8]

Cultivation of Bacteria: Aerobic and anaerobic cultivation, Nutrient media-selective and differential, Nutrient types of bacteria, Growth curve and kinetics of growth, Batch culture, fed-batch culture and continuous culture, synchronous growth, Factors affecting growth, Control of bacteria-physical and chemical agents. [10]

Classification: Bacterial classification, Hackle's three kingdom, Whittaker's five kingdom, Eight kingdom classification, Phenetic and phylogenetic classification, Outlines of Bergeys manual, Use of molecular approaches for classification of bacteria. [7]

Algae: General Characteristics, Classification, Nutrition, Reproduction, Algal ecology, Economic importance of Diatoms, Rhodophyta and Green algae. [8]

MB 521 Virology and Mycology 3-0-0-3

General Concepts of Viruses: Discovery of viruses, Distinctive features, Morphology and Ultrastructure, Envelope and its properties, Virus related agents (Viroids and Prions). Classification-General properties, Nomenclature and classification of bacterial, plant and animal viruses. [5]

General Methods of Diagnosis of Viruses: Cultivation methods-embryonated eggs, experimental animals, cell cultures (Primary and secondary), Serological methods- heamagglutination, complement fixation, immunofluoresecnce, ELISA and RIA, infectivity assay (end point method); Role of electron microscopy in study of viruses. [8]

Bacterial and Plant Viruses: Bacteriophage structure- general characteristics, Life cycle- Lytic and Lysogeny, One step growth curve, Regulation of lytic cycle, brief details of M13, Mu, Lambda and T4, Effect of viruses on plant appearance, histology, cytology, Transmission of plant viruses- Vector(insects, nematodes) and without vector, Common diseases of Paddy, Cotton, Tomato and Sugarcane, Life cycles- TMV, CMV and Potato Virus X. [10]

Animal Viruses: Life cycle and pathogenecity of RNA viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota and HIV, Oncogenic viruses, DNA viruses- Pox, Herpes, Adeno, SV 40, Hepatitis viruses, Basic concepts of viral vaccine. [8]

General Concepts of Mycology: General features of fungi, Classification of fungi, Life cycles of *Aspergillus*, *Saccharomyces*, *Deuteromycetes*, Mycorrhiza: Ecto, endo and VAM, Lichens- general features, Fungal diseases- Systemic and Sub cutaneous Mycoses, Candidiasis, Dermatomycosis. [8]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Molarity and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance. [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates. [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, Michelis Menten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary [6]

electrophoresis.

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean, median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean [6]

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis [9]

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 541 Laboratory Course in Study of Microorganisms 0-0-4-2

Assignments based on MB 511 and MB 521containing exercises on staining and isolation of different microbial types on the basis of cultural and microscopic methods will be conducted.

BC 541 Biomolecules and Instrumentation laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

MB 512 Microbial Physiology and Metabolism 3-0-0-3

Transport Mechanisms: Basic features of transport- Role of cell membrane in transport, Thermodynamics of transport, Types of transport- passive diffusion, facilitated diffusion, active transport, group translocation, uniport, symport and antiport, Transport of siderophores. [8]

Respiratory Metabolism: Glucose Metabolism- Reactions and control of Glycolysis, Pentose Phosphate Pathway, Gluconeogenesis, Citric acid cycle, Oxidative and Substrate level phosphorylation, Glyoxylate cycle, Homo and heterolactic fermentation, Pasteur effect. [10]

Photosynthesis: Brief account of photosynthetic and accessory pigments- Chlorophyll, Bacteriochlorophyll, Carotenoids and Phycobiliproteins, Details of Oxygenic and Anoxygenic photosynthesis, Major groups of photosynthetic bacteria, Fixation of CO_2- Calvin cycle, C3 and C4 pathway; Photorespiration. [10]

Nitrogen and Lipid Metabolism: Nitrogen cycle, Assimilation of nitrogen, Biosynthesis of amino acids, Nitrogen fixation- basic concepts, nitrogenase enzyme, Fatty acid oxidation- □-oxidation, Fatty acid biosynthesis. [6]

Sporulation and Morphogenesis: Endospore formation- structure, properties and germination; Dormancy in selected microbes [5]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori* [10]

Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 592 Bioinformatics , Scientific Communication & Intellectual Property Rights **3-1-0-4**

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management. 6

Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions. 8

Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins. 8

Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index. 3

Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International) 7

Biotechnology and Intellectual Property Rights.
Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy 7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 Molecular Biology 3-0-0-3

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity. [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 631 Microbial Genetics 3-0-0-3

Mutations: Basic concepts of mutation, Molecular nature of mutations, Spontaneous mutation, Reverse mutation, Frameshift mutation, Site directed mutagenesis- deletions, insertions, localized point mutation, Mutations by synthetic oligonucleotides, Evolutionary role of mutation. [8]

Gene Transfer: Transformation, Transduction- specialized and generalized, Conjugation- interrupted mating, Transfection. [8]

Vectors: Plasmids, Colicins and col factors, Plasmids as vectors for gene cloning, Transposons and their use in genetic analysis, Mechanisms of antibiotic resistance by transposons. [6]

Bacteriophage Genetics: Life cycle and uses of following phages in microbial genetics- Lytic phages- T4 and T7, Lysogenic phages- P1, M13, ΦX174, fd [9]

Gene Expression: Gene expression in eukaryotes and prokaryotes and its regulation [8]

MB 542 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver seminar on it.

MB 524 Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory 0-0-4-2

Assignments based on MB 512 MB 514 and MB 592 containing exercises on microbial physiology, genetics and metabolisms of microorganisms and their role in food production and spoilage will be conducted.

BT 572 Molecular Biology and Immunology Laboratory 0-0-4-2

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication 0-0-2-1

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

MB 611 Medical Microbiology 3-1-0-4

Normal Flora of Human Body: Skin, Oral cavity, Gastrointestinal tract, Respiratory tract, Urinogenital tract, Concept of opportunistic pathogens. [3]

Infection: Sources of infection for man, Vehicles or reservoirs of infection, Vertical and horizontal transmission of infection, Pathogenesis of infecting microorganisms-Virulence factors (adhesions, enzymes-coagulases, fibrinolysins, mucinases, lipase, proteases, nucleases, collagenase, neuraminidase). Toxins-endotoxins and exotoxins as agents of disease. [5]

Microbial Strategies for Evading Immune Response: Evading phagocytosis, Survival in phagocytes, Immunosuppression, Induction of ineffective antibodies, Antigenic variation, Avoiding induction of immune response. [5]

Bacterial Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of bacterial diseases caused by- *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Vibrio, Yersinia, Mycobacterium, Treponema, Mycoplasma, Campylobacter, Helicobacter, Rickettsiae and Chlamydiae.* [9]

Viral Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of viral diseases- Pox viruses (Small pox), Herpes viruses (HSV, Epstein-barr virus), Adenoviruses, Picorna viruses (Polio, Rhinoviruses), Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, RSV), Arboviruses (Dengue, Yellow fever,), Rhabdoviruses (Rabies), Hepatitis viruses, Rubella, Reovirus, Rotavirus, Viral Haemorrhagic Fevers, HIV, Oncogenic Viruses. [9]

Fungal and Protozoan Diseases: Pathogenesis, laboratory diagnosis and treatment of fungal and protozoan (Malaria, Kala Azar) diseases. [5]

Antimicrobial Agents: Mode of action of important antibacterial, antifungal, antiviral and antiprotozoan agents. [3]

MB 681 Environmental and Agricultural Microbiology 3-1-0-4

Aerobiology: Droplet nuclei, aerosols, Assessment of air quality- solid, liquid impingment, Air borne transmission of microbes [3]

Types of Soils- physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere [3]

Water Microbiology: Fresh water and marine habitats- general characteristics, Types of microbes, Microbial activity, Eutrophication and its effects, Assessment of water quality- water purification, Potability standards. [7]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles; Role of microbes in biodeterioration- Metal corrosion, Paper; Metal detoxification, Biopesticides. [10]

Microbes in Waste Treatment: Types of wastes- Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and

Tertiary treatment), Trickling filter, Biocontactor, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [8]

Nitrogen Fixation: Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic(Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications. [8]

MB 641 Industrial Microbiology and Fermentation Technology 3-0-0-3

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feed back repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (□-lactam, aminoglycosides). [12]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids. [5]

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomyces cereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

MB 651 Medical, Environmental and Agricultural Microbiology laboratory 0-0-4-2

Assignments based on MB 611 and MB 621 describing role of microorganisms in disease causing and prevention and their positive and negative role in environment and agriculture will be conducted.

MB 671 Genetic Engineering and Fermentation Technology laboratory 0-0-4-2

Assignments based on MB 641and BT 611 containing exercises on genetic engineering of microorganisms and their role in industrial production of various metabolites like antibiotics, vitamins and enzymes will be conducted.

Mody University of Science & Technology

M.Sc. Chemistry
Session 2016-2017

Curriculum Structure

MASTER OF SCIENCE IN CHEMISTRY
M. Sc. – Chemistry
(2014-2015 onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20
M Sc First Year curriculum will be common for ALL specialization

History:

There has been rapid increase in demand of Chemical science professionals. Considering such a requirement, it is proposed to start a new postgraduate programme namely Master of Science in Chemistry with aim of acquiring the knowledge and developing the skills to plan, design and build complex applications which are highly valued in all sectors like pharmaceutical, fertilizer, education, chemical, biotechnology etc.
The first batch of the programme in MITS is proposed to be admitted in the session 2010-2011.

Input Qualification:

Bachelor's degree with Chemistry as a subject for three years / six semesters/ B. Sc. Applied Chemistry / B. Sc. Biochemistry / B.Sc. Industrial Chemistry with 50 % of marks.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of Postgraduate Programmes of MITS shall be followed.

M. Sc.-Chemistry
Academic Curriculum (2014-2015 onwards)
First Year-Common to ALL Specialization

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 511	Inorganic Chemistry-I	3	-	-	3	3	25	25	50
	CH 513	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 531	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH 523	Spectroscopy-I	3	-	-	3	3	25	25	50
	CH 551▲/ CH 561▲▲	Mathematics for Chemists▲/ Biology for Chemists ▲▲	3	-	-	3	3	25	25	50
	CH 571	Inorganic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 581	Organic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 591	Physical Chemistry Laboratory -I	-	-	4	2	4	25	25	50
		Sub Total	**15**	-	**12**	**21**	-	-	-	-
		Foreign Language –I ‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 512	Inorganic Chemistry-II	3	-	-	3	3	25	25	50
	CH 514	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH 532	Physical Chemistry-II	3	-	-	3	2	25	25	50
	CH 524	Spectroscopy-II	3		-	3	3	25	25	50
	CH 534	Colloids and Surface Chemistry	3		-	3	3	25	25	50
	CH 562	Inorganic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 572	Organic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 582	Physical Chemistry Laboratory -II	-	-	4	2	4	25	25	50
		Sub Total	**15**		**16**	**21**	-	-	-	-
		Foreign Language-II‡	3	-	-	3	-	25	25	50

Total Credits 42

▲ *For students without Mathematics in B. Sc.*

▲▲ *For students without Biology in B. Sc.*

‡ *Refer to Foreign Language Section*

M. Sc.-Chemistry
(Specialization in Organic Chemistry)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 611	Photochemical Reactions	3	-	-	3	3	25	25	50
	CH 621	Bioorganic Chemistry	3	-	-	3	3	25	25	50
	CH 631	Organic Synthesis-I	3	-	-	3	3	25	25	50
	CH 641	Separation Techniques and Data Analysis	3	-	-	3	3	25	25	50
	CH 651	Environmental and Green Chemistry	3	-	-	3	3	25	25	50
	CH 661	Advanced Organic Chemistry Laboratory-I	-	-	4	2	4	25	25	50
	CH 671	Advanced Organic Chemistry Laboratory-II	-	-	4	2	4	25	25	50
	CH 681	Advanced Organic chemistry Laboratory-III	-	-	4	2	4	25	25	50
		Sub Total	**15**	**-**	**12**	**21**	**-**	-	-	-

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 612	Organic Synthesis-II	3	-	-	3	3	25	25	50
	CH 622	Heterocyclic Chemistry	3	-	-	3	3	25	25	50
	CH 632	Chemistry of Natural Products	3	-	-	3	3	25	25	50
	CH 642	Medicinal Chemistry	3	-	-	3	3	25	25	50
	CH 652	Dissertation[#]	-	-	-	10	-	100		
		Sub Total	**12**	**-**	**-**	**22**	**-**	-	-	-
		Total Credits				**87**				

[*] *Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.*

[#] *Student will perform project work for a period of 2 months and submit two copies of Dissertation report to the department. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

COURSE DESCRIPTION
M. Sc. (Chemistry)

CH 511 **Inorganic Chemistry-I** **3-0-0-3**

Stereochemistry and Bonding in Main Group Compounds: Walsh diagrams (tri-atomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. [9]

Metal-Ligand Equilibria in Solution : Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. [8]

Reaction Mechanism of Transition Metal Complexes : Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. [15]

Metal-Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. [7]

Suggested Books:

1. Advanced Inorganic Chemistry; F.A. Cotton and G. Wilkinson, 6th Edn. John Wiley & Sons.
2. Inorganic Chemistry; James E. Huheey, 4th Edn. Addison-Wesley Pub. Co.
3. Physical Methods in Inorganic Chemistry; R. S. Drago, International Edn. East-West Press.
4. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.

CH 513 **Organic Chemistry-I** **3-0-0-3**

Nature of Bonding in Organic Molecules: Delocalized chemical bonding, conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. [6]

Stereochemistry: Conformational analysis of cycloalkanes, Decalines. Chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. [10]

Reaction Mechanism, Structure and Reactivity: Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation. [8]

Aliphatic Nucleophilic Subsitution: The SN2, SN1 mixed SN1 and SN2 and SET mechanism. Neighbouring group participation mechanism by σ and π bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The SN i mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Ambident nucleophile, regioselectivity. [5]

Aliphatic Electrophilic Substitution: Bimolecular mechanisms SE2 and SEi, The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving groups and the solvent polarity on the reactivity. [6]

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction. [4]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, 5th Edition. John Wiley & Sons.
2. A Guide book to Mechanism in Organic Chemistry; Peter Sykes, 6th Edition, Orient Longman Ltd..
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Organic Chemistry; R.T. Morrison and R.N. Boyd, Prentice- Hall of India.

6. Organic Reactions and Their Mechanisms; P.S. Kalsi, New Age International Publication.

CH 531 Physical Chemistry-I 3-0-0-3

Quantum Chemistry:

A. Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

C.Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

D. Molecular Orbital Theory: Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

[15]

Thermodynamics:

A. Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; Partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems, second order phase transitions.

B. Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translational, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics; distribution Law and application to helium.

C. Non Equilibrium Theromodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity

relations, electrokinetic phenomena, diffusion, electric conduction. [15]

Symmetry and group theory in chemistry: Symmetry elements and symmetry operations, definitions of group, subgroups, relation between orders of a finite group and its subgroup, similarity transformation and classes, point groups, Schonflies symbols, representation of groups by matrices(representation for the Cn, Cnv, Cnh, Dnh, etc. groups to be worked out explicity), character of a representation, the great orthogonality theorem (without proof) and its importance, character tables and their use. [9]

Suggested Books:

1. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
2. Chemical Kinetics; K. J. Laidler, Harper & Row.
3. Physical Chemistry; P. W. Atkins, Oxford University Press.
4. Physical Chemistry; I.N. Levine, Tata McGraw Hill Pub. Co. Ltd.
5. Kinetics and Mechanism of Chemical Transformations; J. Raja Ram and J.C. Kuriacose, MacMillan Indian Ltd.
6. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.

CH 523 Spectroscopy-I 3-0-0-3

Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, applications [8]

Vibrational Spectroscopy: Symmetry and shapes of AB2, AB3, AB4, AB5 and AB6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins. [8]

Raman Spectroscopy: Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS). [8]

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. [7]

Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of
(1) Bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin.
(2) Sn^{+2} and Sn^{+4} compounds; nature of M-L bond, coordination number, structure.

(3) Detection of oxidation state and inequivalent MB atoms. [8]

Suggested Books:

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. NMR, NQR, ESR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
3. Physical Methods in Chemistry, R.S. Drago, Saunders College.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
5. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
6. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.

CH 551 **Mathematics for Chemists** **3-0-0-3**

Vectors and Matrix Algebra: A. Vectors: Vectors, dot, cross and triple products etc The gradient, divergence and curl, Vector Calculus.

B. Matrix Algebra: Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

[12]

Differential and Integral Calculus: Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus.Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar).

[8]

Elementary Differential equations: Exact First-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc, second order differential equation and their solutions.

[10]

Permutation and Probability: Permutations and combinations, probability and probability theorems, average, root means square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc) with a general polynomial fit.

[9]

Suggested Books:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemists, Doggett and Suiclific, Longman.
3. Mathematical preparation for Physical chemistry: F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Bararnte, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.

CH 561 **Biology for Chemists** **3-0-0-3**

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP - the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules. [8]

Carbohydrates: Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides; cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway. [8]

Lipid: Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-β-oxidation of fatty acids. [8]

Amino-acids, Peptides and Proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. Force responsible for holding of secondary structures. α- helix, -β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure, Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical / enzymatic / mass spectral, racemization / detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH). [8]

Nucleic Acids: Purine and pyrimidine bases of nucleic acids, base pairing via H -bonding. Structure of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside [7]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 571 Inorganic Chemistry Laboratory - I 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $VO(acac)_2$
b) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
c) $Na[Cr(NH_3)_2(SCN)_4]$
d) $Mn(acac)_3$
e) $K_3[Fe(C_2O_4)_3]$
f) Prussian Blue, Turnbull's Blue

II. Qualitative and Quantitative Analysis; Two metal ions in cationic/ anionic forms.

Rare elements: Tl, W, Se, Mo, Ti, Zr, Ce, Th, V, U, Li
Insolubles: Oxides, sulphates and halides

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experimens, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 581 Organic Chemistry Laboratory - I 0-0-4-2

Qualitative Analysis: Separation, purification and identification of compounds of binary mixture (one liquid and one solid / two liquids / two solids) using TLC and Column Chromatography, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis:

a) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
b) Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol
c) Grignard reaction : Synthesis of triphenylmethanol from benzoic acid
d) Aldol condensation: Dibenzal acetone from benzaldehyde.
e) Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.

CH 591 Physical Chemistry Laboratory - I 0-0-4-2

a) To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
b) To determine the electron polarization and electron polarizability of a liquid refractometrically.
c) To determine the concentration of a given solution of an optically active substance by polarimetric measurements.
d) To determine the specific and molar rotation of an optically active substance, like cane sugar at a number of concentrations and hence find the intrinsic rotation of the substance.
e) To verify the Beer's law for the solution of the potassium permanganate and determine the concentration of the given aqueous solution of unknown concentration of this salt.
f) To determine the equilibrium constant of the given reaction, potentiometrically.
g) To determine the heat of neutralization of hydrochloric acid using a classical calorimeter.
h) To determine the stability constant of a $FeSCN^{2+}$ complex ion keeping ionic strength constant.
i) To determine the solubility of Ca $(IO_3)_2$ in deionized water and in dilute solution of potassium chloride at room temperature. Also evaluate the thermodynamic solubility product.
j) To determine the formula and the stability constant of a metal ion complex (Lead oxalate complex.)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 512 **Inorganic Chemistry-II** **3-0-0-3**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of D_q, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

[10]

Metal π-Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation,important reactions of metal carbonyls; preparation, bonding, structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphene as ligand.

[8]

Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes compounds with metal metal multiple bonds

[5]

Role of metal ions in biological processes: Brief study of various metal ions (Fe, Mo, Cu, Co, Ni, V, Cr, Mn, Zn, Se, B, Na, K and Ca) in biological processes.

[10]

Isopoly and Heteropoly Acids and Salts: Brief study

[6]

Suggested Books:

1. Mechanism of Inorganic Reactions; F. Basalo and R.G. Pearson, Wiley Eastern Ltd.
2. Inorganic Chemistry; D. F. Shriver and P. W. Atkins, ELBS.
3. Advanced Inorganic Chemistry; F. A. Cotton and G. Wilkinson, Edn. John Wiley & Sons.
4. Electronic Absorption Spectroscopy and Related Techniques; D.N. Sathyanarayana, Universities Press (India) Ltd.
5. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.
6. Inorganic Reaction Mechanisms; Martin L. Tobe and John Burgess, Longmans.

Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1 mechanism, Reactivity; effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet - Hauser, and Smiles rearrangments. [5]

Free Radical Reactions: Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction. [7]

Addition to Carbon Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation. [7]

Addition to Carbon-Hetero Multiple bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. [7]

Elimination Reactions: The E2, E1 and E1CB mechanisms and their spectrum. Orientation of the double bond. Mechanism and orientation in pyrolytic elimination. [5]

Pericyclic Reactions: Molecular orbital symmetry, Electrocyclic reactions, cycloaddition reactions and sigmatropic reactions, FMO and PMO approach. Correlation diagram, selection rules. Claisen, Cope and aza-Cope rearrangements, Ene reaction [8]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, John Wiley & Sons.
2. A Guide Book to Mechanism in Organic Chemistry; Peter Sykes, Orient Longman Ltd.
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Mechanism and Theory in Organic Chemistry; S.M. Mukherjee and S.P. Singh, Mac Millan India.

6. Organic Reactions and Their Mechanisms; P. S. Kalsi, New Age International Pub.

CH 532 Physical Chemistry II 3-0-0-3

Surface Chemistry:

A. Adsorption -Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of dropletes (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).

B. Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles. [12]

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures. [8]

Electrochemistry: Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham- Devanathan - Mottwatts, Tobin, Bockris, Devanathan models, Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance. [10]

Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions). [9]

Suggested Books:

1. Modern Electrochemistry; J.O'M. Bockris and A. K. N. Reddy, Plenum Press.
2. Physical Chemistry; P. W. Atkins Oxford University Press.
3. Physical Chemistry; I. N. Levine, Tata McGraw Hill Pub. Co. Ltd.
4. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.
5. Text Book of Polymer Science; F.W. Billmayer, Wiley-Interscience.
6. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
7. Chemical Kinetics; K. J. Laidler, Harper & Row.

CH 524 Spectroscopy-II 3-0-0-3

Ultraviolet and Visible spectroscopy: Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. [7]

Infrared Spectroscopy: Instrumentation and Sample handling.Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. [7]

Nuclear Magnetic Resonance Spectroscopy: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplifications of complex spectranuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE). [8]

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic , alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOSY, DEPT, INEPT, APT and INADEQUATE techniques. [6]

Mass Spectrometry: Introduction ion production EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Example of mass spectral fragmentation of organic compounds with [6]

respect to their structure determination.

Problems: Structure elucidation based on spectroscopic data. [5]

Suggested Books:

1. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J. Martin, Heyden.
2. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
3. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 534 Colloids and Surface Chemistry 3-0-0-3

Introduction: Introduction: Colloid & surface science - small particles, association structures, surfaces, interfaces, interphases and macromolecules, Survey of technologies reliant upon colloid and surface science. [5]

Particulate Dispersions (solids dispersed in fluids): Single particles, Scattering of electromagnetic radiation from matter, Single particles in external fields (gravity, electrical, etc.), Particle sizing (microscopy, scattering (ILS, DLS, x-ray, neutron), sedimentation, centrifugation, chromatography, acoustics, adsorption), Particles in fluids, Particle trajectories' Transport phenomena; Brownian motion, diffusion; Rheology & rheology of dispersions; Particle-particle interactions, potential energy diagrams; Colloid stability - aqueous, non-aqueous; Consequences of colloid stability (dispersal, flocculation, coagulation, phase separation); Measuring colloid stability; Particle-particle interactions: Dispersion forces (Hamaker theory); Solid-liquid interfaces (charging of surfaces, Electrical Double Layer, adsorption); Particle-particle interactions: Electrostatic forces; Analysis of surface charge and surface chemistry (electrokinetics [electrophoresis, streaming; potential, electro-osmosis, sedimentation potential], electroacoustics, surface spectroscopy, ESR); Particle-particle interactions: steric forces & polymer-mediated forces'' Particle-particle interactions: hydrophobic forces, Analysis of particle interactions (rheometry, AFM, CFM, MASIF, SFA); Flocculation & coagulation - Schulze-Hardy rule, inorganic coagulants, polymeric flocculants ; wastewater treatment

[15]

Wetting & Capillarity: Surface and interfacial tension; Phenomena of liquid surfaces - Phenomena of liquids near solid surfaces Wetting, spreading, penetration, film formation, adhesion, detergency and floation; Contact angles, their analysis and interpretation - component analysis; Surface roughness, chemical heterogeneity, contamination; Surface energy methods on planar, particulate, hollow and fiber surfaces; Relation of capillarity to phase diagrams; Adhesion & Contact mechanics.

[10]

Bubbles and Foams (gases dispersed in liquids): Foam stability; Film drainage; Film rupture; Film rheology; Emulsion and pseudo-emulsion films; Phase diagrams; Measuring thin film properties - disjoining pressure, thin film balance, Frothing agents', Foam breaking, Antifoaming agents & mechanisms, Flotation. [9]

Suggested Books:

1. Colloidal Dispersions: Suspensions, Emulsions, and Foams I.D. Morrison and S. Ross (2002, Wiley Interscience, NY; ISBN: 0-471-17625-7).
2. Basic Principle of Colloid Science, D.H. Everett (1988, Royal Society of Chemistry, London, ISBN : 0-85186-443-0)

CH 562 Inorganic Chemistry Laboratory - II 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $[Co(NH_3)_6]\ [Co(NO_2)_6]$
b) Cis-$[Co(trien)\ (NO_2)_2]\ Cl.H_2O$
c) $Hg[Co(SCN)_4]$
d) $[Co(Py)_2Cl_2]$
e) $[Ni(NH_3)_6]Cl_2$
f) $Ni(dmg)_2$
g) $[Cu(NH_3)_4]SO_4H_2O$

II. Qualitative and Quantitative Analysis; Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

III. Chromatography; Separation of cations and anions by
Paper Chromatography.
Column Chromatography : Ion exchange

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experiments, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 572 Organic Chemistry Laboratory - II 0-0-4-2

I. Organic Synthesis:

a) Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.
b) Friedel Crafts reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
c) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. The Products may be Characterized by Spectral Techniques
d) Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation

II. Quantitative Analysis:

a) Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
b) Estimation of amines/phenols using bromate bromide solution/or acetylation method.
c) Determination of lodine and Saponification values of an oil sample.
d) Determination of DO, COD and BOD of water sample.
e) To estimate the percentage of sulphur in the given organic sample by Messenger's method
f) To estimate the percentage of nitrogen in the given organic sample by Kjeldahl's method.
g) To estimate a halogen in the given sample by the alkaline reduction method (Modified Stepenow method).

Suggested Books:

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

CH 582 Physical Chemistry Laboratory - II 0-0-4-2

a) To determine the molecular weight of a macromolecule by viscometry.
b) To determine the order with respect to Ag(I) in the oxidation of Mn(II) by $S_2O_8^{2-}$ and the rate constant for the uncatalyzed reaction.
c) To determine the formation constant for the $[Ce^{IV}\text{-}H_3PO_2]$ intermediate complex and also the rate constant of its decomposition at 45° C.
d) Study the effect of hydrogen ion on the $H_2O_2 - I^-$ reaction and to determine the rate constants K_1 and K_2 of the given rate equation.
e) To determine the equivalent conductivity of an electrolyte at infinite dilutions, and to determine the dissociation constant of an acid at different dilutions.
f) To determine the standard electrode potential of the ferrous ferric system by titrating ferrous ammonium sulphates against potassium dichromate potentiometrically.
g) To determine the surface tension of an organic liquid (Ethyl acetate) at different temperatures by double capillary method and hence test the constancy of parachor.
h) To determine the critical micelle concentration of a soap (sodium laurate, sodium palmitate etc.) by surface tension measurements.
i) To determine the solubility and solubility product of sparingly soluble salts e.g. PbSO4, BaSO4) conductometrically.
j) To determine the strength of the given acid conductometrically using standard alkali solution. Select suitable pair for titration. (SA-SB, SA-WB, WA-SB, WA-WB)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 611 Photochemical Reactions 3-0-0-3

Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. [7]

Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy state; determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. [8]

Photochemistry of Alkene: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. [5]

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. [8]

Photochemistry of Aromatic Compounds: Isomerisations, additions and substitutions. [5]

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction, Singlet molecular Oxygen reaction, Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. [6]

Suggested Books:

1. Fundamentals of photochemistry, K.K. Rohtagi - Mukherjee, Wiley-Eastern.
2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.

CH 621 Bioorganic Chemistry 3-0-0-3

Introduction: Basic considerations, Proximity effects and molecular adaptation. [4]

Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and

enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver - Burk plots, reversible and irreversible inhibition.

[11]

Mechanism of Enzyme Action: Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase A. [6]

Kinds of Reactions Catalysed by Enzymes: Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisation reactions, β-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. [9]

Industrial Applications of Enzymes : Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-Brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. [9]

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

CH 631 Organic Synthesis-I 3-0-0-3

Reagents and reactions: Gilman's reagent – Lithium dimethylcuprate, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DDC), 1,3-Dithiane (Umpolungreagent), trimethylsilyliodide, Petersons synthesis, Bakers yeast, Organophosphorus compounds (Wittig reaction), Sulphur ylides, Phase transfer catalysts: Quaternary

ammonium and Phosphonium salts, Crown ethers. Heck reaction, Suzuki coupling and Mukaiyama reaction. [9]

Oxidation: Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate. [9]

Reduction: Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Epoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis. [8]

Rearrangements: General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil – Benzillic acid. Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. [8]

Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds: General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene, fluorine and undone). [5]

Suggested Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Uni. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier

CH 641 Separation Techniques and Data Analysis 3-0-0-3

Adsorption and partition chromatography:
(a) Definition of terms, techniques and chemical concepts
(b) Column adsorption chromatography
(c)Partition chromatography-column, paper and TLC [8]

High performance liquid chromatography -
Introduction, choice of the system, instrumentation and applications. [5]

Gas liquid chromatography: Introduction, choice of the system, instrumentation, qualitative and quantitative analysis of mixtures. [5]

Gel permeation/size exclusion Chromatography: Introduction, theory and applications. [5]

Ion exchangers: Theory, action of ion-exchange resins, ion exchange chromatography, exchange capacity, ion-exchange resins and liquid ion-exchange resins, applications of cation and anion ion exchangers. [5]

Solvent Extraction: - Introduction, principles, factors that influence solvent extraction, ion association complexes and applications of solvent extraction. [5]

Data analysis: Types of errors, propagation of errors, accuracy and precision, and least- square analysis, average standard deviation. [6]

Suggested Books:

1. Principles of Instrumental Analysis; D.A. Skoog, Saunders College Publishing.
2. Instrumental Methods of Chemical Analysis; G.W. Ewing, McGraw Hill Books Co.
3. Modern Methods of Chemical Analysis; R. L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, John Wiley.
4. Analytical Chemistry: Principles; J.H. Kennedy, Saunders Holt.

CH 651 Environmental and Green Chemistry 3-0-0-3

Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in the atmosphere, stratospheric chemistry: The chemistry of ozone layer, The role of chemicals in ozone destruction, The green-house effect and Global warming, El-Nino phenomenon. [8]

Hydrosphere : Complexation in natural water and waste-water, Micro-organism in aquatic chemical reactions, Eutrophication, Re-cycle of waste-water in process industry, Treatment of sewage and reuse of water in industry and agriculture, Microbiology mediated redox reactions and Nitrogen transformation by bacteria. [8]

Lithosphere : The terrestrial environment, Soil formations, soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, waste classification and disposal. [8]

Chemical Toxicology: Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monooxide, nitrogen oxides, sulphur oxides, ozone, PAN, cyanide, pesticides, insecticides and carcinogens. [7]

Green Chemistry: Green chemistry – Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. Microwave induction, ultrasound assisted, green solvents- reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen , citral, urethane, adipic acid and styrene. [8]

Suggested Books:

1. Green Chemistry, P. Anastas, RSC.
2. Environmental Chemistry, S.E. Manahan, Lewis Pub.
3. Environmental Chemistry, Sharma and Kaur, Krishna Pub.
4. Environmental Chemistry, A.K. De, Wiley Eastern
5. Environmental Chemistry, C. Baird, W.H. Freem

CH 661 Advanced Organic Chemistry Laboratory - I 0-0-4-2

I. Qualitative Analysis: Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

II. Multi –step Synthesis of Organic Compounds: The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques. (Any Five)

a) Photochemical reaction Benzophenone - Benzpinacol - Benzpinacolone
b) Beckmann rearrangement : Benzanilide from benzene Benzene - Benzophenone - Benzphenone oxime - Benzanilide
c) Benzilic acid rearrangement : Benzilic acid from benzoin Benzoin - Benzil -Benzilic acid.
d) Synthesis of heterocyclic compounds Skraup synthesis: Preparation of quinoline from aniline Fisher Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine.
e) Enzymatic synthesis; Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ehtyl-3-hydroxybutanoate and determine its optical purity.
f) Biosynthesis of ethanol from sucrose.
g) Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
h) Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethylacetoacetate with an alkyl halide.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R.Tatchell,J.Wiley

CH 671 Advanced Organic Chemistry Laboratory - II 0-0-4-2

Extraction of Organic Compounds from Natural Sources. (Any Five)

a) Isolation of caffeine from tea leaves.
b) Isolation of benzoic acid from tea leaves.
c) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
d) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf values reported).
e) Isolation of nicotine dipicrate from tobacco.
f) Isolation of cinchonine from cinchona bark.
g) Isolation of piperine from black pepper.
h) Isolation of lycopene from tomatoes.
i) Isolation of β-carotene from carrots.
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
k) Isolation of eugenol from clove.
l) Isolation of (+) limonine from citrus rind.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

CH 681 Advanced Organic Chemistry Laboratory - III 0-0-4-2

I. Separation and identification of the sugars and Amino acids present in the given mixture by paper chromatography and determination of Rf values

II. Identification of organic compound with the help of spectral datas.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley
3. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J.

Martin, Heyden.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
5. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
6. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
7. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 612 Organic Synthesis-II 3-0-0-3

Disconnection Approach: An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis. [8]

Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. [6]

One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis. [6]

Two Group C-C Disconnections: Diels-Alder Reaction, 1,3-difunctionalised compounds, α, β- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation. [6]

Ring Synthesis: Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings. aromatic heterocycles in organic synthesis. [5]

Synthesis of Some Complex Molecules: application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A. [8]

Suggested Books:

1. Designing Organic Synthesis, S.Warren. Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O. House, W.A Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

CH 622 Heterocyclic Chemistry 3-0-0-3

Aromatic Heterocycles: Nomenclature, General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. [6]

Non-aromatic Heterocycles: Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1, 3-diaxial interaction. Stereo-electronic effects, anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions. [7]

Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes. [4]

Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofuranes and benzothiophenes. [4]

Meso - ionic Heterocycles: General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. [4]

Six - Membered Heterocycles with one Heteroatom: Synthesis and reactions of pyrilium salts and pyrones and their comparison with pyridinium & thiopyrilium salts and pyridones. Synthesis and reactions of quinolinium and benzopyrylium salts, coumarins and chromones. [6]

Six Membered Heterocycles with Two Heteroatoms: Synthesis and reactions of diazines, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines. [8]

Suggested Books:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Techinal.

5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M.Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

CH 632 Chemistry of Natural Products 3-0-0-3

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Gereniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene. [9]

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-Coniine, Nicotine, Atropine, Quinine and Morphine. [9]

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of Steroids. [9]

Flavonoids and Anthocyanins: Occurrence, nomenclature, biogenesis and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidine, Hirsutidin. [9]

Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll. [3]

Suggested Books:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.
2. Organic Chemistry: Vol. 2 1L. Finar, ELBS
3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic

Publishers.

CH 642 Medicinal Chemistry 3-0-0-3

Structure and activity : Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery. [9]

Antibiotics and antibacterials: Introduction (i) Antibiotic β-Lactam type Penicillins, Cephalosporins (ii) Antitubercular Streptomycin(iii)Broad spectrumantibiotics-Tetracyclines (iv)Anticancer-Dactinomycin (Actinomycin D) (v)Antifungal –polyenes(vi) Antibacterial Ciprofloxacin,Norfloxacin(vii) Antiviral – Acyclovir [9]

Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine. [4]

Non-steroidal Anti-inflammatory Drugs : Diclofenac Sodium, Ibuprofen and Netopam [4]

Antihistaminic and antiasthmatic agents: Terfenadine,Cinnarizine, Salbutamol and Beclomethasone dipropionate [4]

Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurines. Recent development in cancer chemotherapy. Hormone and natural products. [9]

Suggested Books:

1. Medicinal Chemistry; Burger, Wiley Interscience Publications.
2. Principles of Medicinal Chemistry; W. O. Foye Lea & Febiger: Varghese Publishing House
3. The Organic Chemistry of Drug Synthesis; D. Lednicer and L. A. Mitscher Wiley Interscience.
4. Medicinal Chemistry ; Kar, , Wiley Eastern Ltd

Mody University of Science & Technology

M.Sc. Physics

Session 2016-2017

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc. Physics

Academic Curriculum (2015 – 16 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 511	Mathematical Physics-I	3	1	0	4	3	25	25	50
	PH 521	Classical Mechanics	3	0	0	3	3	25	25	50
	PH 531	Classical Electrodynamics and Plasma Physics	3	1	0	4	3	25	25	50
	PH 541	Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 551	Statistical Physics and Thermodynamics	3	1	0	4	3	25	25	50
	PH 561	General Physics and Optics Laboratory	0	0	4	2	4	100		
	PH 571	Programming Language Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**4**	**8**	**23**	**-**	**-**		
		Foreign Language-I (Non-Credit)‡	3	0	0	3	3	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 512	Mathematical Physics -II	3	1	0	4	3	25	25	50
	PH 522	Atomic & Molecular Physics and Lasers	3	1	0	4	3	25	25	50
	PH 532	Condensed Matter Physics	3	0	0	3	3	25	25	50
	PH 542	Computational Physics	3	0	0	3	3	25	25	50
	PH 552	Elements of Nuclear and Particle Physics	3	0	0	3	3	25	25	50
	PH 562	Computational Physics Laboratory	0	0	4	2	4	100		
	PH 572	Advance Physics Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**2**	**8**	**21**	**-**	**-**		
		Foreign Language-II (Non-Credit)‡	3	0	0	3	3	25	25	50

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 611	Semiconductor Physics and Devices	3	1	0	4	3	25	25	50
	PH 621	Digital Electronics	3	1	0	4	3	25	25	50
	PH 631	Physics of Nano-Materials	3	0	0	3	3	25	25	50
	PH 641	Ancient Indian Science	2	0	0	2	3	25	25	50
	PH 651	Electronics Laboratory	0	0	4	2	4	100		
		Specialized Paper –I	3	1	0	4	3	25	25	50
		Specialized Paper –II	3	1	0	4	3	25	25	50
	Sub Total		**17**	**4**	**4**	**23**	**-**	**-**		

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 612	Advance Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 622	Instrumentation and Characterization Techniques	3	0	0	3	3	25	25	50
		Specialized Paper –III	3	1	0	4	3	25	25	50
		Specialized Paper –IV	3	1	0	4	3	25	25	50
	PH 682	Project	0	0	0	8	-	100		
	Sub Total		**12**	**3**	**0**	**23**	**-**	**-**		

Total Credits = 90

Specializations:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE**	ETE
A	**Nanoscience**								
PH 661	Elements of Nanoscience	3	1	0	4	3	25	25	50
PH 671	Nano-Fabrication Techniques	3	1	0	4	3	25	25	50
PH 632	CNT and Sensor Applications	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
B	**Photonics**								
PH 681	Advance Opto-Electronics	3	1	0	4	3	25	25	50
PH 691	Fiber and Non-linear Optics	3	1	0	4	3	25	25	50
PH 652	Quantum Optics	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
C	**Condensed Matter Physics**								
PH 613	Advance Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 623	Soft Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 662	Material Science	3	1	0	4	3	25	25	50
PH 672	Smart Materials	3	1	0	4	3	25	25	50

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

[#]*Student will perform* ***project work*** *for a period of 2 months and submit two copies of Dissertation report to the Ddepartment. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

Detailed Syllabus (M.Sc. Physics):

PH 511 **Mathematical Physics-I** **3 - 1 - 0 - 4**

1. **Vector Analysis:** Gradient, divergence, Curl and their representations in Orthogonal curvilinear coordinates. [11]

   Linear algebra: Linear vector spaces, linear operators, dual space, ket and bra notation, Hilbert space, Metric space, Function spaces.

   Matrices: The algebra of matrices, Special matrices, Rank of a matrix. Elementary transformations, Elementary matrices, Equivalent matrices, Solution of linear equations. Linear transformations, Change of Basis, Eigenvalues and eigenvectors of matrices, The Cayley-Hamilton theorem, Diagonalisation of matrices.

2. **Tensor Analysis:** Tensor analysis, Coordinate transformations, scalars, Covariant and Contravariant tensors, Addition, Subtraction, Outer product, Inner product and Contraction, Symmetric and antisymmetric tensors, Quotient law, Metric tensor, Conjugate tensor. [8]

3. Partial Order Differential Equations and Special Functions: Separation of variables-ordinary differential equations, singular points, Bessel, Leguerre, Legendre, Hermite equations. Recurrence relations, generating functions and Rodrigues formulae for the Bessel, Leguerre, Legendre and Hermite functions [11]

4. **Greens Functions:** Sturm-Lioville operators and eigen values and eigen functions. Dirac delta functions-properties and representations, Definitions and physical significance of Greens functions, Eigen function expansion of Greens function, Greens function for ordinary differential operators [9]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990.
3. M.D. Greenberg:Advanced Engineering Mathematics, 2nd Edition, PHI, New Jersey, 1998.
4. B.D. Gupta: Mathematical Physics, 3rdedition, Vikas Publishing House, New Delhi. , 2006.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, 8th ed., Wiley, New York, 1999.
2. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
3. Satyaprakash, Mathematical Physics, Sultan Chand & sons, 6th edition, New Delhi, 2004.

PH 521 **Classical Mechanics** **3 - 0 - 0 - 3**

1. **Fundamental Principles and Lagrangian Formulation and Applications:** Newtonian Mechanics: Mechanics of a particle and system of particles, Conservation laws, Constraints, Generalized coordinates, D' Alembert's principle and Lagrange's equation, Hamilton's Variational principle, **Lagrangian Problems:** Double Pendulum, Spherical pendulum, Cylinder rolling down an inclined plane. [8]

2. **Hamiltonian Formulation and Application:** Hamilton's equations, cyclic variables, Principle of least action, **Hamiltonian Problems:** motion of a particle in a central force field, charged particle moving in an electromagnetic field, Equations of motion and first integrals, Kepler's laws, Scattering by central potential, Transformation from center of mass to laboratory frame. [10]

3. **Rigid Body Dynamics and Canonical Transformations:** Rigid body motion – Kinematics - Euler's angles - Angular momentum and kinetic Energy – Moment of inertia tensor - Euler's equations of motion –Canonical transformation and their generators – simple examples, Poisson brackets. [8]

4. **Jacobi Theory and Theory of Small Oscillations :** Hamilton-Jacobi equations – application to Linear Harmonic Oscillator problem - Action Angle variables - Application to Kepler's problem - Oscillatory motion - Theory of small oscillation –Two coupled pendulums, Vibrations of a triatomic molecule. [8]

5. **Relativity:** Reviews of basic ideas of special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence [5]

Text Books:

1. H. Goldstein, C.Poole and J.Safko; Classical Mechanics, Pearson, New Delhi, 3rd ed 2002.
2. N.C.Rana and P.S.Joag; Classical Mechanics, Tata Mc: Graw Hill, New Delhi, 1991.

Reference Books:

1. L. D. Landau E.M. Lifshitz; Mechanics: Volume 1 (Course of Theoretical Physics), Pergamon Press Ltd, 2nd ed. 1969.

PH 531 Classical Electrodynamics and Plasma Physics 3 - 1 - 0 - 4

1. **Electrostatics:** Electric potential, Poisson and Laplace‟sequations.Boundary value problems, Uniqueness theorems, Green‟stheorem.Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion. [6]

2. **Electromagnetic Waves:** Maxwell‟s equations, Boundary conditions, Wave equation and its complex notation, Electromagnetic waves in vacuum, Electromagnetic waves in non-conducting and linear media, Electromagnetic waves in linear conducting media. Poynting theorem, Reflection, refraction and polarization of electromagnetic waves, [6]

3. **Waveguides and Cavities:** Metallic boundary conditions, Electromagnetic waves confined to hallow metallic pipe,TE, TM and TEM modes, TE and TM modes in rectangular waveguides, Bessel‟s function, TE and TM modes in cylindrical waveguides, Dielectric waveguides, TE and TM modes in rectangular and cylindrical Resonant cavities. [6]

4. **Potential, Fields and Radiations:**

   Scalar and vector potentials, Gauge transformation, Coulomb and Lorentz gauge, Retarded potential, Lienard-Wiechert potentials, Fields due to moving charge, Power radiated by an accelerated charge and angular distribution, Bremstrahlung Cerenkov and Synchrotron radiations. [6]

5. **Relativistic Electrodynamics:** Four vectors, Lorentz transformation in terms of Four vectors, Lorentz transformation matrix, Transformation of electromagnetic fields, Field Tensor, Dual field strength tensor, Maxwell's equations in terms of strength tensors, [6]

6. **Plasma Physics:** Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, Motion of charged particles in electric and magnetic fields, Adiabatic Invariants Wave in Plasma: Polarisation, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and Perpendicular to the Magnetic Field Propagation at Finite Angle. [9]

Text Books:

1. David J. Griffith; Introduction to Electrodynamics, PHI Private Limited, 1999
2. John D. Jackson; Classical Electrodynamics, Wiley Eastern Limited, 1998
3. F.F. Chen; Plasma Physics and Controlled Fusion,Springer,2006

Reference Books:

1. Edward C. Jordan and Heith G. Balmain; Electromagnetic Waves and Radiating Systems, PHI, 1991
2. W.K.H. Panofsky and M. Phillips; Classical Electricity and Magnetism, Dover Publications; 2nd Ed., 2005
3. J A Bittencourt; Fundamentals of Plasma Physics, 3rd Ed, Springer, 2004

PH 541 **Quantum Mechanics** **3 - 1 - 0 - 4**

1. Limitations of classical mechanics, development of Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states. Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest‟s theorem, momentum Eigen functions in the coordinate representation, box normalization and Dirac delta function. Coordinate and momentum representations, Schrodinger equation in momentum representation [10]

2. Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, Eigen values and Eigen vectors, Hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations. Matrix representation of operators, change of basis, unitary transformations, quantum dynamics, Schrodinger, Heisenberg and interaction picture. [10]

3. Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method. Angular momentum operator, commutation relations, expression for L2 operator in spherical polar coordinates, Role of L2 operators in central force problem, eigen value problem for L2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator. [10]

4. Generalized angular momentum, raising and lowering operators, matrices for J2, Jx, Jy, Jz operators, Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions. [9]

Text Books:

1. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
2. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

Reference Books:

1. L.I.Schiff; Quantum Mechanics, TMH, 2010.
2. Mathews and Venkatesan; A Textbook of Quantum Mechanics, TMH 1976,
3. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
4. J.J.Sakurai; Modern quantum Mechanics, Addison Wesley; 2 ed., 2010

PH 551 Statistical Physics and Thermodynamics 3 - 1 - 0 - 4

1. **Review: (Elementary Probability Theory & Thermodynamics):** Preliminary concepts, Random walk problem, Binomial distribution, mean values, standard deviation, various moments, Gaussian distribution, Poisson distribution, mean values. Extensive and intensive variables, laws of thermodynamics, thermodynamic potentials, Maxwell relations, applications of thermodynamics to (a) ideal gas, (b) magnetic material, and (c) dielectric material. Laws of thermodynamics [4]

2. **Statistical Description of System of Particles and Statistical Thermodynamics:** State of a system, microstates, ensemble, basic postulates, behavior of density of states, density of state for ideal gas in classical limit. Thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of density of states on external parameters, Statistical calculation of thermodynamic variables [10]

3. **Classical Statistical Mechanics :** Microcanonical ensembles and their Equivalence, Canonical and grand canonical ensembles, partition function, thermodynamic variables in terms of partition function and grand partition function, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem. Maxwell-Boltzmann gas velocity and speed distribution. Chemical potential, Free energy and connection with thermodynamic variables, First and Second order phase transition; phase equilibrium. [10]

4. **Quantum Statistical Mechanics :** Formulation of quantum statistics, Density Matrix, ensembles in quantum statistical mechanics, simple applications of density matrix. The theory of simple gases : Maxwell-Boltzmann, Bose-Einstein, Fermi Dirac gases. Statistics of occupation numbers, Evaluation of partition functions, Ideal gases in the classical limit. [10]

5. **Ideal Bose System :** Thermodynamic behavior of an Ideal Bose gas, Bose-Einstein condensation. Thermodynamics of Black body radiation, Stefan-Boltzmann law, Wien's displacement law. [5]

Text Books:

1. B. B. Laud; Fundamentals of Statistical Mechanics, New Age International, 2007.
2. F. Reif; Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965
3. S. Loknathan&Gambhir; Statistical and Thermal Physics: An Introduction, PHI Learning, 1991.

Reference Books:

1. K. Huang; Statistical Mechanics, 2nded, John Wiley & Sons, 1987.
2. R. K.Pathria, Paul D. Beale, Statistical Mechanics;Butterworth-Heinemann Press, 2011.
3. L. D. Landau and E. M. Lifshitz; Statistical Physics: Volume 5 (Course of Theoretical Physics), 3rded Butterworth-Heinemann Press, 1980.

PH 561 General Physics and Optics Laboratory 0-0-4-2

Experiments based on Mechanics, Optics, Basic Electronics, PH 531.

PH 571 Programming Language Laboratory 0-0-4-2

Programming based on C^{++} related to Physics.

PH 512 Mathematical Physics -II 3 - 1 - 0 - 4

1. **Complex Analysis :**Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula, Taylor's series and Laurent's series expansion, Zeros and singular points, Multivalued functions, Branch Points and Cuts, Riemann Sheets and surfaces, Residues, Cauchy's Residue theorem, Evaluation of definite integrals. [11]

2. **Group Theory:** Definition of groups e.g. matrix groups- transformation groups , Representation of groups: matrix, faithful, Unitary, reducible and irreducible representations' Lie groups and algebras: Definition of Lie groups with examples- O(3), SO(3), SU (2) groups- representation of SU(2), SO(3). [9]

3. **Fourier Series & Transforms**: Integral transforms, Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives [9]

4. **Laplace Transforms:** Convolution Theorems, Momentum representation, Laplace transform, Properties and examples of Laplace Transform, Laplace transforms of derivatives, Use for solving differential equations [10]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. M. R. Spiegel: Theory and Problems of Complex Variables, Schaum's outline series, 6thed., 2008
3. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990,
4. B.D. Gupta: Mathematical Physics, 3rd edition, Vikas Publishing House , New Delhi. , 2006,

Reference Books:

1. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
2. E. Kreyszig: Advanced Engineering Mathematics, 8thed., Wiley, New York, 1999.
3. M.D. Greenberg: Advanced Engineering Mathematics, 2nded., PHI, New Jerrsey, 1998,

PH 522 **Atomic & Molecular Physics and Lasers** **3 - 1 - 0 - 4**

1. Time independent perturbation theory, First order perturbation theory applied to nondegenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic [11]

2. **Pauli's Principle and Shell Structure:** Systems with several electrons and spin functions. [2]

3. **Complex Spectra:** LS-Coupling scheme, normal triplets, basic assumptions of the theory, identification of terms, selection rules, jj- coupling (Qualitative). [2]

4. **Infrared and Raman Spectra:** Rigid rotator, energy levels, spectrum (no derivation of selection rules), Harmonic oscillator: energy levels, eigenfunctions, spectrum, comparison with observed spectrum, Raman effect, Quantum theory of Raman effect, Rotational and Vibrational Raman spectrum. Anharmonic oscillator: energy levels, Infrared and Raman Spectrum, Vibrational frequency and force constants. Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of Dunham coefficients), Symmetry properties of rotational levels, influence of nuclear spin. [12]

5. **Electronic Spectra:** Electronic energy and potential curves, resolution of total energy,Vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronicbands: General relations, branches of a band, band-head formation, Intensity distribution in avibrational band system. [6]

6. **Lasers:** Basic concept and principle of laser, Component of lasers, Einstein's and Gain coefficient, Types of lasers and pumping, Gas laser, YAG laser and chemical laser, Erbium lasers, Fibre lasers, Erbium-doped fibre lasers. Q-Switching:Laser Spiking and relaxation oscillations, Rate equations, TW and PW laser systems, Application of lasers. [6]

Text Books:

1. Kuhn H., Atomic Spectra, Academic Press, 1962
2. Herzberg I G., Molecular Spectra and Molecular Structure Van-Nostrand Rein-hold, 1950

Reference Books:

1. White H.E., Atomic Spectra, Mc-Graw Hill, 1934.
2. C N Banwell and E M McCash, Fundamentals of Molecular Spectroscopy: Tata Mc-Graw Hill, 2008
3. Chandra S., Molecular Spectroscopy, Narosa, 2009.
4. Vishwakarma H. L., Applied Physics, Wiley India Pvt. Ltd., 1st Edition, 2013.

PH 532 **Condensed Matter Physics** **3 - 0 - 0 - 3**

1. **Elastic Constants:** Binding in solids; Stress components, stiffness constant, elastic constants, elastic waves in crystals. [5]

2. **Lattice Dynamics and Thermal Properties:** Rigorous treatment of lattice vibrations, normal modes; Density of states, thermodynamic properties of crystal, anharmonic effects, thermal expansion. [5]

3. **Energy Band Theory**: Electrons in a periodic potential: Bloch theorem, Nearly free electron model; tight binding method; Semiconductor Crystals, Band theory of pure and doped semiconductors; elementary idea of semiconductor superlattices. [8]

4. **Transport Theory:** Electronic transport from classical kinetic theory; Introduction to Boltzmann transport equation; electrical and thermal conductivity of metals; thermoelectric effects; Hall effect and magnetoresistance. [7]

5. **Dielectric Properties of Materials:** Polarization mechanisms, Dielectric function from oscillator strength, Clausius-Mosotti relation; piezo, pyro- and ferro-electricity. [6]

6. **Liquid Crystals:** Thermotropic liquid crystals, Lyotropic liquid crystals, long range order and order parameter, Various phases of liquid crystals, Effects of electric and magnetic field and applications, Physics of liquid crystal devices. [8]

Text Books:

1. Kittel C., Introduction to Solid State Physics, Wiley, New York, 2005.
2. Kittel C., Quantum Theory of Solids, Wiley, New York, 1987.
3. Ziman J., Principles of the Theory of Solids, Cambridge University Press, 1972.

Reference Books:

1. Ibach H. and Luth H., Solid State Physics, Springer Berlin, 3rd ed. 2002.
2. Walter A. Harrison Solid State Theory, Tata McGraw-Hill, New Delhi, 1970.
3. Chandrasekhar S. Liquid Crystals, Cambridge University, 2nd ed. 1992.
4. Sluckin T.J., The Liquid Crystal Phases, Physics & Technology, Contemporary Physics Taylor & Francis, 2000.

PH 542 **Computational Physics** **3 - 0 - 0 - 3**

1. **Errors analysis and curve fittings:** General formula for errors – Errors of observation and measurement, Empirical formula, Graphical method, Method of averages, Least square fitting, curve fitting, parabola, exponential. Least square curve fittings methods for linear and polynomial functions. [7]

2. **Numerical solution of algebraic and transcendental equations:**

   The bisection method, the iteration method, The method of false position, Newton – Raphson method. [7]

   Linear systems of equations: Direct methods, Gauss elimination method, Gauss–Seidel method.

3. **Interpolation:** Finite differences (Forward, backward and central difference), Newton Interpolation formula, Central difference Interpolation formula, Cubic spline interpolation formula, Newton's interpolation formula for unequal intervals. [8]

4. **Numerical Differentiation and Integration:** Newton's forward and backward difference formula for numerical derivatives, Numerical Integration: the trapezoidal rule and Simpson's rule. [7]

5. **Numerical Solutions of Ordinary and Partial Differential Equations:** Taylor's method, modified Euler's method, second and fourth order Runge-Kutta methods, Predictor-Corrector methods. Finite-difference approximation to derivatives, S.O.R. and Jacobi methods for solving Laplace equations, Parabolic equations and Hyperbolic equations. [10]

Text Books:

1. S.S. Sastry; Introductory Methods of Numerical analysis, PHI New Delhi, 3rd Ed, 2003.
2. E. Balagurusamy; Numerical methods, Tata Mc Graw Hill, New Delhi, 2008.

Reference Books:

1. Erwin Kreyszig; Advanced Engineering Mathematics, 10thed, John Wiley and Sons, 2011.
2. W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling ; Numerical Recipes in C, , Cambridge University, 1996.

PH 552 **Elements of Nuclear and Particle Physics** **3 - 0 - 0 - 3**

1. **Nuclear Properties and Models:** General properties of Nuclei: nuclear size, Rutherford scattering, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magnetic dipole moment and electric quadrupole moment. Liquid drop model, Bethe-Weizs¨acker binding energy/mass formula, Fermi model, Shell model. [6]

2. **Nuclear Two-body Problem:** Properties of deuteron, Schr¨odinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces. Experimental n-p scattering data, Partial wave analysis and phase shifts, scattering length, magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Scattering from molecular hydrogen and determination of singlet and triplet scattering lengths, effective range theory, low energy p-p scattering, Nature of nuclear forces: charge independence, charge symmetry and iso-spin invariance of nuclear forces. [10]

3. **α, β and γ Decay:** α-decay, Gamow theory, Barrier penetration, fine structure of α spectrum. alpha decay, neutrino hypothesis β emission and electron capture, Fermi's theory of allowed β decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment, Gamma decay- Multiple transitions in nuclei- Angular momentum and parity selection rules [8]

4. **Nuclear Reactions and Fission:** Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions — Breit Wigner dispersion relation; Compound nucleus formation and break-up, Statistical theory of nuclear reactions and evaporation probability, Optical model; Principle of detailed balance, Transfer reactions, Nuclear fission and fusion. [8]

5. **Elementary Particle Physics:** Elementary particles: Photons, quarks, baryons, mesons, leptons, hadrons, Elementary idea of quark model. Conservation laws in particle reactions, Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula, C, P, T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic Kinematics. [7]

Text Books:

1. B L Cohen; Concepts of Nuclear Physics, Tata-McGraw Hill, 2008
2. Kenneth S. Krane; Introductory Nuclear Physics, Wiley India Pvt., 1988.
3. I.Kaplan;Nuclear Physics; Addison-Wesley, 1955

Reference Books:

1. S S M Wong; Introductory Nuclear Physics, Wiley, 1998.
2. S.B.Patel; Introductory Nuclear Physics, New Age International, 1991.
3. D.C.Tayal; Nuclear Physics, Himalayan Publishing House, 5th Edition, 2014.
4. R. R. Roy and B. P. Nigam; Nuclear Physics: Theory and Experiments, John Wiley & Sons, 1967.

PH 562 Computational Physics Laboratory **0-0-4-2**

Practical exercises based on 542, 512 and computational methods in Physics

PH 572 Advance Physics Laboratory **0-0-4-2**

Practical exercises based on 522, 532, 552 and related experiments.

PH 611 Semiconductor Physics and Devices 3 - 1 - 0 - 4

1. **Network Theorems:** Thevenin's, Norton's theorem and analysis of equivalent Circuits of networks. [9]

   Power Supplies: Half-Wave, Full-Wave and Bridge rectifiers with Capacitive input, Inductance input and PI filters, Shunt regulated power supplies using Zener diodes, Series regulated power supply. I. C. Voltage regulators.

2. **Transistor Amplifiers:** The CE, CB and CC configurations. Class A, Class B and Class C amplifiers. Low-frequency amplifiers. The transistor hybrid model and the h-parameters for a transistor. Conversion formulae for the h-parameters of the different transistor configurations. Analysis of a transistor CE amplifier at low frequencies using h-parameters. The CE amplifier with un-bypassed emitter resistor. The emitter follower at low frequencies. The emitter-coupled differential amplifier and its characteristics. Low frequency power amplifiers. The push-pull and the complementary - symmetry power amplifiers. Transistor biasing, Self-bias and thermal stability. [10]

3. **BJT and FET:** The BJT at high frequencies – the hybrid – model. Analysis of CE amplifier at high frequencies. Single stage CE amplifier and the gain-bandwidth product. Cascaded amplifiers. The emitter follower at high frequencies. The field effect transistor and its small signal model. The CS and CD amplifiers at low frequencies. Biasing the FET. The CS and CD amplifiers at high frequencies. [7]

4. **Feedback:** The Gain of an amplifier with feedback. General characteristics of negative feedback amplifiers. Stability of feedback amplifiers, The Barkhaussen Criteria. Grain and Phase margins. Compensation. Sinusoidal oscillators: RC oscillators – The Phase shift and the Wien's bridge oscillators. LC oscillators. Frequency stability and the crystal oscillators. [7]

5. **Operational Amplifiers:** Characteristics of an ideal operational amplifier. Applications of operational amplifiers – Inverting and Non-inverting amplifiers. Summing circuits, integration and Differentiation. Waveform generators. [6]

Text Books:

1. Maillman and Halkias, Integrated Electronics, Tata McGraw-Hill 1972.
2. V K Mehta; Principal of Electronics S. Chand and Sons 2008.
3. Donald Neamen; Semiconductor Physics and Devices, McGraw-Hill; 4th ed. 2011.

Reference Books:

1. M K Achuthan and K N Bhat; Fundamental of Semiconductor Devices, TMH 2006.
2. Rolf Enderlein, Norman J. M. Horing; Fundamentals of semiconductor physics and devices, World Scientific Pub, 1997.
3. John D. Ryder & Charles M. Thomson; Electronic Circuits & Systems, PHI Publication, 1976.

PH 621 **Digital Electronics** **3 - 1 - 0 - 4**

1. **Binary Number System:** Binary number system and other codes, binary arithmetic series and parallel processing of bites, logic of the addition operation, logic fundamentals, Boolean theorems, synthesis of Boolean functions, Karnaugh diagram. [8]

2. **Basics of Digital Electronics**: Basics and derived gates: OR gate, AND gate, NOT gate, NAND gate, NOR gate, XOR gate, Boolean identities and logic circuits using gates, Boolean algebra- DeMorgans Theorems, Sum of products and product of sums expressions, Minterm, Maxterm, SOP and POS from truth tables. [10]

3. **Combinational and Sequential Circuits:** Parity checker and generator, Half adders, full adders, Binary adders, decoders, multiplexer, demultiplexer, encoders, ROM and applications, Digital comparator, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and applications, A/D and D/A converters; Microprocessor and microcontroller basics. [12]

4. **Digital Circuits with MOS:** MOSFET, MOS invertors- static inverter, dynamic inverter, two phase inverter, MOS NAND gates, NOR gates, complementary MOSFET technology, CMOS inverter, CMOS NOR gates and NAND gates, MOS shift register and RAM. [9]

Text Books:

1. Malvino & Brown:Principle Of Digital Computer Electronics, 3rd Ed., McGraw-Hill, 1992.
2. Morris Mono: Digital logic Design, 4th edition, PHI, 2006.
3. J. Millman and C.C. Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi, 1991.

Reference Books:

1. Mottershed: Electronics fundamentals and application, 8th edition, PHI, 2009.
2. A.P. Malvino and D.P. Leach, Digital Principles and. Applications, 6thed., TMH, 2003.

PH 631 **Physics of Nano-Materials** **3 - 0 - 0 - 3**

1. **Introduction**: An overview of quantum mechanical concepts related to low dimensional systems. [12]

   Concepts related to Electronic Structure: direct lattice, Reciprocal lattice, Brilloujn zones, Diffraction from 2D structures, Free —electron approximation, periodic boundary Conditions, allowed k values, Fermi energy, density of electronic states for electron gas, Energy bands, Electron statistics, carrier concentration and Fermi level, Direct- and Indirect- gap semiconductors, Lattice matching, Effective mass, Variation of energy bands with alloy compositoin and its exploitation for devices.

2. **Hetrostructures and Electron States**: Hetero junctions, Type I and Type II hetero structures, Classification of Quantum confined systems, Electrons and holes in Quantum wells. Surface to volume ratio in quantum confined systems, Electronic wave functions, energy sub bands and density of electronic states in Quantum wells, Quantum wires, and Quantum dots, Effective mass mismatch in hetero structures. Coupling between Quantum wells, Super lattices, Wave functions and Density of States for super lattices, Unit cell for quantum well, for quantum wire and for quantum dot. [12]

   EXCITONS: Excitons in bulk, in Quantum structures and in hetero structures.

3. **Nanoclusters and Nanoparticles**: Introduction, Particle shape and the surface, Collective surface area, Porosity, Spherical cluster approximation, Metal nanoclusters – Magic numbers, Geometric structures, Electronic structure, Bulk to nanotrasition, Magnetic clusters; Semiconducting nanoparticles; Rare-gas and molecular Clusters. [6]

4. **Carbon nanotubes**: Chiral vector, Chiral angle and the Unit cell for the Carbon nanotubes. [5]

5. Bulk Nanostructurs Materials: Solid disordered nanostructures, Nanostructured crystals, photonic crystals. [4]

Text Books:

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio; Quantum Heterostructures: Microelectronics and Optoelectronics, Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens; Introduction to Nanotechnology, Wiley India, 2003.
3. T. Pradeep; Nano: The essentials, Tata McGraw-Hill, New Delhi, 2007.
4. P. Harrison; Quantum Wells, Wires, and Dots: Theoretical and Computational Physics of Semiconductor Nanostructures, Wiley, 2009.

Reference Books:

1. G. Streetman and S. Banerjee; Solid State Electronic Devices, Prentice Hall of India, 6th Edition, 2005.
2. A. Y. Shik ; Quantum Wells: Physics and Electronics of two-dimensional systems, World Scientific, 1997.
3. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao; Introduction to Nanoscience, CRC Press, 2009.

PH 651 Electronics Laboratory 0-0-4-2

Practical exercises based on 611, 621 related to analog and digital electronics.

PH 641 Ancient Indian Science 2 - 0 - 0 - 2

1. **Reference of Science in Vedas** [3]

2. **SAGE Scientists and Their Achievements:** Baudhayan, Aryabhatta,Brahmgupta, Bhaskaracharya , varahamihira, Mahaviracharya, Acharya Kanad, Varahamihira, Nagarjuna, Acharya Bhardwaj, SusrutaAtreya, Acharya Charak, Patanjali. [8]

   Scientists of modern era: C. V. Raman (1888-1970), S. Ramanujan (1887-1920), J. C. Bose (1858-1937), H. J. Bhabha (1909-1966), V. A. Sarabhai (1919-1970), H. G. Khorana (1922-2011), Harish Chandra (1923 - 1983), S. N. Bose (1894 - 1974)), S. S. Bhatnagar (1894 – 1955), Visvesvaraya (1860 –1962)[, MeghnadSaha (1893–1956) etc.

3. **Discoveries in Astronomy and Physics of Ancient India:** Earth's rotation, Gravity, Speed of light, Lunar Eclipse, Planetary motion, Mechanics, Matter, Magnetism and Optics [5]

4. **Vedic Mathematics**: Algebra & Arithmetic, Geometry, Trigonometry [5]

5. **Chemical and Biological advancement of Ancient India**: Chemistry (Distillation, Caustic Alkali, Cell and Explosives), Metallurgy (Crucible, Furnaces, Air Blowers, Metal Powder, Binder), Botany, Medicine and Pharmacology. [5]

Text Books:

1. Pride of India- A Glimpse into India's Scientific Heritage. SamskritaBharati, New Delhi, 2006.
2. Science in Samskrit, SamskritaBharati, New Delhi, 2007.
3. N. K. Jain; Science and Scientists in India. Kalyani India, Delhi, 2001.
4. Awakening Indians to India, All India ChinmayaYuvaVendra, Central Chinmaya Mission Trust, Mumbai, 2003.

Reference Books:

1. N.K. Jain; History of Science and Scientific Methods. Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi, 1990.
2. S. Soni; India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd., New Delhi, 2006.

PH 612 **Advance Quantum Mechanics** **3 - 1 - 0 - 4**

1. Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission,atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein‟s A and b coefficients and their calculations.Approximation methods: W. K. B. method and its application to barrier penetration.Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential. [10]

2. System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule. [11]

3. Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential , Partial wave method, phase shifts and their importance, scattering by a square well; potential and a perfectly rigid sphere, resonance scattering. [6]

4. Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac‟s relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac‟s theory, negative energy states and their qualitative explanations. [12]

Text Books:

1. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
2. L.I.Schiff; Quantum Mechanics, TMH, 2010.

Reference Books:

1. E. Merzbacher, Quantum Mechanics, Wiley and Sons, 1998
2. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
3. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

4. Pauling, Introduction to Quantum Mechanics, Dover Publication 2008.

PH 622 **Instrumentation and Characterization Techniques** **3 - 0 - 0 - 3**

1. **Imaging Techniques:**

Optical microscopy: Use of polarized light microscopy, Phase contrast microcopy, Interference Microscopy, hot stage microscopy - surface morphology. [2]

Scanning electron microscopy: Basic design of the scanning electron microscopy , Modes of operation, Backscattered electrons, secondary electrons, X-rays – typical forms of contrast, Resolution and contrast, Specimen Preparation, application of SEM. [5]

Transmission electron microscopy: Basic principles, Modes of operation, Specimen preparation, Diffraction in imperfect crystals, Dislocations, precipitates, Structure of Grain boundaries and interface. [4]

Force microscopy: Basic concepts-Interaction force, AFM and the optical lever, force curves, measurements and manipulation, feedback control, different modes of operation, contact non-contact and tapping mode, Imaging and manipulation of samples in air or liquid environments-Imaging soft samples, Applications . [6]

Scanning tunneling microscopy: Principle, Instrumentation, importance of STM for nanostructures, surface and molecular manipulation using STM. [4]

2. **Qualitative and Quantitative analysis**

X-Rays powder diffraction: Single crystal diffraction techniques, Determination of accurate lattice parameters, structure analysis , profile analysis, particle size analysis using Scherer formula. [3]

Thermal analysis methods: Principle and Instrumentation of Thermogravimetry, Differential Thermal Analysis and Differential scanning calorimetry. Electron Energy Loss Spectroscopy; Atom probe field ion microscopy-X-Ray Photoelectron Spectroscopy, X-Ray Characterization, EDAX and WDA analysis, EPMA, ZAP corrections. [7]

Spectroscopic techniques: Introduction to Molecular Spectroscopy and Differences-With Atomic Spectroscopy-Infrared (IR) Spectroscopy and Applications- Microwave Spectroscopy-Raman Spectroscopy and CARS Applications-Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique. [8]

Text Books:

1. Cullity, B. D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
2. Loretto, M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.

Reference Books:

3. Rose, R.M., Shepard, L.A. and Wulff, J., The Structure and Properties of Materials, 2nd Ed., Wiley Eastern Ltd, 2005.

PH 661 **Elements of Nanoscience** **3 - 1 - 0 - 4**

1. **History , Scope and Classes of Nanomaterials:** Pre-nanotechnology, origins of concepts of Nano, Basics and basis of Nanotechnology, Generations and Development, Molecular aspects, Top down and Bottom up approaches, fullerenes: properties of fullerenes [8]

2. **Nanomagnetics**: Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics. [12]

   Quasicrystals: Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

3. **Optical and Vibrational Spectroscopy**: spectroscopy of semiconductor; infrared surface spectroscopy, Raman spectroscopy, Brillouin spectroscopy, luminescence (photoluminescence, thermoluminescence), [7]

4. **Biological Materials**: biological buildings blocks, nucleic acids, biological nanostructures. [6]

5. **Nanomachines and Nanodevices**: MEMS, MEMSs, molecular and super molecular switches. [6]

Text Books:

1. S. Shanmugam; Nanotechnology, MJP Publishers, Chennai, 2010.
2. Guozhong Cao; Nanostructures and Nanomaterials, Imperial College Press, London, 2004.
3. Charles P. Poole, Frank J Owens; Introduction to Nanotechnology, Wiley, 2003.
4. T. Pradeep; Nano: The Essentials, TMGH, New Delhi, 2009.

Reference Books:

1. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

PH 671 **Nano-Fabrication Techniques** **3 - 1 - 0 - 4**

1. **Physical and Chemical Methods:** Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE), Sol-Gel Process — Self-assembly – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Photochemical Synthesis - Sonochemical Routes – Reverse Micelles and Micro emulsions - Combustion Method – Template Process - Chemical Vapor Deposition (CVD) – Metal Oxide Chemical Vapor Deposition (MOCVD) [12]

2. **Optical Lithography:** Introduction - Necessity for a clean room- different types of clean rooms-construction and maintenance of a clean room- Lithography -Optical lithography- Optical projection lithography- Multistage scanners resolution- Photomask- Binary mask- Phase shift mask - Attenuated phase shift masks - alternating phase shift masks - Off axis illumination- Optical proximity correction - Sub resolution assist feature enhancement-Optical immersion lithography- Optical interferometric lithography- Holographic lithography. [9]

   Maskless optical projection lithography - Zone plate array lithography-Extreme ultraviolet lithography.

3. **Electron Beam and Ion Beam Lithography:** Scanning electron-beam lithography- maskless EBL- parallel direct-write e-beam systems-electron beam projection lithography - Scattering with angular limitation projection e-beam lithography- Projection reduction exposure with variable axis immersion lenses. [8]

   Focusing ion beam lithography - Ion projection lithography - Projection focused ion multi-beam - Masked ion beam lithography- Masked ion beam direct structuring- atom lithography.

4. **Nanoimprint Lithography and Soft Lithography**: Nanoimprint lithography (NIL)- NIL- hot embossing- UV-NIL- Soft Lithography- Moulding/Replica moulding: Printing with soft stamps- Edge lithography -Dip-Pen Lithography-set up and working principle. [5]

5. **Etching Techniques**: Reactive Ion etching- RIE reactive ion etching- Magnetically enhanced RIE- IBE Ion beam etching- Other etching techniques. [5]

Text Books:

1. Zheng Cui; Nanofabrication-Principles, Capabilities and Limits, Springer, 2008
2. Guozhong Gao; Nanostructures & Nanomaterials: Synthesis, Properties & Applications, , Imperial College Press, 2004.

Reference Books:

1. K. Suzuki and B W Smith, Microlithography: Science and Technology, 2nd Ed., CRC Press, 2007.
2. M.Ratner, D Ratner. Nanotechnology - A Gentle Introduction to the Next Big Idea, Pearson, 2003.
3. Bhushan, B., Handbook of nanotechnology, 2nd Ed., Springer, 2007.

PH 632 CNT and Sensor Applications 3-1-0-4

1. Structure of CNTs

Allotropes of carbon, Buckminsterfullerene, Fullerene-related carbon nanotubes, Single- and double-walled nanotubes, Catalytically produced carbon nanotubes, Bonding in carbon materials, Vector notation for carbon nanotubes, Unit cells of nanotubes, Symmetry classification of nanotubes, Defects in the hexagonal lattice, The layer structure of multiwalled nanotubes, Theory of nanotube capping, multiwalled nanotubes produced by arc-evaporation, multiwalled nanotubes produced by catalysis, experimental studies: single-walled nanotubes General features Electron diffraction of SWNTs, HRTEM of SWNTs, Scanning tunnelling microscope of SWNTs, Neutron diffraction.

[9]

2. Physical properties of CNTs

Electronic properties of graphite, Electronic properties of nanotubes, Band structure of single-walled tubes, Effect of curvature and of tube–tube interactions, Electron transport in nanotubes, Effect of a magnetic field, Correlation between electronic properties and structure of single-walled nanotubes, Quantum conductance, Electronic properties of nanotubes in a magnetic field, Superconductivity, Mechanical properties of carbon nanotubes, Optical properties of nanotubes, Thermal properties of nanotubes.

[8]

3. Chemistry and biology of CNTs

Covalent functionalization, Functionalization of nanotube ends and defects, Functionalization of sidewalls, Non-covalent functionalization, Characterizing chemically functionalized nanotubes, Biological functionalization, Proteins, Nucleic acids, Toxicity of carbon nanotubes.

[6]

4. Synthesis, Purification and processing of CNTs

Production of multiwalled nanotubes by arc-evaporation, Growth mechanisms of multiwalled nanotubes in the arc, Production of multiwalled nanotubes by high-temperature heat treatments, Production of single-walled nanotubes by arc-evaporation, Production of single-walled nanotubes by laser vaporization, Growth mechanisms of SWNTs in the arc and laser methods, Purification of single-walled and multiwalled tubes, Processing of single-walled and multiwalled nanotubes.

[10]

5. Probes and sensors Applications

Nanotube tips for atomic force microscopy, Preparing nanotube tips: mechanical assembly, Preparing nanotube tips: chemical vapour deposition, Imaging using nanotube AFM tips, Gas sensors, Biosensors, Physical sensors.

[6]

Text Books

1. Applied Physics of Carbon Nanotubes: Fundamentals of Theory, Optics and Transport Devices, Rotkin Slava V. , Subramoney Shekhar, Springer (2005)
2. Aligned Carbon Nanotubes: Physics, Concepts, Fabrication and Devices, Zhifeng Ren, Yucheng Lan, Yang Wang, Springer-Verlag Berlin Heidelberg (2013)

3. Carbon Nanotube and Graphene Device Physics, H.-S. Philip Wong, Deji Akinwande , Cambridge University Press (2011)

Reference Books

1. Carbon Nanotubes – Growth and Applications Edited by Mohammad Naraghi Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia (2011)
2. Carbon nanotubes : properties and applications Edited by Michael J O'Connell, CRC Press (2006)
3. Carbon Meta-Nanotubes: Synthesis, Properties and Applications, Edited by Mark Monthioux, Willey (2011)

PH 642 Nanophotonics 3 - 1 - 0 - 4

1. **Photons and electrons:** Isomorphism of Schrodinger and Helmholtz equations, free space propagation. Confinement of photons and electrons. Bloch waves, reciprocal space, and Brrilouin zones Propagation through well and barriers, Cooperative effects for photons and electrons. [8]

2. **Quantum Confinement Effect:** Quantum confinement effects in solids, nanoscale interaction dynamics, quantum wells, quantum wired, quantum dots, quantum rings. Manifestation of quantum confinement: linear and nonlinear optical properties. [10]

3. **Photonic Crystals**: Basics Concepts, Light in periodic nanostructures, Features of Photonic Crystals, photonic bandgaps, Band gap and band structures in 1-D, 2-D and 3-D photonic lattices. Photonic Crystal Sensors, Microstructure Fibers: Photonic crystal fiber, photonic band gap fibers (PBG), band gap guiding, single mode and multi mode, dispersion and nonlinear effect of Photonic crystal devices using crystal fibers. [12]

4. **Plasmonics:** Optical response of metals, plasmons, shell nanoparticles, metal-dielectric shell nanoparticles, Nonlinear optics with surface plasmons, Plasmon waveguides, Applications of Metallic Nanostructures: nanolasers, nanowire lasers, resonant cavity LED, Metamaterials. [9]

Text Books:

1. Paras N Prasad: Nanophotonics, John Wiley & Sons, 1st edition, NJ, 2004.
2. S V. Gaponenko, Introduction to Nanophotonics, 1st ed., Cambridge University Press, NY, 2010.
3. J D Joannopoulos, R.D. Meade and J.N.Winn: Photonic Crystals: Modelling Flow of Light; 2nd ed. , Princeton University Press, NJ, 2008.

Reference Books:

1. Lukas Novotny and Bert Hecht: Principles of Nano Optic,2nd ed., Cambridge Univ. Press, 2012.
2. J MLourtioz, H Benisty; V Berger, Jean-Michel Gerard: Photonic Crystals: Towards Nanoscale Photonic Devices, 2nd ed., Springer, Berlin 2008.

PH 681 **Advance Opto-Electronics** **3 - 1 - 0 - 4**

1. **Optical Properties of Semiconductors:** Basic of semi-conductors, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, External quantum efficiency, double hetero-junction, fabrication of hetero-junction, Solar cells, photo-resistors quantum wells and super lattices. [6]

2. **Optical Sources:** Current Densities and Injection Efficiency, Injection Luminescence and the Light-Emitting Diode, Spectrum of Injection Luminescence, Selection of Materials for LEDs, Internal/External Quantum Efficiency The Hetero-junction, Surface-Emitting LEDs, Edge-Emitting LEDs, Super-luminescent Diodes, LASER as an amplifier of light and necessary conditions for amplification, special properties of LASER- monochromatic, coherent and light power nature, directionality, divergence and attenuation of LASER beam. Study of three level Laser (Ruby LASER), Study of four level laser (He-Ne laser), semiconductor laser and applications of high power, low power continuous wave and pulse lasers [14]

3. **Light Detectors:** Idea of light detectors and their basic types, Optical Absorption Coefficient and Photocurrent, Quantum Efficiency, Responsivity, Long-Wavelength Cut-off, p-i-n-Photodiode, Avalanche photodiodes (APDs) [4]

4. **Opto-electronic Modulator and Display Devices:** Optical polarization, Electro-optic effect, Longitudinal and Transverse Electro-optic modulator, Acousto-optic effect, Raman-Nath Modulator, Bragg Modulator. Display devices, Photoluminescence, cathodo luminescence, EL display, LED display, drive circuitary, plasma panel display, liquid crystals, properties, LCD displays, numeric displays. [9]

5. **Organic Optoelectronic Devices:** Organic Light-Emitting Diodes (OLEDs), Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs Organic photovoltaic diodes (OPVDs), Exciton absorption, Exciton dissociation ,Charge collection Characterization of OPVDs [6]

Text Books:

1. A. YarivOptical Electronics,4thed, Saunders Collage Press, 1991.
2. A. Ghatak&K.Thyagarajan; Optical Electronics, Cambridge University Press, 1989.
3. R. P. Khare; Fiber Optics and Optoelectronics, Oxford University Press, 2004.
4. Wolfgang Brutting;Physics of Organic Semiconductors, Wiley, 2006.

Reference Books:

1. Pallabh Bhattacharya, Semiconductor Optoelectronics Devices, Prentice Hall; 2nd ed. 1996.
2. A. Roger, Essentials of Optoelectronics, Chapman Hall, 1997.
3. Jasprit Singh, Electronic & Optoelectronic properties of Semiconductor, Cambridge University Press, 2007.

PH 691 **Fiber and Non-linear Optics** **3 - 1 - 0 - 4**

1. **Basic Optics :** Basic optical laws, reflection at plane interface, Brewster angel and total internal reflection, Linear and nonlinear medium, Maxwell's equations, Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides, polarization, dielectric susceptibility, first and higher order susceptibilities. [6]

2. **Optical Fiber Waveguides and Sources:** Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays, evanescent field and Goos-Haechen shift, step index and graded index fibers, single and multi-mode fibers. [5]

3. **Transmission Characteristics of Optical Fibers:** Attenuation , material absorption losses in silica fibers, linear and nonlinear scattering losses, fiber bend loss, mid-infrared and far-infrared transmission, intra-modal and inter-modal dispersion, overall fiber dispersion in multimode and single-mode fibers, modal birefringence. [8]

4. **Fabrication Techniques and Connection of Optical Fibers:** Glass fibers, Preparation of optical fibers, Liquid-phase (melting) and Vapour-phase deposition techniques, characteristics of single-mode, multimode, plastic-clad and all-plastic fibers, Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen absorption, fiber alignment and joint loss, fiber splices, Fiber connectors, Fiber couplers, Sources to Fiber Power launching. [8]

5. **Nonlinear Optical Effects in Fiber and Solitons in Optical Fiber Communication:** Refractive index, frequency and intensity dependent refractive index, group velocity dispersion, self-phase modulation, Kerr effect, chirping, stimulated Raman scattering , stimulated Brillouin scattering, self-steepening, self-focusing, self-defocusing, concept of solitons, formation of solitons, Nonlinear Schrödinger equation for solitons, soliton switching, soliton laser, advantages of soliton based communication. [12]

Text Books:

1. AGhatak and K. Thyagarajan; Introduction to fiber optics, Cambridge University press, 6th ed., 2006.
2. K. Thyagarajan and A Ghatak; Fiber Optic Essentials, , Wiley-IEEE Press, 2007.
3. G. Keiser, Optical Fiber Communications, Mc Graw-Hill, 5th ed., 2013.
4. Govind P. Agrawal, Nonlinear Fiber Optics, Academic Press, 2001

Reference Books:

1. John M. Senior; Optical fiber communications: Principles and practice, PHI, 3rded, 2009.
2. B.B. Laud; Lasers and Non-Linear optics, John Wiley & Sons, 1985.
3. Robert W Boyd; Nonlinear fiber optics, Elsevier, 2nd ed., 2006.

PH 652 **Quantum Optics** **3 - 1 - 0 - 4**

1. **Quantized States of Radiation**: Quantization of the radiation field, quantum harmonic oscillator, the zero-point energy. the connection between the positive and negative frequency parts of the electric field operator; states of the quantized radiation field - single mode number states, thermal states, phase states, the minimal uncertainty states; the coherent and squeezed coherent states. [6]

2. **Semi-classical and Quantum Descriptions of a Radiation Field**: Various definitions of a coherent state: the minimal uncertainty states, the states with classical motion, the displacement operator eigen states etc; the Glauber-Sudarshan P-function, the Q-function and other quasi-probability distribution functions and their use in the semi-classical description of a radiation field; Nonclassical aspects like squeeezing and antibunching and examples of nonclassical states and experimental status. Important experiments in Quantum Optics: Photon counting experiments, Intentsity-intensity correlation - Hanbury-Brown and Twiss experiment. [8]

3. **Classical and Quantum Theories of Optical Coherence**: The concept of an analytic signal, elementary description of stochastic processes, correlation functions and coherence functions; Stationary and ergodic processes, Wiener-Khinchin relations etc. Young's double slit experiment to discuss the conditions on the classical coherence functions and quantum coherence functions for various orders of coherence; higher-order correlations functions etc. [8]

4. **Interaction Between Light and a Two-level Atom**: The Jaynes-Cummings model interaction and the corresponding Hamiltonian - its solution and the expression for the population inversion; the experimental developments; the classical and quantum signatures -collapses and revivals. [6]

5. **Quantum Theory of Laser**: Photon rate equations, threshold conditions, laser photon distribution, fluctuations in laser light and laser phase diffusion. [12]

   Special topics: Spontaneous emission, laser cooling, collective and cooperative effects in the light-atom(s) interaction, quantum beats, the role of quantum optics in the problem of quantum entanglement and quantum information.

Text Books:

1. L. Mandel and E. Wolf; Optical coherence and quantum optics, Cambridge, 1995.
2. M Fox; Quantum Optics, An Introduction, Oxford University Press, 2006.

Reference Books:

1. P. Meystre and M. Sargent; Elements Of Quantum Optics 3Ed, Springer (India) Pvt. Ltd., 2006.

PH 613 Advance Condensed Matter Physics 3 - 1 - 0 - 4

1. **Plasmons, Polaritons and Polarons:** Dielectric function of the electron gas, Plasma optics, Dispersion relation for electromagnetic waves, Transverse optical modes in plasma, Longitudinal plasma oscillations, Plasmons, electrostatic screening, Mott metal-insulator transition, Screening and phonons in metals; Polaritons and LST relation, Electron-electron interaction; Electron –phonon interaction (Polarons). [9]

2. **Optical Properties and Raman Effect in Crystals:** Optical reflectance, Kramers-Kronig relations, Excitons, Frenkelexcitons, weakly bound excitons, Raman Effect in crystals, Electron spectroscopy with X-rays, Energy loss of particles in a solid. [8]

3. **Superconductivity:** Superconductors, Meissner effect, heat capacity, energy gap, isotope effect, London penetration depth, coherence length, BCS theory, Flux quantization in a superconducting ring, Josephson tunnelling. [5]

4. **Magnetic Properties of Solids and Magnetic Resonance:** Langevin diamagnetism, quantum theory of paramagnetism, paramagnetic susceptibility of conduction electrons, ferromagnetic, Curie point, temperature dependence and saturation magnetization at absolute zero, Magnons, Curie temperature and susceptibility of Ferrimagnets, Antiferromagnetics and susceptibility below Neel temperature, Ferromagnetic domains, Nuclear magnetic resonance, line width, hyperfine splitting, electron paramagnetic resonance [12]

5. **Imperfections in crystals and diffusion in solids:** Point, line and surface imperfections, Dislocations; Fick's law of diffusion, Fick's second law, Kirkendall effect, Temperature dependence of diffusion coefficient, determination of diffusion coefficient and activation energy [5]

Text Books:

1. Kittel C, Introduction to Solid State Physics, Willey 7th ed. 2005
2. Hayden W., Moffatt W. G. And Wulff J., Structure and properties of materials, Willey Vol. 3rd.
3. Dekker A., Solid State Physics, Prentice-Hall, 1967

Reference Books:

1. Azaroff L. V., Introduction to Solids, Mc-Graw Hills, 2010
2. Vijaya M. S. And Rangrajan G., Material Science, Tata McGraw Hills, 2006
3. J. R. Hook, H. E. Hall., Solid State Physics, Wiley; 2 edition, 1995.
4. Narula and Gupta, Material Science, Tata McGraw Hills, 2007

PH 623 **Soft Condensed Matter Physics** **3 - 1 - 0 - 4**

1. **Introduction and Review of Statistical Mechanics:** Examples of soft materials in industry and biology, Foams as a lead-off example of macro properties derived from micro, Atomic- and molecular-scale forces and bonds, Repulsion, entropy, hydrophobicity. Probabilities; Boltzmann distribution, Helmholtz energy, Equipartition theorem, Example of pulling RNA and measuring stiffness of a network (experiments). [8]

2. **Van der Waals Forces and Fluctuation-induced forces:** Keesom, Debye, and London contributions, Mean-field models of media, Measurements; list of Hamaker constants, relationship to surface tension, Derjaguin approximation; interaction between spherical particles. Osmotic pressure, Depletion attraction, Repulsion between membranes, Tension in a polymer. [7]

3. **Polymer :** Part A: Survey of types of polymers. Ideal-chain and Freely-jointed chain models.

   Part B: Worm-like chain (Kratky-Porod) model. The spectrum of fluctuations and the stiffness of a single polymer. [4]

4. **Friction in Fluids and The Diffusion Equation:** The Langevin Equation of motion of a particle in fluid. Viscosity and a simple model for its value; terminal velocity; sedimentation. The mean-square displacement, Fluctuation-dissipation theorem. A free particle; an ink spot; diffusion to capture, etc. Particle-hopping model; Fick's law; diffusion with drift. Experimental methods: Dynamic light scattering and the correlation function. Measuring interactions: terminal velocity; g(r); Boltzmann method. [10]

5. **Fluid Interfaces**, **Fluid Dynamics and Electrostatics in Solution (3D):** Surface tension, surfactants and Pickering emulsions. Consequences of a surface tension: LaPlace pressure, Jurin's Law, the Rayleigh instability, the Young-Dupre law and wetting, the shape of a meniscus: the equation of capillarity. Forces among interfacial inclusions (the 'Cheerios Effect'). Assembly of particles at liquid interfaces. [10]

   The Navier-Stokes equation for an isotropic fluid. Reynolds Number, laminar flow, Poiseuille flow, lubrication. Poisson-Boltzmann theory and Debye length Inter-particle forces,

Text Books:

1. Richard A.L Jones., Soft Condensed Matter, Oxford University Press, 1st Edition, 2002.
2. Chaikin P. M. and Lubensky T.C. , Principles of Condensed Matter Physics, Cambridge University Press, 1st Edition 2000

Reference Books:

1. Poon W.C.K. , David Andelman, Soft Condensed Matter Physics in Molecular and Cell Biology, CRC Press, Taylor and Francis Group, 2006

PH 662 **Material Science**

3-1-0-4

1. **Introduction**

   Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern Materials.

   [2]

2. **Phase Diagrams and Phase Transition in materials**

   Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system.

   Solid solutions, Phases, Thermodynamics of solutions, Phase rule, Binary phase diagrams, Binary isomorphous systems, Binary eutectic systems, ternary phase diagrams, kinetics of solid reactions. Order disorder phenomenon in binary alloys, long range order, super lattice, short range order.

   [14]

3. **Elastic,Anelastic and viscoelastic behaviour**: Atomic model of elastic behavior- Rubber like elasticity- Anelastic behavior- Viscoelastic behavior, Spring-Dashpot model.

   [5]

4. **Plastic deformation, Creep and Fracture**

   Plastic deformation - Slip - twinning - Critical resolved shear stress - theoretical shear strength of perfect crystal - role of dislocation in plastic deformation - methods of strengthening crystalline materials - strain hardening - grain size - solid solution strengthening - precipitation strengthening - fibre reinforced materials - whiskers - creep - creep curves - mechanism of creep - creep resistant materials, Ductile, Brittle fracture, Fracture toughness, Ductile-Brittle transition, fatigue fracture, Method of protection against fracture.

   [14]

5. **Oxidation and Corrosion**

   Mechanisms of oxidation, Oxidation resistant materials, Principles of corrosion, Protection against corrosion

   [4]

Text Books:

1. Dekker A J, "Solid State Physics", Macmillan and Co., (2000).
2. Raghavan V, “Materials Science and Engineering: A First Course", 5th Edition, Prentice Hall of India Pvt. Ltd., (2004).
3. Narula G K,Narula K S and Gupta V K,”Material Science”4th Ed.Tata McGraw Hill,(1993).

Reference Books:

1. Callister W D, "Materials Science and Engineering: An Introduction", 7th Edition, John Wiley & Sons, Inc., (2007).
2. James F Shackelford, "Introduction to Materials Science for Engineers", 7th Edition,Pearson Prentice Hall, (2009).
3. Van Vlack L H, "Elements of Materials Science and Engineering", 5th Edition, Addison Wesley, New York, (1989).

PH 672 Smart Materials 3 - 1 - 0 - 4

1. **Smart Materials: An Introduction:** States of matter, atomic structure, chemical bond, oxidation and reduction, aldehydesand ketones, amines and amino acids, lipids, carbohydrates, proteins and Enzymes, Biological Cell structure, Bacteria, Viruses, DNA and heredity , chromosomes, Genes, Study of Smart Materials and their integration into novel designs. Classifies according to their Response and Stimuli ability. Describes the effect of crystalline structures in the properties of piezoelectric materials, magnetostrictive materials, shape memory alloys. [10]

2. **Sensing Elements And Transducers:** Mechanical spring devices, Cantilever, Helical spring, Torsion bars or Shaft; Pressure Sensitive Devices, Bourdon tubes, bellows; Passive and active transducers, Theory of strain gauges, measurement of temperature, Thermocouples, RTDs, Thermistors, LVDT, Capacitive transducers, Hall effect transducers. [12]

3. **Chemical, Gas and optical Sensors:** pH, pH electrode, pH measurement, Humidity, Absolute and relative humidity, measurement of humidity, P-i-n and APD photodetectors, Fiber optic sensor, sensors using CNTs [6]

4. **MEMS and NEMS:** An elementary idea of MEMS, NEMSs, molecular and super molecular switches. [7]

5. **Biosensors:** Insulin therapy, Enzyme electrode, bio receptor molusles, Transduction mechanisms in biosensors. [4]

Text Books:

1. Jasprit Singh, Smart Electronic Materials, Cambridge University Press,2005.
2. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
3. Vinod Kumar Khanna, Nano Sensors, CRC Press, 2012.
4. Helmut Budzier, Gerald Gerlach; Thermal Infrared Sensors, John Wiley & Sons, Ltd, 2011.

Reference Books:

1. Jon S. Wilson, Sensor Technology Handbook, Elsevier, 2005.

2. Pavel Ripka, AloisTipek,Modern Sensors, ISTE, 2007.

Mody University of Science & Technology

M.Sc. Food and Nutrition
Session 2016-2017

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc-Food & Nutrition
Two Year Programme
Academic Year (2016-17) and onwards

Intake: 10

The specialists in F& N play a vital role in promoting the quality of life of individuals and communities, which contributes significantly to the economic and overall development of the nation. This achieved through a blend of academics, research training and extension as well as industrial applications. The post graduate programme in this discipline has been designed to provide the students intensive and extensive theoretical and experimental learning. The programme allows flexibility in the choice of thrust areas, which students can select, based on their career goals. It is envisaged that the current scenario at the regional and national level require trained professional in areas such as Public Nutrition, Dietetics and clinical Nutrition, Institutional Food administration as well as food science and quality control. Alternatively a broad-based programme covering several varied aspects in this discipline is also possible.

Objectives

The curriculum integrating several courses to provide professionally competent manpower for:

1. Academic and research institutions.
2. Hospital, food service intuitions and industry
3. Managerial roles in agencies and intuitions-both government and NGO sector
4. Planning & monitoring health programme
5. Ensuring food safety and quality for consumers
6. Entrepreneurial ventures
7. Advocacy and consultancy.

Careers

Nutritionists and dieticians could find employment in hospitals, health and recreation clubs, canteens, nursing care facilities; teach the science of nutrition and dietetics in colleges and universities, catering departments of star hotels, research labs of food manufacturers, in health departments of government etc. Moreover they could find openings in the mass media where top priority is given to disseminating vital information on healthy living. The main fields in which a dietician or nutritionists can work is in Food service field, Institutional Catering, Health Care field, Research & Development and Social Welfare. Food service field include food Catering service, Restaurants etc where professionals can do menu planning, monitoring the food preparation etc. Institutional Catering is another field where Nutrition and dietetics professionals are needed to plan, supervise and prepare nutritious and well-balanced meals for schools, colleges, factories or office cafeterias etc. Their work may also include the estimation and purchase of food supplies and equipment; receiving, checking and taking inventories of provisions etc. In Health Care field, people suffering from certain diseases such as diabetics, heart diseases, obesity etc, need to take extra care of their eating habits and the kind of food they eat. Research and Development involves conducting research on various food items to ensure their quality as well as studying the effects of various types of diet on the body chemistry in labs.

Eligibility

Pass with 50% aggregate marks in Bachelor's degree (Sciences, Medical and Applied Medical Sciences, Health and Allied health/Agriculture/ Food Sciences/ Bio-Sciences) or equivalent.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Post graduate Programmes of MITS shall be followed.

Resource Requirement:

One or two faculty of F&N specialist (depends on intake)
Consumables: Rs. 5 Lakhs per year

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2016 –17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FN 511	Basic Principle of Ayurvedic Diet	1	-	-	1	2	20	-	80
	FN 521	Basics of Human Physiology	3	-	-	3	3	25	25	50
	FN 531	Human Nutrition	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	FN 541	Basic Research Methodology	2	-	-	2	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	-	-	100
		Sub Total	**18**	1	**4**	**21**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BC 522	Nutritional Biochemistry	3	-	-	3	3	25	25	50
	FN 512	Food Packaging and Quality Control	3	-	-	3	3	25	25	50
	FN 522	Women Nutrition and Health	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	FN 532	Nutrition For Health And Fitness	3	-	-	3	3	25	25	50
	FN 542	Nutraceuticals & Functional Foods	3	-	-	3	3	25	25	50
	FN 552	Seminar	-	-	-	1	-	-	-	100
	FN 562	Food and Nutrition Laboratory -I	-	-	4	2	4	-	-	100
		Sub Total	**18**	**-**	**4**	**21**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2016 –17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	FN 611	Public Health and Nutrition	3	1	-	4	3	25	25	50
	FN 621	Institutional Food Administration	3	1	-	4	3	25	25	50
	FN 631	Clinical and Therapeutic Nutrition	3	1	-	4	3	25	25	50
	FN 641	Food Service Management	3	-	-	3	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	FN 651	Food and Nutrition Laboratory -II	-	-	4	2	4	100		
		Sub Total	**15**	**3**	**4**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	-	-	**20**				
		Total Credits				**80**				

$Evaluation of proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Dissertation and presentation will carry 50% weightage each.

(II year curricular and structure and syllabus got passed in AC 30, Syllabus in AC30 minutes)

FN 511 BASIC PRINCIPLES OF AYURVEDIC DIET 1-0-0-1

History of Ahara Nutrition, Vedic and Madhyayugin diet and its processing, Basic Principle: Ayurveda and Aharashastra, Ayurvedic components, Ritucharya (Seasonal regimen) [4]

Ayurvedic Principles: Lokpurushasamya (Doctrine of Macrocosm and Microcosm), Karyakarana Siddhanta (Principles of Caouse and Effect), Samanya-Vishesh Siddhanta (Principles of Similarity and Dissimilarity), **Panchamahabhoota Siddhanta** (Theory of Five Elements), Swabhavoparmvada Siddhanta (Theory of Healing)- in relation with diet and its importance [5]

Fundamentals of Dosha-Dhatu-Mala: Doshavigyana Dhatuvigyana - Tissue/ Cell metabolism, Malavigyana – Excretary, Vigyana Strotovidyana – Systematic circulation, Dhatusharta - Cell replenishing, Prakriti – Constitution, Dosha-Dhatu-Mala vigyana – The importance of diet in physiological process. [4]

Text Book:

1. Tripathi B. (2007) (Ed.) Acharya Charaks' Charak Samhita, Chowkhamba Surbharati Prakashan Varanasi.
2. Panda S.K. (2006) Basic Principles of Kriya Sharira, Chaukhamba Orientalia, New Delhi.

References:

3. Lochan Kanjiv (2007). Astanga Hridayam, (Sutrasthana), Chowkhamba Sanskrit Bhawan Varanasi
4. Srikanthamurthy K.R. (2005), (Ed.) Acharya Vagbhatas' Ashtanga Samgraha, Chaukhamba Orientalia, Varanasi.
5. Lochan Kanjiv, Dietary Rules & Prohibitions in Different Diseases, Chowkhamba Sanskrit Bhawan Varanasi. 2004
6. Sushruta, Sushruta Samhita (1994) 5th Edition, Motilal Banarasidas , New Delhi.
7. Brahmavarchas (2005) Ayurved Darshan,Vedmata Gayatri Trust, Shantikunj, Haridwar.
8. Radhakrishnan Sarvapalli (1999) Indian Philosophy, Vol.1, Oxford University Press, London.

FN 521 BASICS OF HUMAN PHYSIOLOGY 3-0-0-3

Cell structure and function

Levels of cellular organisation and fucntion-organelles, tissues, organs and systems-Brief review. Cell membrane, transport across cell membrane and intercellular communication. Regulation of cell multiplication. [4]

Nervous system [4]

Review of structure and function of neuron, conduction of nerve impulse, synapses, role of neurotransmitters.

Organisation of central nervous system, structure and function of brain and spinal cord, afferent and efferent nerves, Blood brain barrier, CSF. Hypothalamus and its role in various body function-obesity, sleep,

memory.

Endocrine system [4]

Endocrine glands-structure, function, role of hormones, regulation of hormonal secertion. The neuroendcrime axis.Disorders of endocrine glands. Emphasis on physiology of diabetes and stress hormones.

Sense organs [3]

Review of structure and function. Role of skin, eye, ear, nose and tongue in preception of stimuli.

Digestive System [4]

Review of structure and function. Secretory, Digestive and absorptive functions. Role of liver, pancreas and gall bladder and their dysfunction. Motility and hormones of GIT

Respiratory system [4]

Review of structure and function. Role of lings in the exchange of gases. Trasport of oxygen and CO_2. Role of haemoglobin and buffer sstems. Cardio-respiratory response to excercise and physiological effects of training.

The circulatroy system [3]

Structure and function of heat and blood vessel. Regulation of cardic output and blood pressure, heart failure, hypertension.

Blood formation, compsotion, blood clotting and haemostasis [3]

Formation and function of plasma proteins. Erythropoesis. Blood groups and histocompatibility. Blood indices. Use of blood for investigation and diagnosis of specific disorders. Anemia.

The excretory system [2]

Structure and function of nephron. Urine formation. Role of kidney in maintaining ph of blood. Water, electrolytes and acid base balance, diuretics

The Musculo-skeletal system [2]

Structure and function of bone, cartilage and connective tissue. Disorders of the skeletal system. Types of muscles, structure and function.

Immune System [3]

Cell mediated and humoral immunity. Activation of WBC and production of anitbodies. Role in inflammation and defence.

Reproduction [3]

Menstrual cycle, spermatogenesis, physiological changes in pregnancy

Text Book:

1. Jain A.K. (2010) Textbook of Physiology, Vol. I and II, Avichal publishing co., New Delhi.
2.

References:

1. Applied Physiology, MFM 001 Course, Indira Gandhi National Open University
2. Vander A.J., Sherman J.H., Luciono D.S. (2000) Human Physiology. 7th edition, New York, McGraw Hill
3. Guyton A.C. and Hall J.B. (1996) Textbook of Medical Physiology. 9th edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.

FN 531 HUMAN NUTRITION 3-0-0-3

Energy: Energy content of foods. Physiological fuel value-review. Measurment of energy expenditure: BMR, RMR, Thermic effects of feeding and physical activity, methods of mesaurment. Estimating energy requirments of individuals and groups. Regulation of energy metabolism: control of food intake, digetio, absorption and body weight. [4]

Carbohydrates: Types, calssification, digestion and transprt-review, dietry fibre, fructo-oligosaccharides, resistant strach-chemical copmposition and physilogical effects. Glycemic index of food. Sweeteners-nutritive and non-nutritive. [5]

Proteins: Classification, digestion, absorption and transport – review. Metabolism of proteins: Role of muscle, liver, and gastro intestinal tract. Protein quality, metods of evaluating protein quality. Protein and amino acid requirements. Therapeutic applications of specific amino acids: Branched chain, glutamine arginine, homocysteine, cysteine, taurine. [4]

Lipids: Classification, digetion, absorption, transport-review. Functions of EFA. Role of n-3, n-6 fatty acids in health and disease. Requirements of total fat and fatty acids. Trans fatty acids. Prostaglandins. [6]

Water: Regulation of intra and extra cellular volume. Osmolality, water balance and its regulation. [7]

Minerals: (Note: For each nutrient sources, bioavailability, metabolism, function, requirements, RDI/ESDDI, deficiency and toxicity, interactions with other nutrients are to be discussed).

Macro minerals: calcium, phosphorus, magnesium, sodium, potassium and chloride.

Micro minerals: Iron, copper, zinc, manganese, iodine, fluoride.

Trace minerals: selenium, cobalt, chromium, vanadium, silicon, boron, nickel.

Vitamins: Historical background, structure, food sources, absorption and transport, metabolism, biochemical function, assrssment of status. Interactions with other nutrients. Physiological, pharmacological and therapeutic effects, toxicity and deficiency with respect to the following: [7]

a) *Fat soluble:* Vitamins A,D, E & K.
b) *Water soluble:* Thiamine, riboflavin, niacin, biotin, pyridoxine, folic acid, pantothenic acid, ascorbic acid, cyanocobalamin, choline, inositol.

Non-nutritive food components with potential health effects: Polyphenols, tannins, phytate, phytoestrogens, cyanogenic compounds, lectins and saponins. [6]

Nutritional regulation of gene expression.

Nutrition management in special conditions: Space travel, high altitudes, low temperatures, submarines.

Text Book:

1. Bamji M.S., Rao N.P., Reddy V. Eds. (2009). Textbook of Human Nutrition. 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.

References:

2. ICMR (1990). Nutrient Requirements and Recommended Dietary Allowances for Indians.
3. FAO/WHO/UNU (2004). Human Energy Requirements. Report of a Joint Expert Consultation.
4. WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.
5. Nutrition in Developmental Transition. (2006). NFI-WHO (SEARO) Symposium. NFI
6. ICMR. A Manual of Laboratory Techniques.
7. Gibney M.J., Margetts B.M., Kearney J.M., Arab L. (2004). Public Health Nutrition. The Nutrition Society. Blackwell Publishing, Oxford, UK.
8. Sundararaj P. and Siddhu A. (2006). Qualitative tests and quantitative procedures in Biochemistry- A Practical Manual. Third edition. Elite Publishers, New Delhi.
9. AOAC (1997). Official Methods of analysis. 16th edition. Association of official Analytical Chemists.

FN 541 BASIC RESEARCH METHODOLOGY 2-0-0-2

Research Methodology- Meaning, objectives and Significance of research. Types of research, research approaches and scientific methods. Research process and criteria of good research [2]

Definition and identification of a research problem- Selection of research problem, Justification, development of hypothesis, basic assumptions. Limitations and delimitations of the problem, Methods of data collection [4]

Research design- Meaning and needs, Different research designs- exploratory, descriptive and diagnostic (epidemiology and clinical trials). Pilot studies. Qualitative vs quantitative research [5]

Sampling design- Steps in sampling design, Criteria for selecting a sampling procedure, Different types of sampling techniques- Merits and demerits of sampling [5]

Basic principles and regulations in humans and animal research. [3]

Report writing – Significance of report writing, Different steps in writing report, Types of reports, Mechanics of writing reports and precautions to be taken while writing research reports [7]

Text Book:

1. Kothari C.R. (2004) Research Methodology, Methods & Techniques, 2nd ed. New Age International Publishers.

References:

2. Best J.W. and Kahn J.V. (1992) Research in Education.6th ed. New Delhi, Prentice Hall of India Pvt. Ltd,
3. Goode W.J. and Hatt P.K. (1981) Methods in Social Research, McGraw Hill International Editions, Sociology Series.
4. Kerlinger F.N. (1983) Foundations of Educational Research. 2nd ed.
5. Marjory L. Joseph, William D Joseph (1996) Research Fundamentals in Home Economics / Human Ecology. Plycon Press.
6. WHO (2001) Health Research Methodology – A Guide for Training in Research Methods.
7. Stennberg R. J. (1991) The Psychologist's Companion: A Guide to Scientific Writing for students and Researchers. Cambridge: CUP.
8. Scrimhshaw N.S. and Gleason G.R. (2009) Rapid Assessment Procedures, Qualitative Methodologies for Planning and Evaluation of Health Related Programmes. International Nutrition Foundation for Developing Countries, Boston.

BC 522 NUTRITIONAL BIOCHEMISTRY 3-0-0-3

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements. Specific dynamic action of proteins. [5]

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions. [10]

Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. [5]

Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins. [5]

Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing. [10]

Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. [2]

Obesity – Definition, Genetic and environmental factors leading to obesity [2]

Text Book:

1. Devlin T M. (2002) Text Book of biochemistry with Clinical Correlations 5th ed. John Wiley and Sons.

References:

2. Berg J M, Tymoczko J L and Stryer L. (2002) Biochemistry 5th ed. W.H. Freeman.
3. Horton R. H., Moran L. A., Ochs R. S., Rawn J. D. and Scrimgeour.(2002) Principles of Biochemistry 3rd ed. Prentice Hall.
4. Murray R.K., Granner D.K., Kayes P.A. and Rodwell V.W.(2003) Harper's Illustrated Biochemistry. 26th ed. McGraw-Hill. Asia.
5. Voet D. and Voet J.G. (2004) Biochemistry. 3rd ed. John Wiley and Sons.

FN 512 FOOD PACKAGING AND QUALITY CONTROL 3-0-0-3

[6]

Packaging- Concepts, Definition, Significance, Classification.
Packaging-development, Unit/Retail.
Packaging of food(s)- fresh and processed, general characteristics & food preservation.
Primary Packaging Media- Properties and applications

a) Paper boards, metals, plastics, wood & plywood, glass, flexible etc.
b) Labels, caps & closures & wads, adhesives, inks & lacquers, cushioning materials, reinforcements etc.

Testing & evaluation of packing media – retail packs (including shelf life evaluation) and transport packages. [9]
Packaging systems and methods for food products- vacuum packaging, gas flush. Packaging, CAP & MAP, Aseptic & retort packing, Bag-in Box etc.
Food products- General classification and packing types, varieties and trends.
Storage, handling and distribution of packages (foods) – including palletisation & Containerizetion.
Food marketing and role of packaging.
Packaging Aesthetic & graphic design.
.
Packaging – Laws & Regulations - FDA, PFA, Packaging commodity Rules, Weight & Measures Act etc [3]
Introduction to quality assurance and food safety assurance. Current concepts of quality control.
Quality assurance programme: Quality plan, documentation of records, product standards Product and purchase specifications, process control and HACCP hygiene and housekeeping, corrective action, quality and programme and total quality process.
Quality costs: Measurement and analysis.

[10]

Product Evaluation: [11]

- Sampling for product evaluation and line control.
- Statistical quality and process control.
- Specifications and food standards. International, national-Mandatory,

Voluntary.
- Sample Preparation.
- Reporting results and reliability of analysis.
- Tests for specific raw food ingeredients and processed. Foods including additives:
  a) Proximate principles
  b) Nurient analysis
  c) Quality parameters and test of adulterants.

Consumer protection.

Text Book

1. Joshi, V.K. and Pandey, A. Ed. (2009). Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.

References

2. Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford. Crueger, W. and Crueger A. 1984.
3. Knorr, D. 1982. Food Biotechnology. Marcel Dekker, New York.
4. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
5. Pomeranz, Y. and MeLoan, C.E. (1996): Food Analysis: Theory and Practice, CBS Publishers and Distributor, New Delhi.

FN 522 WOMEN NUTRITION AND HEALTH 3-0-0-3

Role of women in National Development.

Women in Family and Community

- Demographic Changes, menarche, marrige, fertility, morbidity, mortality, life-expactancy, sec ratio, aging and wodowhood, female-headed families.

Women and Work

- Environmental stress, production activities, nutrition, health and gender, living conditions, occupational health, health facilities.

Women's nutritional requirements and food needs.

Women and Society

- Women's role, their resoures and contribution to family and community and effect on nutritional status.
- Effect of urbanisation on women.
- Impact of economic policies, industrializzation, and globlization on women.

Women and Health

- Health facilities
- Disease patterns and Reproductive health
- Gender and health
- Health seeking behaviour
- Women- pregnancy and lactation

Safe motherhood

Care of at-risk mothers

Family planning

Women and aging- Special concerns in developed and developing societies: Menopause, osteoporosis, chronic degenerative diseases, neurological problems.

Women and AIDS

Women and Nutrition

- Situation of women in global, national and local context. Improving the nutritional and health status. Intervantions throughout the life cycle.

Policies and Legislations

- CEDAW (Convention on elimination of all forms of Discrimination Against Women), Women's Right to Life and Health (WRLH).

Empowerment of Women-Role of Education and various national schemes

Text Book:

1. Gopalan, C. and Kaur, S (Eds) (1989): Women and Nutrition in India, Nutrition Foundation of India

References

2. ACC/SCN Policy Discussion papers.
3. Wallace, H.M. and Giri,K. (1990): Health care of women and children in developing countries, Third party Publishing Co., Oakland, California.
4. UNICEF: The Urban Poor and Household Food Security, UNICEF
5. NGO committee on UNICEF (1997): Women and children in Urban Poverty-What Way Out?
6. Census Reports, Government of India.
7. UNICEF-State of the world children.
8. International Nutrition Foundation-Micronutrient Initiative (2010): preventing Iron Deficiency in Women and Children; Technical Consensus on Key issues.

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation: [10]
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).

Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia,* Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens, Campylobacter jejuni, Helicobacter pylori* [10]

Packaging and Quality Control: [9]
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane.
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

Text Book:

1. Prescott L.M., Harley J.P., Klein D.A. (2008) Microbiology. 6th ed. WMC Brown Publishers

References

2. Banwart G.J. (1987) Basic Food Microbiology. CBS Publishers and Distributors.
3. Frazier W.C., Westoff D.C. (1998) Food Microbiology. 4th ed. Tata McGrawHill Publishing Co. Ltd.
4. Garbutt John (1997) Essentials of Food Microbiology. Arnold London.
5. Jay J.M., Loessner D.A., Martin J. (2005) Modern Food Microbiology. 7th ed. Springer
6. Pelczar M.J., Chan E.C.S., Krieg N. (1993) Microbiology. 5th ed. Tata McGraw-Hill Publishing Co. Ltd.

FN 532 NUTRITION FOR HEALTH AND FITNESS 3-0-0-3

Definition, components and assessment criteria of age: Specific fitness and health status. [8]

Holisitic approache to the management of fitness and health: Enrgy input and output. Diet and exercise. Effect of specific nutrient on work eperformance and physical fitness. Nutrition, exercise, physical fitness and health inter-relationship

Review of fifferent energy system for endurance and power activity: Fuel and nutrients to support physical activity. Shifts in carbohydrates and fat metabolism. Mobilization of fat stores during exercise. [6]

Nutrition in sports: Sports specific requirments. Dient manipulation. Pre-game and post game meals. Assessment of different nutragenic aids and commercial supplements. Diets for persons with high enrgy requirments, stress, fractures and injury.

Water and electrolytesbalances: Losses and their replenishment during excerse and sports events, effects of dehydration, sports drinks. [7]

Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer**.**

Nutrition and exercise regimes for management of obesity: Critical review of various dietary regimes for weight and fat reduction. Prevention of weight cycling. [8]

Definign nutriitonal goals.guidelines approporiate to health, fitness and prevention and management of the above chronic degenerative disorders.

Nutrition and exercise regimes for pre-post-natal fitness: Alternative systmes for health and fitness lile ayurveda, yoga, meditation, vegetarianism and traditional diets. [10]

Text Book:

1. Mahan L.K. & Ecott-Stump S. (2000): Krause's Food, Nutrition and diet Therapy, 10th Edition, W.B. Saunders Ltd.

References:

2. Sizer F. & Whitney E. (2000): Nutrition-Concepts and controversies, 8th Edition, Wadsworth Thomson Learning.
3. Whitney E.N. & Rolfes .R. (1999): Understanding Nutrition, 8th Edition, West/Wadsworth, An Internation Thomson Publishing Co.
4. Parizkova J. Nutrion, Physical activity and health in early life, Ed. Wolinsky, I., CRC press.
5. Ira Wolinsky (Ed) (1998): Nutriton in Exercise and sports, 3rd Edition,CRC Press

FN 542 NEUTRACEUTICALS AND FUNCTIONAL FOODS 3-0-0-3

Nutraceuticals: Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases. [4]

Definition, Classification, food and non food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [8]

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [9]

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [8]

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India. [10]

Text Book:

1. Geoffrey P. Webb. (2006). Dietary supplements and functional foods. Blackwell Publishing.

References:

2. Losso, J.N. (2007). Angi-angiogenic functional and medicinal foods. Press.
3. Cupp, J and Tracy, TS. (2003). Dietary supplements: Toxicology and C Pharmacology. Humana Press.
4. Manson, P. (2001). Dietary supplements (2nd Ed) Pharmaceutical Press.
5. Campbell, JE and Summers, JL. (2004). Dietary Supplement Labeling Compliance .
6. Shi, J.(2007). Functional Food Ingredients and Nutraceuticals: Processing Technologies. Taylor & Francis Publ. CRC Press.
7. Goldberg, I (1994). Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall.
8. Robert E.C. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

FN 562 FOOD AND NUTRITION LABORATORY -I 0-0-4-2

Practical exercises related to BC 522, MB 514 and FN 542

FN 641 FOOD SERVICE MANAGEMENT 3-0-0-3

UNIT-I [9]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel.

UNIT-II [5]

Theories about approaches to food service management -
Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules.

UNIT-III [5]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques

UNIT-IV [6]

Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-V [5]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance.
Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of kitchen records

UNIT-VI [4]

Financial management – Budgeting, costing and cost control, accounting

UNIT-VII [5]

Marketing and advertising, Changing food trends and marketing-influencing factors: Life style changes: economic, socio-cultural, psychological influences and marketing influences, Compatibilities/Challenges in Food Storage and its commercialization, Means of Marketing, National and International measurements

Text Book

1. Sethi, M. (2005): Institution Food Management New Age International Publishers.
2. Taneja S and Gupta SL (2001) Entrepreneurship development, Galgotia Publishing

Reference

3. Bessie, W.B. and Levelle, W. (1988): Food Service in Institutions 6th Edition Revised By Hargar FV, Shuggart SG, &Palgne Palacio June, Macmillian Publishing Company New York.
4. Kazarian, E. A. (1977): Food Service facilities Planning 3rd Edition Von Nostrand Reinhold New York
5. Kotas Richard and Jayawardardene. C (1994) Profitable Food and Beverage Management Hodder& Stoughton Publications
6. Kotler Philip Marketing management (2001) Millennium Edition Prentice Hall of India

FN 611 PUBLIC HEALTH AND NUTRITION **3-1-0-4**

UNIT-I [9]

Concept of public nutrition - Relationship between health and nutrition, role of public nutritionists in the health care delivery system. Population dynamics- Demographic transition, population structure, population policy, fertility behaviour, nutrition and quality of life interrelationship. Nutritional status -methods for assessing nutritional status – Indirect methods – demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR) - Direct – anthropometry, biochemical, clinical, dietary and functional methods of assessments.

UNIT-II [4]

Nutrition during life span – pregnancy, lactation, infancy, preschool age, school going and adolescents, adults and old age.

UNIT-III [9]

Assessment and surveillance of nutritional status in emergency affected populations- Scope for malnutrition assessment, indicators and simple screening methods. Organization for nutritional surveillance. Nutritional relief and rehabilitation- Assessment of food needs, food distribution strategy, targeting food aid, mass and supplementary feeding, special foods/rations for nutritional relief, organization for mass feeding/food distribution, transportation and storage, feeding centers, sanitation and hygiene and public nutrition approach to tackle nutritional and health problems in emergencies, ethical considerations.

UNIT-IV [8]

Approaches and strategies for improving nutritional status and health - Programmatic options – their advantages and demerits. Intervention Programmes – Health based interventions, Food – based interventions including fortification and genetic improvement of foods, supplementary feeding. Malnutrition and Health economics - Its impact on productivity and national development. Cost management.

UNIT-V [9]

Information Education Communication approaches to improve health and nutrition: Concepts – Scope- Elements- Models of communication - Communication Process - Approaches and Barriers to communication, Communication for Extension Education and Development - Introduction to IEC Aims and Objectives, Importance of IEC, relevance to programmes - Nutrition education for behaviour change – Rationale, Planning Execution and evaluation of Department of Food Science and Technology.

Text books

1. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.

Reference

2. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
3. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Bamji, M.S., Rao, P.N., Reddy, V (Eds) (2003): Textbook of Human Nutrition,

Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

FN 621 INSTITUTIONAL FOOD ADMINISTRATION 3-1-0-4

UNIT-I [3]
Review of different types of institutional food service operations, canteens, hotels, restaurants and hospitals.

UNIT-II [7]
Meal planning, Food preparation and Service: Basic factors in successful institutional meal planning, considerations with regard to religion, region, availability of food and season, food habits, personnel, equipment, physical plant and financial resources. Procedures involved in constructions of recipes in large scale cooking. Processes of food preparation in large quantities. Type of food service in different institutions: Formal and informal food service.

UNIT-III [4]
Management: Definition, functions, tools of management-organization chart, job description, job specification, work sheet. Work improvement and work simplification.

UNIT-IV [8]
Personnel Management: Personnel and leadership qualifications for food service administrator, responsibilities and importance of good human relationship in organization. Criteria for selection of staff personnel, employment conditions, employee-training, role of employee unions, welfare provisions for labour.

UNIT-V [9]
Management of Resources: Budget, records and book keeping. Food cost control and Labour cost control: Factors affecting cost-menu, types of service, methods of purchasing, serving and pricing, maintenance of standard portions, waste, and meals for employee, wages. Physical plant: Its location, floor plans, space allowances for food preparation activities, storage units, service units and washing units.

UNIT-VI [8]
Importance of food standards, criteria for good quality products, hazards of adulteration and poor quality, quality control, specifications for quality in food products, food laws regarding quality and adulteration.
Labour laws regarding health and safety of employees, health examination, sanitary working conditions, labour regulations, welfare policies.

Text Book

1. West BB, Wood, L. Harger, V.F. and Shugert, G.S. 1977, Food Service in Institutions. John Wiley and Sons, NewYork
2. Sethi, M and Malhan, S. 1993. Catering Management – An integral approach, Wiliey Eastern Limited, New Delhi.

Reference

3. R. Kinton und V. Ceserani 2000. The theory of catering. Aufl., Seiten, Abb., Tab. Verlag Edward Arnold Ltd, London 1
4. Weiss H. and Edith. 2000. Catering Handbook /9780471284277; Publisher: Wiley
5. Mizer and Porter, 2010. Food Preparation for the professionals. Eich Drummond. New York: John Wiley & Sons, Inc

6. Crusius, V.C. 2001: Quantity Food Management. Minneapolis, Minn. Burgess, (c)1981

FN 631 CLINICAL AND THERAPEUTIC NUTRITION **3-1-0-4**

UNIT-I [6]
Nutritional screening and assessment of nutritional satus of hospitalized and outdoor patients.identification of high risk patiets. Assessment of patient needs based interpretation of patient data-clinical, biochmecial, biophysical, personal etc. Newer trends in delivery of nutritional care and dietary counselling

UNIT-I [10]
Diet nutrient and drug interaction. Effect of drugs on ingestion, digestion, absorption and metabolism of nutrients, effect of foods, nutrients and nutritional status on drug dosage and efficacy.
Nutritional support-recent advances in techniques and feeding substrates

UNIT-I [18]
Etiopathophysiology, metabolic and clinical aberrations, complications, prevention and recent advances in the medical nutritional management of:
Weight imbalances
Cardio vascular disorders
Diabetes mellitus and other metabolic disorders
GI tract disorders
Liver and gall bladder, pancreatic disorders
Renal disorder
Stress and trauma
Cancer
Neurological disorders
Musculo-skeletal disorders
Immuno-deficiency disorder
Genetic disorders
Infection and AIDS
Respiratory problems

UNIT-I [5]
Childhood problems/disorders including inborn errors of metabolism and their nutritional management.

Text Book

1. Mahan, L.K. and Escott-Stump, S. (2000): Krause's Food Nutrition and DietTherapy, 10th Edition, W-13 Saunders Ltd.
2. Shills, M.E., Olson, J.A, Shike, M and Ross, A.C. (2003): Modern Nutrition in Health and Disease, 9th Edition, A. Vaiiiams and Willdns.

Reference

3. Williams, S.R. (2003): Nutrition and Diet Therapy, 7th Edition, Times Mirror/Mosby Collage Publishing.
4. Chandra, R.K. (eds) (2002): Nutrition and Immunology, ARTS Biomedical. St. John's Newfoundland.
5. Sareen, S, James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition, Thomson Wordsworth Publication, USA.

MB 641 INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY 3-0-0-3

UNIT-I

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feedback repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

UNIT-I

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

UNIT-I

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

UNIT-I

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (β-lactam, aminoglycosides). [12]

UNIT-I [5]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids.

Text Book

1. Crueger and Crueger (2003): Biotechnology: a textbook of industrial microbiology, 2nd Edition. Panima publications.
2. Stanbury, P.F. and Whitaker, A. (2016): Principles of fermentation technology. Pergamon press.

Reference

3. Taylor and Francis (2007): Fermentation microbiology and biotechnology. El-mansi. 2nd Edition.
4. Scragg (1991) :Bioreactors in Biotechnology: A Practical approach. Latest Ed.
5. Mansi, E. T., Bryce, C. A, Demain, A. L. and Allman A. R. (2011):Fermentation Microbiology& Biotechnology. 3rd Edition.

FN 651 Food and Nutrition Laboratory-II 0-0-4-2

Practical exercises related to FN 611, FN 621 and FN 631

Mody University of Science & Technology

Ph.D.

(Effective from Academic Year 2016-17)

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

RM20.711 **Research Methodology** **3-0-2-4**

Course Objectives:

1. To equip students with knowledge, abilities and insight in research methodology and related interdisciplinary fields.
2. To plan and design research using scientific and statistical methods.

1. Introduction to Research: Meaning, nature, purpose and motivation; Types of research – exploratory, descriptive, causal, and analytical; Research process; Definition of construct and variables and types of variables; Bases for choosing a topic; Problem definition; Literature review, Identification of research gap; Formulation of objectives; Signification and relevance of research objectives. **[06]**

2. Research Design and Sampling: Research Design - Meaning, need, features, types, important concepts, developing a research plan. **[06]**
Sampling: Census and Sample Survey, implications and types of sampling, process of sample selection, criteria and characteristics of selecting a good sample.

3. Scaling and Methods of Data Collection: Definition and types of scales, construction of measurement scale, errors, test of sound measurement scale. **[06]**
Methods of data collection: Types, sources and methods (Qualitative and Quantitative).

4. Statistical Tools for Data Analysis*: Measures of central tendency – Mean, Median, Mode, Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness, Correlation – Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests – Chi-Square test. **[09]**

5. Application of Computer in Research*: MS office and its application in Research, Use of Internet in Research – Websites, Search Engines, E-journal and E-Library – INFLIBNET. **MS-Excel:** Data representation, application of inbuilt formulas, formulation of equation using BODMAS rule in MS-Excel. **[06]**

6. Foundation of Research and Report Writing*: Significance and technique of interpretation, importance of report writing, types of reports, structure and components, writing research proposal and synopsis, planning phase of report writing (cauterization), Bibliography, Appendices, referencing, Style Manuals – APA style, MLA style, ASA style, Harvard/IEEE etc), plagiarism, journals, citations and indexing, funding agencies, ethics in research, characteristics of a good research report. **[06]**

Remark: 39 Hours for Lecture and 26 Hours for Practical*.

Course Outcome:

1. Develop the ability to understand and analyse the problems and able to connect the problem with practical and present scenario.
2. Develop the ability to think independently as well as scientifically towards for continuous lifelong learning process.
3. Analyse the situation, convert into problem and find its solution.

Suggested Readings

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill.India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics.Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House(Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami, O. R., Ranganatham M. (2011). Methodology of Research in SocialSciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New AgeInternational (P) Publisher. New Delhi
8. Lambert, Joan , Frye, Curtis D. (2016). Microsoft Office 2016 Step By Step. PHI
9. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd. India
10. Sekaran Uma (2003). Research Methods for Business. Wiley India.
11. Zikmund, Babin, Carr, Griffin (2003). Business Research Methods. Cengage Learning,India.

https://www.proschoolonline.com/blog/top-10-data-analytics-tools

BT 761	Forensic Biotechnology	3-0-0-3
Forensic Serology: General Introduction, Collection, preservation and packing of Biological fluids. Forensic applications of Isozymes and Polymorphic proteins. Introduction to Human Leucocyte Antigen, classification and typing		**[6]**
DNA profiling: Nuclear DNA and Mitochondrial DNA Techniques involved: PCR, Sequencing, RFLP analysis, analysis of STR, SNP Significance of DNA profiling DNA extraction/isolation from different samples, FTA cards, Ethical issues		**[7]**
Forensic Toxicology: Brief Idea of Toxins and Drugs, Extraction, separation and Identification		**[4]**
Wild Life Forensics: Collection, Processing and Examination of forensic artefacts: Pug marks, Horn, Skin, Fur, Hair, Nail and Teeth. Extraction of species specific antigens. Introduction to forensic entomology and forensic microbiology, Wild Life Protection Act		**[9]**
Analytical techniques for forensic applications: Spectroscopy: UV-Visible, NMR and Mass Chromatography: Normal and Reverse Phase, Paper and Column (Gel filteration, Ion exchange and Affinity) Electrophoresis: Agarose, PAGE-1D and 2D, IEF Antigens- Antibody reactions. ELISA, Immuno-electrophoresis, RIA, single diffusion, double diffusion, and rocket electrophoresis Microscopy: Simple and Compound microscope, Phase contrast Microscope, Fluorescent Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM) Centrifugation: Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges		**[13]**
Suggested Readings **Text Book** 1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986). 2. Wilson K and Walker J; Principle and Techniques of Biochemistry and Molecular Biology and Practical Biochemistry, Cambridge University Press **Reference Book** 1. Clark, E.G.C. Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986 2. Brown TA; Gene cloning; Willey-Liss Publications, Singapore. 3. Old & Primrose; Principle of Gene Manipulation; Panima Publications, New Delhi 4. Goldsby et al; Kuby Immunology; Freeman and Company, New York.		

Evaluation Pattern

Course Code	Course Title	Contact Hours per Week	Credits	ETE Duration	Weightage (%)

		L	T	P		Hours	CW	MTE	ETE
BT 761	**Forensic Biotechnology**	3	-	-	3	3	100		

Annexure-VIII

Ph.D. Syllabus

BT 711	**Animal Toxicology**	**3-0-0-3**
	Introduction to the subject, History, Terminology, Disciplines. Basic Principles, Dose, Dose Response, Toxic Effects and Testing methods, Risk Assessment, Exposure Standards and Guidelines. Toxicokinetics: Absorption, Distribution, Biotransformation and elimination of toxic agents Environmental Toxicology, Classification of toxicants, Routes of Exposure, Duration and frequency, category of toxic effects, bio-magnification Cellular Toxicology, Introduction, Effects of toxicant on cell structures, DNA damage Cellular Toxicology, Biochemical disturbance, cellular response and repair Mechanism of Toxicity: Introduction, Dose-response Relationship, Receptor Concept Natural Protection Mechanism: Role of cell organelles, Glutathione Metabolism, Antioxidants Antidotal Therapy: Types and Procedures, free radicals Nanotoxicology: Introduction and Interdisciplinary aspects **Suggested Readings:** 1. Landis WG, Sofield RM, Yu MH. Introduction to Environmental Toxicology, Molecular Substructures to Ecological Landscapes, CRC Press 2. Reviews of Environmental Contamination and Toxicology Springer 3. Worth DJH, Howard G J. Fundamental Toxicology Springer	
Course instructor : Dr. R.S.Chundawat		
Evaluation pattern: End Term Examination of 100 marks		

BT 721	**Plant Microbe Interaction**	**3-0-0-3**
	Introduction: Plant and microbe interaction, Plants as a host environment, The effects of microbes on plant physiology such as effects on photosynthesis, respiration, and the translocation of water and nutrients. Plants defense including structural defenses, biochemical defenses, and the hypersensitive response, Biotechnological perspectives of plant-microbe interaction Plant-Bacteria Interaction: Introduction, Abundance and distribution of bacteria in plants, Epiphytic/Endophytic bacteria, Rhizobacteria, Plant growth-	

	promoting rhizobacteria/bacteria (PGPR/PGPB), Pseudomonads *Bacillus* and as PGPR, Bacteria and plant health, Root nodule formation on legumes by *Rhizobium*spp for nitrogen fixation; other nitrogen fixing systems such as in alder/ *Frankia* and *Azolla*/*Anabaena*, Molecular mechanism of plant growth-promotion and biocontrol by bacteria, Microbial response to plants under habitat-imposed stresses (abiotic and biotic), Pathogenic interactions of bacteria with plants Plant-fungal Interaction: Introduction to fungal biology, Abundance and distribution of fungus in plants (Epiphytic/Endophytic), Mycorrhiza: Ecto, endo and VAM, Survey of fungal diseases important in plant pathology, Diagnostics and preventive measures Plant-virus Interaction: Diversity of plant viruses, Plant diseases caused by virus, Life cycles of plant viruses, Diagnostics and preventive measures Plant-nematode Interaction: Root-knot nematode, role of *Meloidogyne*, Plant health and nematode, Diagnostics and preventive measures **Suggested Readings:** 1. Burns and Slater. Experimental Microbial Ecology, Blackwell Scientific Publications, Oxford 2. Alexander M. Microbial Ecology, John Wiley and Sons 3. Atlas RM and Bartha R. Microbial Ecology: Fundamentals and Principles, Benjamin Cummins, USA	
Course instructor : Dr. D.K.Choudhary		
Evaluation pattern: End Term Examination of 100 marks		

BT 731	**Plant Transgenic Biology**	**3-0-0-3**
	Agrobiology: *Agrobacterium*-plant interaction, T-DNA transfer mechanism, *Agrobacterium* based vectors, Binary and shuttle vectors. Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co -integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Gene silencing, Chloroplast transformation Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance, Plants as Bio-factories, Metabolic engineering of plant secondary metabolites pathways of metabolism Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection.	

	Transgenic animal production, Methods of transgene delivery, Integration of foreign genes and their validation, Gene targeting methods and strategies, Expression of mammalian genes into prokaryotic and eukaryotic cell **Suggested Readings:** 1. Henry RJ. Practical Application of Plant Molecular Biology, Chapman and Hall Publishers 2. Glick and Pasternak.Molecular Biotechnology: Principles and application of Recombinant DNA, ASM Press 3. P.K.Gupta: Elements of Biotechnology, Rastogi and Co. Publishers 4. Freshney I. Culture of Animal Cells, Wiley-Liss. 5. Hafez B, Hafez ESE. Reproduction in Farm Animals, Wiley-Blackwell. 6. Houdebine LM. Transgenic Animals: Generation and Use, CRC Press. 7. Decker J and Reischl U. Molecular Diagnosis of infectious diseases, 2nd Edition, Humana Press	
Course instructor: R.K. Gaur		
Evaluation pattern : End Term Examination of 100 marks		
BT 741	**Biocatalysis and Biotransformation**	**3-0-0-3**
	Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc. Stresses related defense enzymes in plants and animals Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc. **Suggested Readings:** 1. Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press 2. Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press 3. Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford	

	4. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.	
Course instructor: Dr. K.P.Sharma		
Evaluation pattern: End Term Examination of 100 marks		

BT 751	**Environmental Biotechnology**	**3-0-0-3**
	Sources, generation, classification & composition of pollutants;effect on living organism;Persistence and biomagnification of xenobiotic molecules. Biological and Chemical methods for detection ofWastes; Need for management of resources. Biodegradation. Acclimation, detoxification activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Methods in determining biodegradability; Contaminant availability for biodegradation. Microbial degradation of aliphatic and aromatic compounds; Microbial degradation of halogenated and sulfonated compounds; Biodegradation of pesticides. Bioremediation, Constraints, advantages and applications; Types of bioremediation, Bioaugmentation and biostimulation; factors affecting	

	bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol. Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, bioreactors; Phytoremediation. Sources of heavy metal pollution; Microbial interactions with inorganic pollutants - Microbial metal resistance; Microbial transformation; Accumulation and concentration of metals; Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills. **Suggested Readings:** 1. Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition,McGraw-Hill, 2000. 2. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999. 3. K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999. 4. Martin Alexander, Biodegradation and Bioremediation, 2nd edition, Academic Press, 1999. 5. M.N.V. Prasad, Kazimierz Strzalka, Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, Kluwer Academic Publishers, Dordrecht Hardbound, 2002. 6. Baker, K.H and Herson, D.S.BioremediationMcGraw Hill, Inc. New York, 1994. 7. M.V.Levin&Gealt, M.A., Biotreatment of Industrial & Hazardous Waste McGraw Hill. Inc. 1993. 8. Martin Alexander, Biodegradation and Bioremediation (2nd editon). Elsevier Science & Technology. 1999. 9. Raina M. Maier, Ian L. Pepper, Environmental Microbiology. Academic Press. 2001.	
Course instructor: Dr. Pankaj Kumar Jain		
Evaluation pattern: End Term Examination of 100 marks		

MS 711 Advanced Computational Methods and MATLAB 3-1-0-4

Algebraic and Transcendental Equations: General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graeffe's root squaring method, Muller's method, Bairstow iterative method. **[7]**

System of Linear Equations and Boundary Value Problems: Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. Finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method **[8]**

Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations. **[8]**

Elements of MATLAB-I: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. **[8]**

Elements of MATLAB-II: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[8]**

Text Books:

1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd.
2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
3. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.
4. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW	MTE	ETE

MS 711	Advanced Computational Methods and MATLAB	3	1	-	4	3	---	---	100

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
1.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
2.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
3.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
4.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**
5.	**Elements of MATLAB:** Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 3. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 4. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.		
Reference Books: 1. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 2. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.		

3. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education.
4. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
6.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
7.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
8.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
9.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**

10. Elements of MATLAB: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 5. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 6. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 7. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 8. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.	
Reference Books: 5. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 6. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited. 7. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education. 8. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.	

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

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Session 2017-2018

Mody University of Science & Technology

B.Sc. (Hons) Biotechnology

Session 2017-2018

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H)-Biotechnology-Three years programme
2016-2017 and onwards
FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	CORE (Compulsory)									
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	CH 113	Chemistry I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Laboratory I	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 171	Biotechnology and Human Welfare	2	-	-	2	3	25	25	50
	BT 181	Bioethics and IPR	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	80
		Sub Total	15	1	6	19				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CORE (Compulsory)									
	BT 152	Genetics	3	1	-	4	3	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
	CH 114	Chemistry II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Laboratory II	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 172	Basics of Drug Designing	2	-	-	2	3	25	25	50
	BT 182	Basics of Forensic sciences	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	16	1		20				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H)-Biotechnology-Three years programme
(2016-2017 and onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	Core Compulsory (CC)									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Bio-Instrumentation Lab	-	-	2	1	4	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Laboratory	-	-	2	1	4	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BO 211	Plant Anatomy and Physiology	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 291	Introductory Biomedical Science	2	-	-	2	3	25	25	80
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-I‡	3	-	-	3	2	25	25	50
		Sub Total				21				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	Core Compulsory (CC)									
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	BO 212	Plant Developmental Biology	2	-	-	2	3	25	25	50
	BO 222	Plant Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 381	Modern Biology	3	-	-	3	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total				18				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology-Three years programme
(2016-2017)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	Core Compulsory (CC)									
	BT 311	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 341	Genetic Engineering Lab	-	-	2	1	4	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocess Engineering Laboratory	-	-	2	1	4	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	4	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 333	Introduction to Research Methodology	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
		Sub Total				22/25				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology-Three years programme
(2016-2017)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	Core Compulsory (CC)									
	BT 352	Bioinformatics	3	-	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	BT 322	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 313	Animal Tissue Culture	3	-	-	3	3	25	25	50
	BT 323	Tissue Culture Laboratory	-	-	2	1	4	25	25	50
	BT 342	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 392	Environmental Biotechnology Laboratory	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 334	Enzyme Technology	3	-	-	3	3	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	BO 132	Botany -II	3	-	-	3	3	25	25	50
		Sub Total				23/26				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

The syllabus for already approved courses is not enclosed herein.

*The student has to take maximum two courses in each semester of Third year from the DCS. The minimum strength of student should be five (5) in the particular DCS course.

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BT 171 Biotechnology and Human Welfare **2-0-0-2**

[8]

UNIT I

Industry Application: protein engineering; enzyme and polysaccharide synthesis, Metabolites: Alcohol and antibiotic production.

UNIT II [8]

Agriculture Application: N_2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III [10]

Human Health: Diagnostics and Treatment: development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, Human genome project.

Text Book

1. Concepts in Biotechnology by Balasubrahmanian et. al.,University press, 2010

Reference Book

2. Recombinant DNA technology by Watson et. al., Scientific American Books, 2012.
3. Principles of Gene Manipulation by Old and Primrose. Blackwell, 2010
4. Biotechnology: Applications In Human Healthcare Hardcover, Sampat Nehra, Pointer Publishers (2009)

BT 181 Bioethics and IPR **2-0-0-2**

UNIT I [11]

Bioethics – Meaning and Necessity of Bioethics, different paradigms of Bioethics – National & International, Ethical issues against the molecular technologies

UNIT II [8]

IPR- Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions.

UNIT III [7]

Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

Text Book:

1. Patterns of Entrepreneurship 2005: Jack M. Kaplan. Wiley,
2. Sateesh MK. 2010 Bioethics and Biosafety, I. K. International Pvt Ltd.

References:

3. Entrepreneurship: New Venture Creation: David H. Holt Tata McGraw – Hill 2002
4. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BT 172 Basics of Drug Designing 2-0-0-2

UNIT I [5]
Drug designing-Meaning and Introduction, Disease and drug target identification

UNIT II [5]
Identification of Lead compound, SAR, optimising target interactions

UNIT III [8]
Toxicology and safety issues, Development and Production, Clinical trials, Patenting issues

UNIT IV [8]
Newer drugs, Drug discovery in cancer research/new target based drugs in clinical trials. Microbial genomics for new antibiotics, immunotoxin drug

Text Book

1. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
2. J.M. Haile , Molecular Dynamics Simulation Elementary methods, , John Wiley and Sons ,1997

References:

3. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
4. Remington's Pharmaceutical Science, Mark Publishing and Co.
5. The Organic Chemistry of Drug Design and Drug Action, by R. B. Silverman
6. An Introduction to Medicinal Chemistry by G. L. Patrick

BT 182 Basics of Forensic Science 2-0-0-2

UNIT I [8]
Introduction and principles of forensic science, tools and techniques in forensic science, Classification of injuries and their medico-legal aspects, method of assessing various types of deaths

UNIT II [6]
Fire arms and explosives, Handwriting analysis, Significance of toxicological findings

UNIT III [6]
Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification

UNIT IV [6]
Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Introduction to Cyber security.

Text Book:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

References:

3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

BT 291 Introductory Biomedical Science 2-0-0-2

UNIT I [8]

Introduction to human biology, Clinical biochemistry of human diseases, microbiology, epidemiology, and biomedical engineering

UNIT II [6]

Screening for disease, Application of biochemical techniques to inborn errors of metabolism, tumor markers, liver function, iron and porphyrins

UNIT III [7]

Enzymes and their use in laboratory medicine, clinical applications of protein biochemistry, nutrition in health and disease, lipids and atherosclerosis

UNIT IV [5]

Electronic devices used as sensors

Text Book

1. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

Reference

2. Campbell, N.A. and Reece, J.B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

BO 212 Plant Developmental Biology 2-0-0-2

UNIT I

Development and morphology of gametophyte – formation of vegetative and generative cells, microsporogenesis, organization of mature pollen grain, types of ovules, integument, nucellus, megasporogenesis, types of embryo sacs. [6]

UNIT II [4]
Pollination and fertilization – Pollen transfer, artificial pollination, pollen germination, double fertilization, self-incompatibility.

UNIT III [5]
Endosperm – development, cytology and functions of endosperm
Endosperm types - nuclear, cellular - helobial - Ruminate endosperms, function of endosperms.

UNIT IV [5]
Embryo – Development of embryo in Dicot (Capsella) and Monocot (Najas). A brief account on Polyembryony, parthenocarpy.

UNIT V [6]
Seed – Development, classification, dispersal and dormancy

Text Book

1. Plant Physiology by Taiz and Zeiger, Sinauer Associate Inc. Publishers

Reference

2. The Arabidopsis Book, ASPB publication (available freely at www.aspb.org)
3. Biochemistry and Molecular Biology of plants Ed. Buchanan, Grussem and Jones, ASPB publication.
4. Bhojwani. S.S. and Bhatnagar. S.P. 1978. The embryology of Angiosperms. Vikes Publishing Pvt. Ltd., Delhi.
5. Maheswari P.1971. An introduction to embryology of Angiosperms Tata Mc Graw Hill, Delhi.
6. Swamy B.G.L. and Krishnamurthy K.V. 1950. From flower to fruit. Tata Mc Graw Hill, Hew Delhi.

BO 222 Plant Developmental Biology Laboratory 0-0-2-1

Assignments are based on the course BO 212 Plant Developmental Biology containing exercises on plant developmental studies using permanent slides and embryo development related experiments.

BT 333 Introduction to Research Methodology 2-0-0-2

UNIT I [5]
Introduction to Research Methodology: Objectives and motivation in research

UNIT II
Defining the Research Problem, Selecting and defining a research problem, Reviewing and conducting literature search, developing a research plan [7]

UNIT III

Designing of Experiment, Number of Different experimental designs – single and multifactorial design [6]

UNIT IV

Making measurements and sources of error in measurements, Methods of data collection and record keeping. Report writing, Writing a research paper - abstract, introduction, methodology, results and discussion. [8]

Text Book

1. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi)

Reference

2. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
3. Montgomary, Douglas C. &Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
4. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT II [8]

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital

UNIT III [8]

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 **Plant and Animal Biotechnology** **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 **Tissue Culture Laboratory** **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics.	**[3]**
2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering.	**[3]**
3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases.	**[4]**
4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology.	**[3]**
5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs.	**[4]**
6. **Tissue Engineering** – Skin, Liver, Pancreas.	**[3]**
7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues.	**[3]**
8. **Drug delivery** – conventional & new approaches to drug delivery.	**[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,

2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.

4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their **[6]**

functions.

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
   (a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

   (b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**
   Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.

6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, **[6]**

Animal Environment, Extreme Habitats.

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]

3. Natural Resources: Renewable and Nonrenewable resources. [**2**]

4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. [**3**]
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of

Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION

B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.

6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 Cell Biology 3-1-0-4

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of

Zoology; WCB Mc Graw-Hill, New Delhi

5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface **[4]**

tension and viscosity and parachore.

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and

racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 Cell Biology Laboratory 0-0-2-1

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 Animal Diversity Laboratory-I 0-0-2-1

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.

2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics 2-0-0-2

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing

House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut

3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 Bio-Instrumentation 3-1-0-4

Principle of pH meter.	[1]
Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow.	[6]
Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications.	[8]
Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.	[8]
Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE.	[8]
Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography.	[8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson
and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith
G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, [4]

thermoregulation.

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.

3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.

4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory

based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination **[7]**

compounds, valence bond theory of transition metal complexes.

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T- [5]

lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's

equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV 2-0-0-2

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk and hazard associated with their use; Potential uses and applications [12]

of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc.

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory.

[7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture.

[8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement.

[8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement.

[8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods.

[8]

MB 331 General Microbiology **3-0-0-3**

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph [12]

Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters.

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al*.; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New

Delhi.

4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation. [4]

Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium). [5]

Biofuels: Bioethanol, Biodiesel, Methanogenesis. [4]

Biopesticides: Bacterial, Fungal and Viral pesticides. [4]

Biofertilizers: Nitrogen fixing microbes and their application in crop productions. [5]

Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and pesticide biodegradation, Biobleaching of industrial effluents. [6]

Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling. [6]

Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process. [5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.

6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 Environmental Biotechnology Laboratory **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 Tissue Culture Laboratory

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 Internship **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 Genetic Engineering **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase. [6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors.

[6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for selection of recombinant DNA molecules.

[6]

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing.

[7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen.

[6]

BT 352 Bioinformatics **3-0-0-3**

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP)

[5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized

[7]

databanks).

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X-ray crystallography), Algorithm for modeling protein folding. [5]

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 Bioprocess Engineering 3-0-0-3

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's [10]

mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation.

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics. [10]

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.), Bioprocess Engineering, Prentice Hall PTR, New Jersey. 1.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.* 2.
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York. 3.

***latest edition**

BT 334 Enzyme Technology 3-0-0-3

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes. [12]

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular emphasis on change in pH and hydrophobicty [8]

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of Biochemistry , MacMillian Worth Publishers, US.
2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.
3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.
4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.
5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.
6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different

biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory 0-0-2-1

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory 0-0-2-1

Assignments are based on the course BT 334 Enzyme Technology containing exercises on enzymes kinetics.

Mody University of Science & Technology

B.Sc. (Hons) Maths
Session 2017-2018

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc (Honours) in Mathematics
(Mathematics, Physics and Computer Science*/Chemistry)**
Three-Year Programme
Academic Curriculum
First Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
						5				
	Mathematics									
	MS 111	Calculus	3	-	-	3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 111	Mechanics, Properties of Matter and Relativity	3	-	-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 121	Programming concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 181	Physical and Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 23*/23.5**									
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 23
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

First Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
						6				
	Mathematics									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2	-	-	2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 122	Data Structure Through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
						8				
	Chemistry*									
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 27*/24.5**									
	GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 27

**Mathematics, Physics and Chemistry 24.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language I ‡	3	-	-	**3**	3	25	25	50
	Mathematics									
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
						7				
	Physics									
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
						8				
	Computer Science*									
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
						8				
	Chemistry**									
	CH 291	Physical Chemistry- I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry -III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry -III	-	-	3	**1.5**	4	25	25	50
						7.5				
	Total Credits: 26*/25.5**									
	GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Autumn Semester

*Mathematics, Physics and Computer Science 26

**Mathematics, Physics and Chemistry 25.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language II ‡	3	-	-	3	3	25	25	50
	Mathematics									
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3	3	25	25	50
						7				
	Physics									
Spring Semester	PH 212	Mathematical Physics and Special theory of Relativity	3	1	-	4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
						6				
	Computer Science*									
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 272	Physical Chemistry- II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry- II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry -IV	-	-	3	1.5	4	25	25	50
						7.5				
	Total Credits: 21*/23.5**									
	GE 202	Proficiency (Non-Credit) #	-	-	-	1	-	-		

‡ *Refer to the Foreign Languages Section*

*Mathematics, Physics and Computer Science 21
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Third Year -Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	Mathematics									
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
	MS 331	Combinatorics	3	-	-	3	3	25	25	50
	MS 341	Vector Calculus	3	-	-	3	3	25	25	50
	MS 351	Probability and Statistics	3	1	-	4	3	25	25	50
	MS 361	Analytical Solid Geometry	3	1	-	4	3	25	25	50
	Total Credits:21									
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Third Year - Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	Mathematics									
	MS 312	Special Functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
	MS 332	Advanced Calculus	3	-	-	3	3	25	25	50
	MS 342	Graph Theory	3	-	-	3	3	25	25	50
	MS 352	Basic Differential Geometry	3	-	-	3	3	25	25	50
	MS 362	Dissertation	-	-	-	5	-	100		
	Total Credits:21									
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Total Credits (all Semester)- 139/139

$ CW (Course work): It would include attendance, assignments, class /quiz test.

MS 331 **Combinatorics** **3-0-0-3**

1. Relation: Definition, different forms, properties and operations on sets, principle of inclusion and exclusion, partition of a set, definition of relation, types of relation, composition, properties and graphical representation of relation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice and different forms. **[10]**

2. Function: Properties, definition of function and different forms, composition and properties of functions, recursively defined functions, applications of functions. **[10]**

3. Induction: Mathematical induction, strong induction and well-ordering, definition of recursive, structural induction. **[10]**

4. Counting: Basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.

Reference Books:

1. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd edt., Mc Graw Hill Education, New Delhi.
2. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International

MS 341 **Vector Calculus** **3-0-0-3**

1. Vector Differentiation I: Vector algebra, operations with vectors, scalar and vector product of three vectors, product of four vectors, reciprocal vectors, scalar-valued functions over the plane and the space, vector function of a scalar variable, curves and paths, vector differentiation. **[10]**

2. Vector Differentiation II: Directional derivative, gradient of a scalar function, conservative field, divergence, curl, related properties of gradient, divergence and curl of sums, second order differential operator, cylindrical and spherical coordinates. **[10]**

3. Vector Integration I: Integration of a vector function of a scalar argument, line integral, work done , potential, conservative field and area, surface integrals, surface area and flux, volume integrals. **[10]**

4. Vector Integration II: Green's theorem in plane, transformation between line integral and double integral, area in Cartesian and polar coordinate, Stoke's theorem, Gauss divergence theorem. **[09]**

Text Books:

1. Shanti Narayna, A Text Book of Vector Calculus by, S. Chand & Co., New Delhi.
2. R.Murrary, Theory and Problems of Advanced Calculus by Spiegal, Schaum's Publishing Company, New York.

Reference Books:

1. N. Saran and S.N. Nigam, Introduction to Vector Analysis by Pothishala Pvt. Ltd., Allahabad.
2. Thomas, Calculus by Thomas, 11 Editions, Pearson.
3. G. Paria, A Text Book on Vector Calculus by Scholar's Publishing House, Indore.
4. B.V. Ramana(2006), Higher Engineering Mathematics by TMH.

MS 351 **Probability and Statistics Theory** **3-1-0-4**

1. Basic Statistics: Mean, mode, median for grouped and ungrouped data, variance, standard deviation, dispersion and measures of dispersion, skewness and measures of skewness, moments. **[10]**

2. Probability Theory: Recapitulation of basic probability theory, law of addition and law of multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[10]**

3. Random Variables and Distribution: Discrete and continuous random variables, types of distribution, probability mass and density functions, mean variance and standard deviation of distribution, discrete distributions (binomial and Poisson), continuous distributions (normal and uniform). **[10]**

4. Hypothesis and Correlation-Regression: Simple and composite hypothesis, type I and type II errors, tests of significance, simple correlations, linear regression. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics, 3rd ed., SCS Publisher.

MS 361 **Analytical Solid Geometry** **3-1-0-4**

1. Plane and Straight Line: Different form of plane, angle between two planes, perpendicular distance of a point from a plane, plane through intersection of two planes, bisectors of two intersecting planes, locus of a plane, different form of straight line, angle between two lines, distance of a point from a straight line, coplanarity of straight lines, shortest distance between two lines, intersection of three planes. **[10]**

2. Sphere: Different form of sphere, plane section of a sphere, intersection of two spheres, sphere through a given circle, intersection of a straight line and sphere, tangent planes and normal, touching spheres and condition of orthogonality. **[10]**

3. Conicoids I: Different form of cone, equation of the cone with given vertex and a given conic for its base, angle between the lines in which a plane cuts a con, tangent lines and tangent plane, reciprocal con, right circular con, different form of cylinder, equation of tangent plane, enveloping cylinder, right circular cylinder. **[10]**

4. Conicoids II: Ellipsoid, hyperboloid of one and two sheets, elliptic paraboloid , hyperbolic paraboloid, tangent plane , equation of normal, director sphere, polar plane and pole of the plane. **[09]**

Text Books:

1. R.J.T. Bell (1994), Elementary Treatise on Co-Ordinate Geometry of Three Dimensions by, Macmillan India Ltd.
2. Shanti Narayan, Analytical Solid Geometry by S. Chand & Company, New Delhi.

Reference Books:

1. Deepak Chatterjee, Analytic Solid Geometry by PHI Learning Private Ltd., New Delhi.
2. H.M. Vasavada (1992), Analytical Geometry of Two and Three Dimensions.

MS 332 **Advanced Calculus** **3-0-0-3**

1. Preliminary: Functions, continuity, the derivative, composite functions Rolle's theorem, theorem of the mean, Taylors's series with remainder indeterminate forms, fundamental theorems on infinitesimals. **[10]**

2. Power Series: Definition, tests for convergence, region of convergence, uniform convergence, integral and derivative of power series, operations with two power series, exponential, trigonometric, hyperbolic and dominant functions, conditionally convergent series. **[10]**

3. Partial Differentiation: Functions of two variables, partial derivatives of composite function, Euler's theorem on homogeneous functions, directional derivative, higher differential, implicit functions, one equation of two or more variables, two equations of four variables, four equations of six variables, Jacobians. **[10]**

4. Definite Integral: Definition and properties, existence proof, Simpson's rule, change of variables, differentiation of a definite integral, differentiation under the integral sign, differentiation and integration of integral with infinite limit, infinite integrand, multiple integrals, beta and gamma functions, Dirichlet's integral. **[09]**

Text Books:

1. Frederick S Woods (1934), Advanced Calculus by Ginn and Company.
2. George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Thomas Calculus by Pearson.

Reference Books:

1. R.C Buck , Advanced Calculus by Waveland Press, Inc.
2. Walter Rudin, Principles of Mathematical Analysis by McGraw-Hill.
3. Gerald B. Folland, Advanced Calculus by Pearson.

MA 342 **Graph Theory** **3-0-0-3**

1. Graphs: Introduction, definition and applications of graphs, finite and infinite graphs, null graph, sub graphs, incidence and degree, isolated vertex, pendant vertex, walk, path and circuits, connected graphs, disconnected graphs and components, isomorphism, Euler graphs, operations on graphs, Hamiltonian paths and circuits, the travelling sales man problem, matrix representation of graphs, properties and some standard theorems on graphs. **[10]**

2. Directed Graphs: Definition, in-degree, out-degree, isomorphic digraphs, types of digraphs, digraph and binary relations, relation matrices, directed paths and connectedness, Euler digraphs, fundamental circuits in digraphs, properties and some standard theorems on digraphs. **[10]**

3. Trees: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's algorithm and Prim's algorithm. **[10]**

4. Cut-Sets and Cut-Vertices: Cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism, some standard theorems. **[09]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science, PHI.
2. Chartland G., Zhang P. (2006) Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.

MS 352 **Basic Differential Geometry** **3-0-0-3**

1. Preliminaries: Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces orientation, the gauss map. **[10]**

2. Tensors: Definition of tensors and basic properties, Christoffel symbols, uses of tensors in differential geometry. **[10]**

3. Geodesics I: Parallel transport, Weingarten map, curvature of plane curves, arc length and the line integrals, curvature of surfaces. **[10]**

4. Geodesics II: Envelops and evolutes, first fundamental form, metric potentials, direction coefficient and angle between two curves on a surface. **[09]**

Text Books:

1. Chuan-Chih Hsiung (1997), A First Course in Differential Geometry by International Press, Cambridge.
2. T.J. Willmore(1964), An Introduction to Differential Geometry by Oxford University Press.

Reference Books:

1. M. Abate and F. Tovena, Curves and Surfaces by Springer.
2. A. K. Peters (2010), Differential Geometry of Curves and Surfaces by Ltd., Natick.
3. D.J. Struik(1988) , Lectures on Classical Differential Geometry by 2nd Edition, Addison-Wesley.

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 *Physics Laboratory-I* 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. [7]

Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission [10]

grating and its resolving power.

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.

3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10] [8]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and [8]

grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments.

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of [6]

cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon-nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and [6]

Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]
Applications of Matrices: Applications of matrices to a system of linear	[9]

(both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.

2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd.,

Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 *C Language Laboratory* 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi
4. Achyut S Godbole, "Operating Systems", TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and [8]

Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes.

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, "Let Us C++", BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, "Mastering C++" , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, "C++ The Complete Refernce", TMH, New Delhi.
2. Lafore R, "Object Oriented Programming Using C++", GalgotiaPulications, New Delhi
3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 *Computational Numerical Analysis Laboratory* **0-0-4-2**

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular

velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's **[5]**

equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey,

reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child [5]

Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and

pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand

& Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing [8]

mechanism

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology 3-0-0-3

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons, Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal

system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.

4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

B.Sc. (Hons) Psychology
Session 2017-2018

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (Hons.) Psychology
Three-Year Programme
Academic Curriculum
(Batch 2017 – 18 only)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab. -I	-	-	2	1	4	25	25	50
	PL 111	Basic Psychological Processes-I	3	-	-	3	3	25	25	50
	PL 121	Experimental Methodology & Elementary Statistics-I	3	-	-	3	3	25	25	50
	PL 131	Psychology - I	-	-	2	1	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	ZO 132	Animal Diversity - II	3	-	-	3	3	25	25	50
	BT 152	Genetics	3	1	-	4	3	25	25	50
	PH 112	Basic Physics	2	-	-	2	3	25	25	50
	ZO 142	Animal Diversity Lab. -II	-	-	2	1	4	25	25	50
	PL 112	Basic Psychological Processes-II	3	-	-	3	3	25	25	50
	PL 122	Experimental Methodology & Elementary Statistics-II	3	-	-	3	3	25	25	50
	PL 132	Psychology - II	-	-	2	1	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	**20**	**2**	**4**	**24**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (Hons.) Psychology
Three-Year Programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Lab	-	-	2	1	3	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	BT 271	Food Technology	2	-	-	2	4	25	25	50
	BT 261	Food Technology Lab.	-	-	2	1	4	25	25	50
	PL 221	Psychology of Human Development - I	3	-	-	3	3	25	25	50
	PL 231	Applied Psychology - I	3	-	-	3	3	25	25	50
	PL 241	Psychology Lab - III	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	BT 262	Sensitive Sciences	2	1	-	3	3	25	25	50
	ZO 232	Animal Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Animal Developmental Biology Lab.	-	-	2	1	4	25	25	50
	PL 212	Psychology of Human Development - II	3	-	-	3	3	25	25	50
	PL 222	Applied Psychology - II	3	-	-	3	3	25	25	50
	PL 232	Psychology Lab - IV	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

B.Sc. (Hons.) Psychology
Three-Year Programme
Third year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE	ETE
Autumn Semester	PL 311	Social Psychology-I	3	-	-	3	3	25	25	25
	PL 321	Biological Basis of Behaviour	3	-	-	3	3	25	25	50
	PL 331	Systems of Psychology	3	-	-	3	3	25	25	50
	PL 341	Psychopathology-I	3	-	-	3	3	25	25	50
	PL 351	Industrial and Organizational Psychology-I	3	-	-	3	3	25	25	50
	PL 361	Psychological Testing-I	3	-	-	3	3	25	25	50
	PL 371	Psychology Lab.-V	-	-	4	2	3	25	25	50
		Sub Total	**18**	**-**	**4**	**20**				
	GE 303	Proficiency (Non-Credit)#				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE	ETE
Spring Semester	PL 312	Social Psychology-II	3	-	-	3	3	25	25	25
	PL 322	Guidance and Counseling	3	-	-	3	3	25	25	50
	PL 332	Experimental Psychology	3	-	-	3	3	25	25	50
	PL 342	Psychopathology-II	3	-	-	3	3	25	25	50
	PL 352	Industrial and Organizational Psychology-II	3	-	-	3	3	25	25	50
	PL 362	Psychological Testing-II	3	-	-	3	3	25	25	50
	PL 372	Psychology Lab.-VI			4	2	3	25	25	50
		Sub Total	**18**	**-**	**4**	**20**				
	GE 306	Proficiency (Non-Credit)#				1				

Total Credits 130

PL 111 Basic Psychological Processes-I 3-0-0-3

UNIT-I
Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

UNIT-II
Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

UNIT-III [6]
Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance.

UNIT-IV [9]
Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.

UNIT-V [8]
Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

UNIT-I
Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

UNIT-II [5]
Problems and Hypothesis: Nature, Type and Sources.

UNIT-III [7]
Variables: Nature and Types; Control of Variables.

UNIT-IV [5]
Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement.

UNIT-V
Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

UNIT-VI [8]
Measures of Central Tendency: Mean, Median and Mode.

UNIT-VII
Reliability of Statistics: Significance of Difference Between Two Means [3]

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., &Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 131 Psychology Lab.-I 0-0-2-1

Assignments are based on the course PL 111 Basic Psychological Processes-I containing exercises on learning and personality.

PL 112 Basic Psychological Processes-II 3-0-0-3

UNIT-I
Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

UNIT-II
Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

[6]

UNIT-III
Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.

[9]

UNIT-IV
Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation.

[9]

UNIT-V
Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference:

2. Atkinson, R. L., Atkinson, R. C., &Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 122 Experimental Methodology & Elementary Statistics-II 3-0-0-3

UNIT-I [4]
The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales.

UNIT-II [7]
Sampling Methods: Probability and Non-Probability Sampling Methods.

UNIT-III [8]
Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs.

UNIT-IV [5]
Measures of Variability: Range, Quartile Deviation and Standard Deviation.

UNIT-V [4]
Normal Probability Curve: Properties and Applications. Skewness and Kurtosis.

UNIT-VI [6]
Reliability of Statistics: Chi-Square.

UNIT-VII [5]
Correlations: Product-Moment and Rank Order.

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., & Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 132 Psychology Lab.-II 0-0-2-1

Assignments are based on the course PL 112 Basic Psychological Processes-II containing exercises on memory and intelligence.

PL 221 Psychology of Human Development-I 3-0-0-3

UNIT-I [8]
Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.

UNIT-II [6]
Determinants of Development: Biological and Socio- Cultural.

UNIT-III [9]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.

UNIT-IV [8]
Prenatal Development: Stages and Factors Affecting Prenatal Development.

UNIT-V [8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.

Text Books:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 231 Applied Psychology-I 3-0-0-3

UNIT-I [8]
Introduction: Nature and Fields of Applied Psychology.

UNIT-II
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services. [7]

UNIT-III [6]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling.

UNIT-IV [9]
Psychology in Education: School as an Agent of Socialization, Factors

Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.

UNIT-V [9]
Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. Rao, S. N. Counselling and Guidance. Tata McGraw-Hill, New Delhi.
4. Charles, J. G., & Bruce, R. F. Counseling Psychology: Practices, Issues and Intervention. CENGAGE Learning, New Delhi.
5. Sue, R., Sue, D., & Sue, S. Understanding Abnormal Behaviour. Houghton Mifflin.

PL 241 Psychology Lab.-III 0-0-2-1

Assignments are based on the courses PL 221 Psychology of Human Development-I and PL 231 Applied Psychology-I containing exercises on the study of the characteristics of the neonate and guidance and counseling.

PL 212 Psychology of Human Development-II 3-0-0-3

UNIT-I
Development during Infancy: PhysicalGrowth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

UNIT-II
Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

UNIT-III [9]
Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity.

UNIT-IV [8]
Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family.

UNIT-V [8]
Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues.

Text Book:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 222 Applied Psychology-II 3-0-0-3

UNIT-I

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

UNIT-II

Psychology and Health: Mental Health and General Health, Dimensions of Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

UNIT-III

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

UNIT-IV

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

UNIT-V

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. Industrial Psychology. Prentice Hall, Englewood Cliffs.
4. Misra, G. Psychological Perspective on Stress and Health. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. Social Psychology. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. Psychology in Sports: A Contemporary Perspective. Friends, New Delhi.

PL 232 Psychology Lab.-IV 0-0-2-1

Assignments are based on the courses PL 212 Psychology of Human Development-II and PL 222 Applied Psychology-II containing exercises on the study of developmental pattern of various stages of human life and stress management.

PL 311 Social Psychology - I 3-0-0-3

UNIT-I [3]
Social Psychology: Nature and Subject Matter; Relationship with other social sciences.

UNIT-II [5]
Methods: Experimental, Observation, and Sociometry.

UNIT-III
Socialization: Nature, Process and Agents of Socialization. [4]

UNIT-IV [8]
Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.

UNIT-V [5]
Social Norms: Meaning, Characteristics and Formation

UNIT-VI [6]
Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants

UNIT-VII [8]
Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional

Text Book:

1. Baron, R.A., Byrne, D. Social Psychology (10th Edn)-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E.The Handbook of Social Psychology (2nd Edn.), Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S. Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M.Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. Social Psychology (8th Edn.)-Tata McGraw Hill International Editions.
7. Penrod, S. Social Psychology (2nd Edn.) New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K.Samaj Manovigyan Ki Rooprekha (6th Edn), NewDelhi: MotiLal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O.Social Psychology (12th Edn) - Pearson Education

PL 321 Biological Basis of Behaviour 3-0-0-3

UNIT-I
Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical. [6]

UNIT-II
Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters. [7]

UNIT-III
Nervous System: Central nervous system and Peripheral nervous system – Structure and Functions. Endocrine system and its behavioral implications. [9]

UNIT-IV
Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention. [6]

UNIT-V
Motivation: Neural mechanism of Hunger, Thirst and Sex [5]

UNIT-VI [6]
Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory.

Text Book:

1. Carlson, N.Biology of Behavior. Boston : Allyn and Bacon.
2. Graham, R.B.Physiological Psychology. California :Wadsworth.

Reference Book

3. Grossman, S.P. A Text book of Physiological Psychology. New York :Siley.
4. Hoyenga, K.B. and Hoyenga, K.T.Psychobiology : The neuron and Behavior. California :Broks/Cole.
5. Kalat, J.N.Biological Psychology. California :Wadsworth.
6. Levinthal, C.R.Introduction of Physiological Psychology. New Jersey : Prentice Hall.
7. Pinel, Johan, P.J.Biopsychology.Boston : Allyn and Bacon.
8. Rosenzweig, M.R. and Liemen, A.L.Physiological Psychology. New York : Random House.

PL 331 Systems of Psychology 3-0-0-3

UNIT-I
Nature and scope of Psychology: Psychology as science; Historical Origins: Pre-experimental period- Science Among Greeks, British Empiricism, German Nativism. [4]

UNIT-II
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status [5]

UNIT-III
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner. [7]

UNIT-IV [6]

Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.

UNIT-V [6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).

UNIT-VI [5]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.

UNIT-VII [6]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.

Text Book

1. Chaplin, T. Kraweic, T.S. Systems and Theories of psychology. Holt Rinehart and Winston.
2. Schiffman, H.R. Sensation and Perception. New York: John Wiley and Sons.

Reference Book

3. Hilgard, E.H., and Bower, G.H. Theories of Learning. Englewood Cliffs : Prentice Hall.
4. Matlin, M.W. Cognition. Bangalore : Prism.
5. Mazur, J.E.Learning and Behaviour. Englewood Cliff's : Prentice Hall.
6. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology. London : Methuen and Co.
7. Marks, M.H. and William, A. Cronan – Hillix, Systems and Theories in psychology. McGraw Hill International Editions, Psychology Series.
8. Vygotsky, L.S. Thought and Language, Cambridge, mass. MIT Press.
9. Hall C.S. :Lindzey, G. Theories of Personlaity. New York : Wiley Eastern Limited.

PL 341 Psychopathology-I **3-0-0-3**

UNIT-I [3]
Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.

UNIT-II [7]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.

UNIT-III [3]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.

UNIT-IV [5]
Diagnostic Assessment: Case History, Interview, Projective Techniques

UNIT-V [12]
Anxiety Based Disorders: Nature, Symptoms and Etiology-Generalized Anxiety Disorders, Phobia, O.C.D, Conversion Hysteria and Dissociative Disorders

UNIT-VI [5]
Psycho physiological Disorders: Nature, Symptoms and Etiology – Asthma, Peptic Ulcer, CHD, Hypertension

UNIT-VII [4]
Mental Retardation: Nature, Types, Causes and its Management

Text Book:

1. Carson, R.C.; Butcher, J.N., et al. Abnormal Psychology ; New Delhi: Pearson Education.

Reference Book

2. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior ;New Delhi: PearsonEducation Inc.
3. Davison, G.C. & Neale, J.M. Abnormal Psychology ;New York: Willy.

PL 351 Industrial and Organizational Psychology-I 3-0-0-3

UNIT-I
Industrial/Organizational Psychology: Nature, historical development and scope. [5]

UNIT-II
Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing. [9]

UNIT-III [9]
Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme

UNIT-IV [10]
Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal

UNIT-V [6]
Work environment: Noise, atmospheric conditions. Illumination and performance

Text Book

1. Blumm M.L. abdNylor, J.C.Industrial Psychology. N.Y : Harper & Row.
2. Davis. K.Human Behaviour at Work. New Delhi : Tata McGraw Hill.
3. Dunnet, M.D.Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.

Reference Book

4. Ganguli, H.C.The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.
6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour,New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A.Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.

9. Mohanty G.Industrial and Organizational Psychology New Delhi: Oxford and IBH.

PL 361 Psychological Testing-I 3-0-0-3

UNIT-I [9]
Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.

UNIT-II [9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.

UNIT-III [9]
Validity: meaning, validation procedures, and special problems.

UNIT-IV [12]
Construction and Standardization of Psychological Tests
General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S.Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L. Psychological Testing : Design, Analysis and UseBoston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods. New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B.Clinical methods in psychology. New York : Wiley inter science publication.

PL 371 Psychology Lab.-V 0-0-4-2

Assignments to be based on the course PL 311 (Social Psychology), PL 341 (Psychopathology) AND PL 351 (Industrial and Organizational Psychology).

PL 312 Social Psychology-II 3-0-0-3

UNIT-I [6]
Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.

UNIT-II [6]
Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects.

UNIT-III [6]
Attribution process Nature and theories: Kelly and Weiner.

UNIT-IV [5]
Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies

UNIT-V [5]
Propaganda: Nature, Tools and Techniques

UNIT-VI [5]
Aggression and Violence: Nature, Determinants and Management.

UNIT-V [6]
Social Change: Nature, Factors and Theories.

Text Book

1. Baron, R.A., Byrne, D. Social Psychology-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E..The Handbook of Social Psychology, Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S .Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. .Social Psychology-Tata McGraw Hill International Editions.
7. Penrod, S.Social Psychology ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Taylor, S.E. Peplau, L.A. Sears, D.O. Social Psychology -Pearson Education.

PL 322 Guidance and Counseling **3-0-0-3**

UNIT-I
Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational. [5]

UNIT-II [5]
Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.

[9]

UNIT-III
Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.

[9]

UNIT-IV
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.

UNIT-V
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling. [7]

UNIT-VI [4]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.

Text Book

1. Bernard, H.W. and Fullmer, D.W.Principles of Guidance. New York : Crowell.
2. Burnard, Philips; Counseling skills for Health Professional. Madras: Chapman and Hall.

Reference Book

3. Crow, L.D. and Crow, A.; Introduction to Guidance. New Delhi: Imersia Pub.
4. Gelso, G. J. and Fretz B.R. ; Counseling psychology, Banglore : Prism.
5. Jones, J.F. ;Principles of Guidance. NY : McGraw Hill.
6. Lynn, S.J. and Garske, J.P. Contemporary Psychotherapies, and methods. Ohio, Bell and Howell.
7. Rao, S.N. Counselling and Guidance, New Delhi : Tata MC Grw Hill.

PL 332 Experimental Psychology 3-0-0-3

UNIT-I
Experimental Psychology: Nature and History, Experimental Method

[4]

UNIT-II
Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. Perception: Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.

[9]

UNIT-III
Psychophysics: Problems and Methods of Classical Psychophysics.

[8]

UNIT-IV
Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.

[6]

UNIT-V
Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning

[5]

UNIT-VI
Verbal Learning: Methods, Materials, Organizational Processes.

[3]

UNIT-VII [4]
Discrimination Learning: Phenomena, Procedures and paradigms

Text Book

1. Bourne, L.E. Jr., Dominowski, R.L., & Loftus, E.F.Cognitive Processes. New Jersey. Prentice Hall.
2. D' Amato, M.R. Experimental Psychology. New Delhi: Tata McGraw Hill.

Reference Book

3. Flaherty, C.F. et. Al. Learning and Memory. Chicago: Rn McNally Pub.Co.
4. Gordon, W.C. Learning and Memory. California: Brooks / Cole.
5. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology.London: Methuen & Co.
6. Mazur. Learning and Behavour, New Delhi: Prentice Hall of India.
7. Snodgrass, J.G., Berger, G.L., & Haydon, M. Human Experimental Psychology, New York: Oxford.
8. Solso, R.L.Cognitive Psychology Allyn& Bacon.

PL 342 Psychopathology-II 3-0-0-3

UNIT-I

Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation. [6]

UNIT-II [10]

Mood Disorders: Unipolar and Bipolar Symptoms and Etiology

UNIT-III [11]

Schizophrenia: Nature , Symptoms , Types and Etiology

UNIT-IV

Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT [12]

Text Book

1. Carson, R.C.; Butcher, J.N., et al.. Abnormal Psychology NewDelhi: Pearson Education.

Reference Book

2. Davison, G.C. & Neale, J.M. Abnormal Psychology New York: Willy
3. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior New Delhi: Pearson Education Inc.

PL 352 Industrial and Organizational Psychology-II 3-0-0-3

UNIT-I

Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory. [7]

UNIT-II

Job Satisfaction: Concept, determinants and measurement. [5]

[6]

UNIT-III

Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.

UNIT-IV

Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents. [6]

UNIT-V [6]
Human engineering: Man-machine system. Designs, displays, controls and action.

UNIT-VI
Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions. [9]

Text Book

1. Blumm M.L. and Nylor, J.C. Industrial Psychology. N.Y. : Harper & Row.
2. Davis. K. Human Behaviour at Work. New Delhi : Tata McGraw Hill.

Reference Book

3. Dunnet, M.D. (Ed.).Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.
4. Ganguli, H.C. The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.
6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour, New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A. Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
9. Mohanty G. Industrial and Organizational psychology New Delhi: Oxford and IBH.

PL 362 Psychological Testing-II **3-0-0-3**

UNIT-I [9]
Personality Tests: Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors.

UNIT-II [9]
Projective- Rorschach and TAT.

UNIT-III [8]
Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.

UNIT-IV [6]
Measurement of aptitude and Interest

UNIT-V [7]
Measurement of Creativity- Torrance Test
Anxiety and Depression,

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S. Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L.Psychological Testing : Design, Analysis and use Boston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods ,New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B. Clinical methods in psychology. New York : Wiley inter science publication.

PL 372 Psychology Lab.-VI **0-0-4-2**

Assignments to be based on the course PL332 (Experimental Psychology), PL342(Psychopathology) and PL362 (Psychological Testing-II).

BT 271 Food Technology **2-0-0-2**

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory **0-0-2-1**

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 **Plant and Animal Biotechnology** **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 **Tissue Culture Laboratory** **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 **Medical Biotechnology** **2-0-0-2**

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. **[8]**

Microbial degradation of xenobiotics. Sewage biodegradation.

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,
2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.
4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**

(a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

(b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: **[5]**

Staphylococcus aureus, Clostridium botulinum and mycotoxins; Indices of food sanitary quality and sanitizers.

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]
2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]
3. Natural Resources: Renewable and Nonrenewable resources. [**2**]
4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]
5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]
6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. [**3**]

Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of

Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION
B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome) [6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]
Porifera: Canal system; Endoskeleton, Reproduction. [3]
Coelenterata: Nematocysts, polymorphism. [3]
Ctenophora: Affinities. [1]
Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]
Annelida: Excretion in annelids. Type study – Earthworm. [6]
Mollusca: Respiration. [1]
Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]
Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]
Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing

exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals.

Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated

dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster [6]

management – Floods, Earthquakes, Cyclones and Landslides.

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: *Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.* [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson

and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 **Mathematics and Statistics for Biology** **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

Mody University of Science and Technology

College of Arts, Science and Humanities

BSc CBZ
2017-18

Department of Science

B.Sc. CZ Biotechnology/Biochemistry/Microbiology
Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	4	25	25	50
	ZO 121	Animal Diversity Laboratory-I	-	-	2	1	4	25	25	50
		Sub Total	15	1	9	20.5				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	BT 152	Genetics	3	1	-	4	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
	PH 112	Basic Physics	2	-	-	2	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	ZO 142	Animal Diversity Laboratory-II	-	-	2	1	4	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	21	2	11	28.5				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

CW: Course Work; MTE: Mid Term Examination; ETE: End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.# Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

B.**Sc. CZ Biotechnology/Biochemistry/Microbiology**
Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	Biotechnology									
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology lab	-	-	2	1	4	25	25	50
	Biochemistry									
	BC 231	Metabolism	2	-	-	2	3	25	25	50
	Microbiology									
	MB 211	Microbial Physiology and Genetics	2	-	-	2	3	25	25	50
	MB 221	Microbial Physiology and Genetics lab	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	17	1	9/7/9	22.5/21.5/22.5				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	Biotechnology									
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	4	25	25	50
	Biochemistry									
	BC 212	Plant Biochemistry	2	-	-	2	3	25	25	50
	Microbiology									
	MB 242	Food and Industrial Microbiology	2	-	-	2	3	25	25	50
	MB 252	Food and Industrial Microbiology lab	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Sub Total	18/17/17	1	9/7/9	22.5/21.5/22.5				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ Refer to the Foreign Languages Section

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B.Sc. CZ Biotechnology/Biochemistry/Microbiology
Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	**Compulsory Courses**									
	ZO 311	Ecology and Economic Biology	3	-	-	3	3	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	4	25	25	50
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	4	25	25	50
	Biotechnology									
	BT 391	Medical Biotechnology	2	-	-	2	3	25	25	50
	Biochemistry									
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
	BC 321	Nutritional and Clinical Biochemistry Lab	-	-	2	1	4	25	25	50
	Microbiology									
	MB 351	Medical Microbiology	2	-	-	2	3	25	25	50
	MB 361	Medical Microbiology Lab	-	-	2	1	4	25	25	50
		Sub Total	16/16/16	2/3/2	5/7/7	20.5/22.5/21.5	-			
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-			

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
0Spring Semester	**Compulsory Courses**									
	BT 352	Bioinformatics	3	-	-	3	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry–VI	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	4	25	25	50
	ZO 332	Zoology Laboratory	-	-	2	1	4	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	Biotechnology									
	BC 312	Enzyme and Industrial Biochemistry	3	-	-	3	3	25	25	50
	BC 322	Enzyme and Industrial Biochemistry Laboratory	-	-	2	1	4	25	25	50
	Biochemistry									
	BC 312	Enzyme and Industrial Biochemistry	3	-	-	3	3	25	25	50
	BC 322	Enzyme and Industrial Biochemistry Laboratory	-	-	2	1	4	25	25	50
	Microbiology									
	MB 312	Microbial Ecology	2	-	-	2	3	25	25	50
	MB 322	Microbial Ecology Lab	-	-	2	1	4	25	25	50
		Sub Total	15/15/14	0	9/9/9	19.5/19.5/18.5	-			

	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

Total Credits 130/130/130

CW: Course Work; MTE: Mid Term Examination; ETE: End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.# Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

SYLLABUS FOR NEW PAPERS OF BIOTECHNOLOGY

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 Plant and Animal Biotechnology 2-0-0-2

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and **[9]**

cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Anianl Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 Tissue Culture Laboratory **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology **2-0-0-2**

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited

3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,
2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.
4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by **[7]**

calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**

(a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

(b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and **[7]**

tampeh and probiotics.

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus, Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission **[6]**

and spread of infection.

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance **[2]**

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem **[2]**

3. Natural Resources: Renewable and Nonrenewable resources. **[2]**

4. Human Population and Environment: Population Growth, World and Indian scenario. **[2]**

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. **[2]**

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. **[3]**
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION
B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 Cell Biology 3-1-0-4

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of

eukaryotic chromosome, Giant chromosome) [6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 Animal Diversity-I **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave

equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.

2. The elements of Physical Chemistry, P.W. Atkins, 4th Edition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation,

electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 General Biochemistry **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs [6]

cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon

compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond

lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy [5]

Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis.

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt.

Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy. [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition - David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology 2-1-0-3

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New

Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. **[11]**

Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213	**Inorganic Chemistry-I**	**2-0-0-2**
	Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[6]**
	Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[5]**
	Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.	**[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π^* and n-π^* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization .

of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons, Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272	**Physical Chemistry-II**	**2-0-0-2**
	Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications.	**[10]**
	Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes.	**[12]**
	Chemical Equilibrium: Equilibrium constant and free	

energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare,

Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic **[6]**

acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk and hazard associated with their use; Potential uses and applications of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc. [12]

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory. [7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture. [8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement. [8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. [8]

Gene Transfer in Plants: Agrobactrium tumefaciens and

Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods. [8]

MB 331 General Microbiology 3-0-0-3

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters. [12]

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al*.; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New Delhi.
4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation. [4]

Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium). [5]

Biofuels: Bioethanol, Biodiesel, Methanogenesis. [4]

Biopesticides: Bacterial, Fungal and Viral pesticides. [4]

Biofertilizers: Nitrogen fixing microbes and their application in crop productions. [5]

Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and pesticide biodegradation, Biobleaching of industrial effluents. [6]

Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling. [6]

Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process. [5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.
6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 Environmental Biotechnology Laboratory **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 Tissue Culture Laboratory

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 Internship **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 Genetic Engineering **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase. [6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors. [6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for [6]

selection of recombinant DNA molecules.

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing. [7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen. [6]

BT 352 Bioinformatics 3-0-0-3

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP) [5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized databanks). [7]

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X-ray crystallography), Algorithm for modeling protein folding. [5]

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 **Bioprocess Engineering** **3-0-0-3**

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation. [10]

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics. [10]

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.,), Bioprocess Engineering, Prentice Hall PTR, New Jersey.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.*
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York.

***latest edition**

BT 334 **Enzyme Technology** **3-0-0-3**

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity [12]

measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes.

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular emphasis on change in pH and hydrophobicty [8]

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of Biochemistry , MacMillian Worth Publishers, US.
2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.
3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.
4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.
5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.
6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory **0-0-2-1**

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory **0-0-2-1**

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory **0-0-2-1**

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory **0-0-2-1**

Assignments are based on the course BT 334 Enzyme Technology containing exercises on enzymes kinetics.

Mody University of Science & Technology

B.Sc. (Hons) Chemistry

Session 2017-2018

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B. Sc. (Hons.) Chemistry
(With Physics and Mathematics or Biotechnology and Zoology) Three-Year Programme
Academic Curriculum (2014 – 15 onwards)
First Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	Compulsory Courses									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	Chemistry									
	CH 181	Physical and Inorganic Chemistry -I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry -I			3	1.5	4	25	25	50
						5.5				
	Optional Courses									
	For XII PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
	Physics									
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
						7				
	Mathematics									
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
						6				
	For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
	Biotechnology									
	BT 151	Cell Biology	3	1	-	4	3	25	25	50

	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
						9				
	Zoology									
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Laboratory-I	-	-	2	1	4	25	25	50
						4	-	-	-	-
	Total Credits					20.5*/20.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Chemistry with Physics and Maths
**Chemistry with Biotech and Zoology

First Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	Compulsory Courses									
	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
						9				
	Chemistry									
	CH 182	Physical and Inorganic Chemistry-II	2			2	3	25	25	50
	CH 192	Organic Chemistry-II	2			2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II			3	1.5	4	25	25	50
						5.5				
	Optional Courses									
	For XI PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
						7				
	Mathematics									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50

					6				
For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
Biotechnology									
BT 152	Genetics	3	1	-	4	3	25	25	50
MB 331	General Microbiology	3	-	-	3	3	25	25	50
MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
					8				
Zoology									
ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
ZO 142	Animal Diversity Laboratory-II	-	-	2	1	4	25	25	50
					4				
Total Credits					27.5*/26.5**				
GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Chemistry with Physics and Maths
**Chemistry with Biotech and Zoology

Second Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn	Compulsory Courses									
	Chemistry									
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
						7.5				
	Optional Courses									
	For XII PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
	Physics									
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
						8				
	Mathematics									
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
						7				
	For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
	Biotechnology									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology lab	-	-	2	1	4	25	25	50
	BC 221	Bio-Instrumentation Laboratory	-	-	2	1	4	25	25	50
						8				
	Zoology									
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50

					4				
Total Credits					22.5*/19.5**				
	Foreign Language-I‡ (Non-credit)	3	-	-	3	3	25	25	50
GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Foreign Language-I‡ Refer to the Foreign Languages Section
*Chemistry with Physics and Maths
**Chemistry with Biotech and
Zoology

Second Year-Spring Semester

Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
	Compulsory Courses									
	Chemistry									
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
						7.5				
	Optional Courses									
	For XII PCM students: Opt Physics and Mathematics along with Chemistry as compulsory									
		Physics								
	PH 212	Mathematical Physics and Special theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
						6				
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
						7				
	For XII PCB students: Opt Biotechnology and Zoology along with Chemistry as compulsory									
		Biotechnology								
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	4	25	25	50

						8				
		Zoology								
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
						4				
	Total Credits					20.5*/19.5**				
		Foreign Language-II‡ (Non-credit)	3	-	-	3	3	25	25	50
	GE 202	Proficiency (Non-Credit) #	-	-	-	-	1	-		

: Foreign Language-II‡ Refer to the Foreign Languages Section
*Chemistry with Physics and Maths
**Chemistry with Biotech and Zoology

Third Year Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Semester Autumn	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 313	Instrumental Methods of Analysis	2	-	-	2	3	25	25	50
	CH 323	Chemistry of Polymers and Petrochemicals	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	3	25	25	50
	CH 333	Laboratory Course for Instrumental Methods of Analysis	-	-	3	1.5	3	25	25	50
	CH 343	Project$	-	-	-	5	-	100		
		Total Credits				18	-	-	-	-
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-	-	-

Total Credits: 18

$ Evaluation of project would comprise project report and viva-voce.

Third Year Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW ◄	MTE	ETE
Spring Semester	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry-VI	2	-	-	2	3	25	25	50
	CH 334	Green and Environmental Chemistry	2	-	-	2	3	25	25	50
	CH 344	Organic Reaction Dynamics, Reactive Intermediates and Photochemistry	2	-	-	2	3	25	25	50
	CH 354	Pharmaceutical Chemistry	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	3	25	25	50
	CH 364	Photochemistry and Green Chemistry Laboratory	-	-	3	1.5	3	25	25	50
	CH 374	Pharmaceutical Chemistry Laboratory	-	-	3	1.5	3	25	25	50
						16.5				

Total Credits: 16.5

Total Course Credits: 115.5*/121.5**

Sr No	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Chemistry with BT and Zoology**	20.5	22.5	19.5	19.5	18	16.5	116.5
Chemistry with Physics and Maths*	20.5	23.5	22.5	20.5			121.5

▲CW: Course Work; MTE: Mid Term Examination; ETE: End Term Examination
* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.
# Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

Detailed Syllabus
PTO.

COURSE DESCRIPTION
B. Sc. Honors Chemistry
Compulsory Courses

COURSE DESCRIPTION
B. Sc. Honors Chemistry
Compulsory Courses

PH 111 **Mechanics, Properties of Matter and Relativity** **3-0-0-3**

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 J$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int E.dr$. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 0-0-4-2

Physics Laboratory-I

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of [7]

temperature.

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with [13]

variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application)

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics

and

Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory

4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998

3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985

2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book

company, Inc.

3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics,

Waveland Press 2009

2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996

3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991

2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 **Basics of Nano-Science and Exotic Materials** **3-0-0-3**

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points. [8]

Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates. [8]

Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. [8]

Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes. [8]

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems. [7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix [13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership

project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure, Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised

Edition,Vikas Publishing House, 1992.
D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons

B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae.	[10]
Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula.	[8]
Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method.	[11]
Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods.	[10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, [9]

Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues.

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi
4. Achyut S Godbole, "Operating Systems", TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.
5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 **0-0-4-2**

Computational Numerical Analysis Laboratory

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava,

2011, RBD.

2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between **[6]**

configuration and conformation.

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and

deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics 2-0-0-2

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, [6]

Nuclear accidents and holocaust, Environmental Protection Laws in India.

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I 2-0-0-2

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors

influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 Inorganic Chemistry-I 2-0-0-2

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra **[6]**

of conjugated enes and enones.

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eu- [8]

karyotes – initiation, elongation and termination

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles **–** regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, [5]

Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-

metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U,

similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro

reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV 3-0-0-1.5

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.

4. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

7. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.

8. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.

9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.

10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.

11. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

12. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

2. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
5. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
6. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 General Biochemistry **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals.

X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
4. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

7. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
8. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D.

Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.

11. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

12. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
4. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.

5. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.

6. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.

2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi

4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.

3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on

computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: *Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.* [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson
   and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith
   G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 Animal Physiology **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control [4]

mechanism, transport of gases, respiratory pigments.

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive [5]

Differentiation.

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal

gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

3. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
4. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

5. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
7. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New

Age International.

Reference Books:

3. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
4. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – [5]

Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair.

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic [5]

movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick).

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B- [5]

lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes.

Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.

4. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

5. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.

6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.

7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

8. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
7. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV 2-0-0-2

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

3. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005,

Prentice Hall.

4. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

Mody University of Science & Technology

B.Sc. (Hons) Food And Nutrition

Session 2017-2018

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	BC111	General Biochemistry	3	-	-	3	3	25	25	50
	FN 111	Principle of Nutrition	3	-	-	3	3	25	25	50
	FN 121	Nutrition through Life	3	-	-	3	3	25	25	50
	CH 113	Chemistry-I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Lab-I	-	-	2	1	3	25	25	50
		Sub Total	17	1	6	21				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MB 331	General Microbiology	3	1	-	4	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	3	25	25	50
	FN 112	Food Science	3	-	-	3	3	25	25	50
	FN 122	Food Science laboratory	-	-	2	1	3	25	25	50
	CH 114	Chemistry-II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Lab-II	-	-	2	1	3	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Sub Total	15	2	10	22				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	FN 211	Food Safety	3	-	-	3	3	25	25	50
	FN 221	Family Nutrition	3	-	-	3	3	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Lab	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	17	1	6	21				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN 212	Public Health Nutrition	3	-	-	3	3	25	25	50
	FN 222	Food Chemistry	3	-	-	3	4	25	25	50
	FN 232	Therapeutic Nutrition	3	-	-	3	2	25	25	50
	FN 242	Nutritional Laboratory-I	-	-	4	2	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total	15	-	6	18				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester										
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
	FN 311	Maternal and Child Nutrition	3	1		4	3	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocessing Engineering Lab	-	-	2	1	4	25	25	50
	FN 321	Nutrigenomics & Personalised Nutrition	3	1	-	4	3	25	25	50
	FN 331	Nutritional Laboratory-II	-	-	4	2	4	25	25	50
		Sub Total	13	4	6	20				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-			

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester										
	MB312	Microbial Ecology	2	-	-	2	3	25	25	50
	MB322	Microbial Ecology Lab	-	-	2	1	4	25	25	50
	FN 312	Dietetics	3	1	-	4	3	25	25	50
	FN 322	Food Services Management	3	-	-	3	3	25	25	50
	FN 332	Nutraceuticals and Health Foods	3	1	-	4	4	25	25	50
	FN 342	Food quality and sensory evaluation	3	1	-	4	3	25	25	50
	FN 352	Nutritional Lab-III	-	-	4	2	4	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	80
		Sub Total	16	3	6	22				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-			

FN 111 Principle of Nutrition 3-0-0-3

UNIT-I [7]
Indian foods - Food and culture, Traditional Indian Dietary patterns and Indian ethnic cuisines, Nutritional/medicinal quality of traditional foods - Traditional food beliefs, foods in Ayurveda. Food processing technologies

UNIT-II [6]
Nutrition and Food Science – Definition, history, RDA (Recent), factors affecting RDA – Methods used for deriving RDA, Basic four/five food groups and the functions of food, Food pyramid

UNIT-III [6]
Carbohydrates – classification, functions, digestion and absorption, Sources, deficiency diseases. Role fo fibre in human Nutrition

UNIT-IV [4]
Protein – classification – functions, sources digestion and absorption, sources and deficiency disorders.

UNIT-V [4]
Lipids – Classification, functions, digestion and absorption, sources, excess and deficiency disorder

UNIT-VI [6]
Vitamins – Fat soluble vitamins A, D, E & K, functions, sources, requirements deficiency diseases. Water soluble vitamins – B like thiamine, Riboflavin, Niacin, Phridoscin, Folic acid, B2 and Vitamin C and their functions sources requirements and deficiency diseases.

UNIT-VII [6]
Minerals – Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Flourine and their functions, sources requirements and deficiency diseases.

Text Book

1. Srilakshmi. B. (2010) Nutrition Science, V Edition, New Age International Publishers, New Delhi

References:

2. Chintapalli Vidya (2004) A Text book of Nutrition, New Delhi: Discovery Publishing House
3. Gopalan. C. Ramasastry, B.V. and Balasubramanian, S.C. (1976), Nutrition value of Indian Foods, Hyderabad: National Institute of Nutrition
4. 4. Swaminathan M. (1972), Essentials of Food and Nutrition, Philadelphia: Ganesh and Company

FN 121 Nutrition through life 3-0-0-3

UNIT-I [6]
Principles of meal planning: Balanced diet, Food groups, Food exchange list, Factors effecting meal planning and food related behavior, Dietary guidelines for Indians and food pyramid

UNIT-II [3]
Nutrient requirements: Dietary Concept, Overview of methods for assessment of

nutrient needs

UNIT-III [10]

Nutrition for adulthood and old age : Adult: Nutrient requirements for adult man and woman, RDA, nutritional guidelines, nutritional concerns, diet and lifestyle related diseases and their prevention, Elderly – Physiological changes in elderly, RDA, nutritional guidelines, nutritional and health concerns in old age and their management, factors contributing to longevity

UNIT-IV [10]

Nutrition during pregnancy and lactation: Pregnancy – Physiological changes in pregnancy, RDA, nutritional guidelines, nutritional needs, effect of nutritional status on pregnancy outcome, optimal weight gain and its components, nutrition related problems in pregnancy and ways to control them, Lactation – Physiology of lactation, RDA and nutritional needs of a nursing mother, nutritional guidelines

UNIT-V [10]

Nutrition during childhood: Growth and development, growth reference/ standards, RDA, nutritional guidelines, nutritional concerns and healthy food choices - Infants - Preschool children - School children – Adolescents

Text Book

1. Barrer. K. (2007) Basic Nutrition Counseling Skill Development Wadaworth Pub. Co.

References

2. Bendich. A. (1997) Preventive Nutrition Humana Press
3. Blackwell Scientific Publication. (1994). Manual Of Dietetic Practice.2nd ed.
4. British Nutrition Foundation. (1999). Obesity. Blackwell Science Pub.
5. Brown. J. (2002). Nutrition Through The Lifecycle. Wadsworth Pub Co.
6. Gable. J. (1997) Counselling skills for Dietitians, Blackwell Publishing House
7. Garrow .J.S (1993). Human Nutrition and Dietetics, 9th ed., Churchill Livingstone Pub.
8. Gibney, J. M. (2005). Clinical Nutrition. Blackwell Publishing House.
9. Gopalan .C.(2000). Nutritive Value of Indian Foods. NIN ICMR Pub.
10. ICMR Pub. (2000). Nutrient Requirement and Recommended Dietary Allowances for Indians

FN 112 Food Science 3-0-0-3

UNIT-I [10]

Cereals and Cereal Products: Structure Nutritive value of rice, wheat, maize and locally available millets, Enrichment and fortification. Batters and Doughs; Milling and parboiling; Malting of cereals. b. Pulses and Nuts : Composition and Nutritive value, factors affecting cooking quality of pulses, germination of whole grams.

UNIT-II [5]

Vegetables and Fruits – classification, Nutritive value, changes during cooking of vegetables, changes during ripening of fruits. Storage

UNIT-III [12]

Milk & Milk Products: Composition and Nutritive value, Different types of milk products; pasteurization of milk. b. Egg: Structure, Composition and Nutritive

value. Measure of quality, factors affecting foam formation, uses of egg in cookery. Home preservation and storage. c. Fleshy Foods: Composition and Nutritive value of meat, fish and poultry selection and storage – Effect of cooking on colour, texture and flavour. Factors affect tenderness.

UNIT-IV [12]

Fats & Oils : Composition and Nutritive value of common fats and oils, and reuse of oils, smoking temperature, rensidity of fat, absorption. b. Beverages : Classification, Nutritive value – Coffee, Tea, Cocoa, milk based fruit juices, aerated and alcoholic beverages. c. Spices and Condiments : Types, uses in Indian cookery

Text Book

1. Swaminathan, M. (6th Edition) Hand Book of Food Science and Experimental Food Text.

References:

2. Hughes and Benion, (1970), Introductory Foods.. McMillan Publishing Company.
3. Peckham, C.G. (1969) Foundation of Food Preparation, McMillan Publishing Company
4. Swaminathan, M. (1976) Essentials of Food and Nutritive Vol.I Bangalore Printing
5. 5. Potler, N. 5th Edition, Food Science. New York : Chapman & Hall

FN 122 Food Science laboratory 0-0-2-1

Experiments based on the contents of FN 112

CH 113 Chemistry - I 3-0-0-3

UNIT-I [6]

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

UNIT-II [8]

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. *Critical Phenomena:* PV isotherms of real gases; continuity of states, the isotherms of Van der Waals equation, relationship between cirtical constants and Vander-Waals constants, reduced equation of state.

UNIT-III [10]

Mechanism of Organic Reactions: homolytic and heterolytic bond cleavage. Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Mechanisms of nucleophilic substitution SN1 and SN2. Reactive intermediates - carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Methods of determination of reaction mechanism.

UNIT-IV [5]

Periodic Properties : Atomic and ionic radii, ionization energy, electron affinity

and electronegativity - definition, methods of determination of evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT-V [10]

Stereochemistry of Organic Compounds : Optical Isomerism- Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, chiral and achiral molecules with two stereogenic centres, diastereomers, resolution of enantiomers, inversion, retention. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature, geometric isomerism in oximes and alicylic compound. Conformational isomerism: Conformational analysis of ethane, propane and n-butane by the Newman projection.

Text Book:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI.

References

2. Malik, W.U., Tuli G.D. and Madan R.D. (2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
3. Puri, Sharma and Pathani (2013) Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
4. Stanley H Pine, Organic Chemistry, 5th Edition, Tata McGraw-Hill.
5. Mukherjee, S.M. and Singh, S.P. 3rd Edition; Reaction Mechanism in Organic Chemistry, Macmillan India Limited.

CH 123 Chemistry Laboratory-I 0-0-2-1

The laboratory experiment will be based on the theory paper CH 113

CH 114 Chemistry - II 3-0-0-3

UNIT-I [9]

Chemical Bonding: Covalent Bond: Valence bond Theory, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, concept of multicentric bonding, percentage ionic character. Ionic Solids: Ionic structures, radius ratio effect and coordination number, lattice energy and Born haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

UNIT-II **[9]**

S and p Block Elements: S-Block elements- Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies. P-Block Elements -Comparative study of groups 13-18 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron- diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride. Structure of Xenon compounds.

UNIT-III **[7]**

Chemical Kinetics and Catalysis: Chemical kinetics and its scope, rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half-life and Radioactive decay as a first order phenomenon. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, collision theory, transition state theory. Catalysis & types of catalysis,

Mechanism of catalysis, Enzyme catalysis

UNIT-IV **[6]**

Alkanes and Cycloalkanes: Classification of carbon atoms in alkanes, isomerism, sources, methods of formation (with special reference of Wurtz reaction, Kolbe reaction, Corey house reaction and decarboxylation of carboxylic acids). Physical properties and chemical reaction of alkanes.

[8]

UNIT-V

Alkenes and Alkynes: Nomenclature, preparation and reactions of alkenes, Saytzeff and Hofmann elimination, Mechanisms of hydrogentation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization. Chemical reaction of alkynes, mechanism of electrophilic and nucleophilic addition reaction, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.

Text Book

1. Bahl, A. and Bahl, B. S.: A Textbook of Organic Chemistry, S. Chand and Co. Ltd. New Delhi.

References

2. Puri, Sharma and Pathania (2013): Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
3. Malik, W.U., Tuli G.D. and Madan R.D.(2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
4. Morrison, R. T. and Boyd R. N. 6th Edition. Organic Chemistry, Prentice Hall, Englewood Cliffs, New Jersey.
5. R.K. Bansal; Organic Reaction Mechanisms, 3rd Ed., Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

CH 124 Chemistry Laboratory-II **0-0-2-1**

The laboratory experiment will be based on the theory paper CH 114

FN 221 Family Nutrition **3-0-0-3**

UNIT-I [7]

Principles of Nutrition - Nutrients and their functions. Food groups, meal planning, RDA, Over nutrition, under nutrition, malnutrition.

UNIT-II

Nutrition during Pregnancy and Lactation. Importance of Nutrition during pregnancy. Complications in pregnancy, food and nutritional requirements for lactating women. [8]

UNIT-III

Nutrition for Infants and Preschoolers Importance of breast milk, food and nutritional requirements for infants, weaning and supplementary foods for infants, food habits of preschoolers, nutritional requirements for preschool children. [8]

UNIT-IV

Nutrition for School Age and Adolescents. Nutritional requirements for school going children and adolescents, factors influencing food intake, nutritional disorders. [8]

UNIT-V

Nutrition during Adulthood and Old age. Food and nutritional requirements for adults. Importance of nutrition during old age, factors influencing food intake, nutritional requirements, nutritional problems and management of old age [8]

Text Book:

1. Gopalan, C. and Balasubramanian, B.C.Diet Atlas of India, NIN, Hyderabad, 1971.
2. Gopalan, C.Ramasastry, B.V. and Balasubramanian, S.C. Nutritive value of Indian foods, NIN, Hyderabad, 1976. 24

Reference:

3. Margaret Mc.Williams, "Food Fundamentals" John Wiley and Sons, London, 1974.
4. Swaminathan, M.Essentials of Food and Nutrition Vol.I& II BAPPCO., The Bangalore Printing and Publishing co., ltd., No.88, Mysore Road, Bangalore.

FN 211 Food Safety 3-0-0-3

UNIT-I [4]

Introduction to Food Safety

Definition, Types of hazards, biological, chemical, physical hazards Factors affecting Food Safety ,Importance of Safe Foods

UNIT-II [5]

Food Hazards of Physical and Chemical Origin

Introduction ,Physical Hazards with common examples ,Chemical Hazards(naturally occurring ,environmental and intentionally added , Packaging material as a threat ,Impact on health ,Control measures

UNIT-III [5]

Food Hazards of Biological Origin

Introduction ,Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes ,Seafood and Shell fish poisoning , Mycotoxins

UNIT-IV [4]

Management of hazards

Need ,Control of parameters ,Temperature control, Food storage

UNIT-V [5]

Hygiene and Sanitation in Food Service Establishments

Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal ,Pest and Rodent, Control Personnel Hygiene

UNIT-VI [4]

Food Safety Management Tools

Basic concept Prerequisites- GHPs, GMPs, HACCP ISO series TQM - concept and need for quality, components of TQM, Kaizen. Risk Analysis Accreditation and Auditing

UNIT-VII [5]

Microbiological criteria

Microbiological standards and limits (for processed food, water) Sampling Basic steps in detection of food borne pathogens Water Analysis

UNIT-VIII [3]

Food laws and Standards

Indian Food Regulatory Regime Global Scenario Other laws and standards related to food

UNIT-IX [4]

Recent concerns

New and Emerging Pathogens Genetically modified foods \ Transgenics Organic foods Newer approaches to food safety

Text Book

1. Lawley, R., Curtis L. and Davis,J. The Food Safety Hazard Guidebook , RSC publishing, 2004
2. De Vries. Food Safety and Toxicity, CRC, New York, 1997

Reference:

3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000
5. Forsythe,S.J.The Microbiology of Safe Food , second edition, Willey-Blackwell,U.K.,2010

FN 212 Public Health Nutrition 3-0-0-3

UNIT-I [8]

Concept of public health nutrition- relationship between health and nutrition, role of public health nutritionists in the health care delivery. Public health and nutrition policies- plan of action and programs.

UNIT-II [6]

Food and nutrition security- food production, distribution, access, availability and consumption. Socio cultural aspects and dietary patterns: their implication for nutrition and health.

UNIT-III [4]

Health care facility- primary health care of the community, health care delivery system.

UNIT-IV [10]

Determinants of nutrition and health status- socio cultural, biologic, environmental and economic factor, indicators of health and malnutrition. Economics of malnutrition- impact on productivity and national development. Socio demographic, health and nutrition transitions

UNIT-V [11]

Approaches and strategies for improving nutritional status and health: national and international contributions, role of government and non-government organizations. Case studies of selected strategies and programs: their rationale and context- health based, intervention, food based interventions including fortification, genetic improvement of foods, supplementary feeding, and nutrition education for behavior change

Text Book

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers

Reference:

2. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill..
3. Sethi P and lakra P Aahaarvigyaan ,Poshanevam Suruksha, Elite Publishing house, 2015
4. Khanna K et al. Textbook of Nutrition and Dietetics;2013; Phoenix Publisher.

FN 222 Food Chemistry 3-0-0-3

UNIT-I [9]

Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam.

UNIT-II [8]

Carbohydrates:Monosaccharides,Oligosaccharides,Polysaccharides,Starch,Cellulose,Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber

UNIT-III [7]

Lipids: Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids.

UNIT-V [7]

Amino Acids, Peptides and Proteins: Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein.

UNIT-VI [8]

Food colorants: pigments in animal and plant tissues. Flavors: Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances.

Text Book

1. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.

Reference:

2. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
3. Fennema, O.R, 2006, Food Chemistry, Academic Press.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. Food Chemistry. Marcel Dekker.

FN 232 Therapeutic Nutrition 3-0-0-3

UNIT-I

Diet in Cardiovascular diseases : Aetiology, Symptoms, Risk factors, pathophysiology, dietary management and prevention of Atherosclerosis, Coronary Artery Disease, Myocardial Infarction, Ischemic Heart Disease, Rheumatic Heart Disease(RHD), Congestive Cardiac Failure (CCF), Hypercholesterolemia, Hypertension – classification, sodium restricted diet, dangers of severe sodium restriction [16]

UNIT-II

Diet in Diseases of Liver and Gall Bladder: Aetiology, Symptoms, Dietary treatment in Jaundice, Hepatitis, Pancreatitis, Cirrhosis, Hepatic Coma. Role of food and alcohol in developing liver diseases. Biliary Tract Diseases- Cholecystitis Cholelithiasis and Choled ocholithiasis [8]

UNIT-III

Diet in Renal disease: Causes, Symptoms and dietary management in Nephritis, Nephrosis, Acute and chronic renal failure, Renal calculi, Acid and alkali producing foods, End Stage Renal Diseases (ESRD), Dialysis. [7]

UNIT-IV

Diet in Cancer: Tumor markers and their applications, Types of cancer, Risk factors, Symptoms, Metabolic alterations and Nutritional problems of cancer and cancer therapy, Medical Nutrition Therapy, Role of food in prevention of cancer. [8]

Text Book

1. Kumar .P. Clark M (2005) , Clinical Medicine, 6th Edition, Elsevier Saunders Publishing Co.

Reference:

2. Gibney M J., Elia.M, Lingqvist. O (2005),Clinical Nutrition, Blackwell Science publishing Co.
3. Guthrie, H.A and Picciano, M.F, (1995), Human Nutrition, Mosby Publishing Co, New York.
4. Kris Etherton.P and Burus J.H.(1998), Cardiovascular Nutrition, American Dietetic Association ,Chicago, Illinosis.

FN 242 Nutritional Laboratory-I 0-0-4-2

Experiments based on the contents of FN 212, FN 222 and FN 232

FN 311 Maternal And Child Nutrition 3-1-0-4

UNIT-I [13]

Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth outcome. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT-II [10]

Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and counselling

UNIT-III [10]

Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality, IMR and U5MR; link between mortality and malnutrition;

UNIT-IV [6]

Overview of maternal and child nutrition policies and programmes.

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s Banarasidas Bhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 321 Nutrigenomics & Personalised Nutrition 3-1-0-4

UNIT-I [6]

Introduction. Concept of functional genomics, systems biology, nutrigenomics, nutrigenetics, personalised nutrition

UNIT-II [13]

Molecular biology and genomics: Nutritional requirements and metabolic responses at cellular level, Impact of a changing nutrient environment, Introduction to molecular diagnostics: nutrients influences on genomes

UNIT-III [9]

Diet and gene expression: nutrients as regulators of activity and transcription factors. Nutrients as epigenetic exchange agents.

UNIT-IV [11]

Diet in early life and metabolic programming. V Diet as a possible risk or preventive factor in illnesses. Gene polymorphisms and responses to diet. Examples related to cardiovascular disease, cancer, osteoporosis. Risk/benefit biomarkers

Text Book

1. Principles and Applications by FransKok, Laura Bouwman, Frank Desiere, CRC press

R**eference**:

2. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition by Lynnette R. Ferguson, CRC press

FN 331 Nutritional Laboratory-II 0-0-4-2

Exercises based on Courses BC 311, FN 311 and FN 321

FN 312 Dietetics 3-1-0-3

UNIT-I [3]
Concept of Diet therapy: growth and source of dietetics, purpose and principles of therapeutic diets, modification of normal diet, classification of therapeutic diets.

UNIT-II [3]
Role of Dietician: Definition of nutritional care, interpersonal relationship with patient, planning and implementary dietary care, Team approach to nutritional care.

UNIT-III [6]
Diet in surgical conditions, burns and cancer.
Obesity and leanness- causes, complication and health effects, dietary treatment and other recommendation

UNIT-IV [3]
Diet in fever and infections- Types- metabolism in fever, general dietary consideration diet in influenza, typhoid fever, recurrent malaria and Tuberculosis.

UNIT-V [3]
Diet in gastritits, peptic ulcer- symptoms, clinical findings, treatment, dietary modification, adequate nutrition, amount of food, and intervals of feeding, Chemically and mechanically irrigating foods, four stage diet (Liquid, soft, convalescent, liberalized diet).

UNIT-VI [3]
Diet in disturbances of small intestine and color. Diarrhoea- (child and adult)- classification, modification of diet , fibre, residue. Fluids & nutritional adequacy. Constipation- flatulence - dietary considerations. Ulcerative colitis (adults) - symptoms, dietary treatment. Spruce, coeliac disease- disaccharide intolerance, dietary treatment.

UNIT-VII [6]
Diet in diseases of the liver, gall bladder and pancreas, a) Etiology, symptoms and dietary treatment in - Jaundice, hepatitis, cirrhosis and hepatic coma. b) Role of alcohol in liver diseases. c) Dietary treatment in cholecystitis, cholelithiasis and pancreatitis. Gout- Nature and occurrence of uric acid, causes, symptoms and diet.

UNIT-VIII [3]
Diet in allergy and skin disturbances: Definition, classification, manifestations, common food allergies and test and dieteric treatment.

UNIT-IX [3]
Diet in Diabetes mellitus: a) Incidence and predisposing factors. b) Symptoms-types and tests for detection. c) Metabolism in diabetes d) Dietary treatment & meal management e) Hypoglycemic agent, insulin and its types. f) Complication of diabetes.

UNIT-X [3]
Diet in Renal diseases: Basic renal function, symptoms and dietary treatment in acute and chronic glomerulonephritis, Nephrosis, renal failure, dialysis. Urinary calculi-causes & treatment, acid and alkali producing and neutral foods and dietary treatment.

UNIT-XI [3]
Diet in Cardiovascular diseases: Role of nutrition in cardiac efficiency, incidence of Atherosclerosis, dietary principles, Hyperlipidenmia, Hypertension- causes and dietary treatment, Sodium restricted diet, level of sodium restriction, sources of sodium, danger of severe sodium restriction.

Text Book

1. Antia P. Clinical Dietetics and Nutrition, 2nd edition, Oxford University press.

Reference:

2. Garrrow J.S, James W. P.T, Ralph A, (2000), Human Nutrition and Dietetics, 10th edition, Churchill Livingston, London.
3. Guthrie H. A, Picciano M. F (1995), Human Nutrition, Mosby, St. Louis Missorie.

FN 322 Food Service Management 3-0-0-3

UNIT-I [6]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel

UNIT-II [6]

Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules. Theories about approaches to food service management

UNIT-III [10]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-IV [9]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance. Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of Kitchen records.

UNIT-V [8]

Financial management – Budgeting, costing and cost control, accounting. 8. Hygiene and sanitation in preparation and serving area – Personal hygiene, types and sources of contamination, prevention and safety measures. Methods of controlling infestation. Methods of dish washing.

Text Book:

1. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.

Reference:

2. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.
3. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.

FN 332 Neutraceuticals and Health Foods 3-1-0-3

UNIT-I

Nutraceuticals: (a) Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases (b) Definition, Classification, food and non-food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [13]

UNIT-II

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [8]

UNIT-III

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [9]

UNIT-IV

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India [9]

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s BanarasidasBhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 342 Food Quality And Sensory Evaluation 3-1-0-3

UNIT-I [4]

Introduction to quality attributes of food, Appearance, flavour, textural factors and additional quality factors

UNIT-II [10]

Gustation: introduction and importance of gustation, Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands. Mechanism of taste perception Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami, Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold, Taste measurement- Electronic Tongue, Taste abnormalities

UNIT-III [10]

Olfaction: Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Theories of odour classification, chemical specificity of odour. Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc. Olfactory abnormalities

UNIT-IV [5]

Colour: Introduction and importance of colour, Dimensions of colour and attributes of colour; gloss etc. Perception of colour. Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, etc. Colour abnormalities

UNIT-V [10]

Texture: Introduction, definition and importance of texture, Phases of oral processing, Texture perception, receptors involved in texture perception, Rheology of foods Texture classification, Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation. Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products

Text Book

1. Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.

Reference:

2. Rao E. S. (2013). Food Quality Evaluation. Variety Books.
3. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.

FN 352 Nutritional Lab-III **0-0-4-2**

Exercises based on Courses FN 312,FN 322, FN 332 and FN 342

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT-I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT-II

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital [8]

UNIT-III

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports [8]

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference:

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

Mody University of Science & Technology

B.Sc. (Hons) Forensic Science
Session 2017-2018

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 151	Cell Biology	3	1	-	4	2	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	25	25	50
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	2	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	2	25	25	50
	FS 101	Introduction to Forensic Science and Criminology	2	1	-	3	3	25	25	50
	EL 101	Foundation Course in English	2	-		2	3	25	25	50
	FS 131	Criminal Law-IPC/CrPC/IEA	2	1	-	3	3	25	25	50
	FS 141	Trace Evidence Analysis	3	-	-	3	3	25	25	50
	FS 151	Trace Evidence Analysis in Lab	-	-	2	1	3	25	25	50
			16	**3**	**7**	**22.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 152	Genetics	3	1	-	4	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	3	25	25	50
	FS 102	Concepts of Physics in FS	2	-	-	2	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
	FS 132	Crime Scene Investigation	2	1	-	3	3	25	25	50
	FS 142	Crime Scene Investigation Practical	-	-	4	2	3	25	25	50
		Sub Total	**15**	**2**	**7**	**20.5**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	3	25	25	50
		Foreign Language-I	3		-	3	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	3	25	25	50
	FS 231	DNA Profiling	2	1	-	3	3	25	25	50
	FS 241	DNA Profiling Lab	-	-	2	1	3	25	25	50
	FS 251	Forensic Anthropology and Personal Identification	2	1	-	3	3	25	25	50
	FS 261	Forensic Anthropology Practical	-	-	2	1	3	25	25	50
		Sub Total	**16**	**3**	**9**	**23.5**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 232	Forensic Toxicology	3	1	-	4	3	25	25	25
	FS 242	Forensic Toxicology Practical	-	-	2	1	3	25	25	25
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	3	25	25	50
		Foreign Language-II	3	-	-	3	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	25
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	3	25	25	50
	FS 252	Fingerprint Science	2	1	-	3	3	25	25	50
	FS 262	Fingerprint Science Practical	-	-	2	1	3	25	25	50
		Sub Total	**16**	**2**	**9**	**22.5**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 371	Forensic Serology and Blood Splatter Analysis	2	1	-	3	3	25	25	50
	FS 381	Serology Practical	-	-	2	1	3	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	3	25	25	50
	FS 391	Digital Forensics	2	1	-	3	3	25	25	50
	FS 313	Digital Forensics Practical	-	-	2	1	3	25	25	50
	FS 323	Programing in C++	2	1	-	3	3	25	25	50
	FS 333	Programing Lab in C++	-	-	4	2	3	25	25	50
	FS 343	Forensic Photography, Digital Imaging and Portrait Parley	3	1	-	4	3	25	25	50
	FS 353	Digital Imaging Lab	-	-	2	1	3	25	25	50
			12	**5**	**12**	**23**	-			
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 372	Instrumentation in Forensic Science	2	1	-	3	3	25	25	50
	FS 382	Instrumentation Practical	-	-	2	1	4	25	25	50
	FS 392	Wildlife Forensics	2	1	-	3	3	25	25	50
	FS 314	Multimedia Forensics	2	1	-	3	3	25	25	50
	FS 324	Questioned Document Examination	2	1	-	3	3	25	25	50
	FS 334	Questioned Document Examination Practical	-	-	2	1	3	25	25	50
	BT 352	Bioinformatics	2	1	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	FS 344	Forensic Ballistics and Toolmarks	2	1	-	3	3	25	25	50
	FS 370	SUMMER INTERNSHIP*				4		100		
		Sub Total	**12**	**6**	**6**	**25**	-			
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

Total = 137

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.#* Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

*Each student will be required to submit a report based on a week long attachment they would be provided after 2 years of their course at any Central/State Forensic Science Laboratory. Weightage would be 100 marks.

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)

FIRST SEMESTER

CELL BIOLOGY

BT 151 **3-1-0-4**

CELL BIOLOGY LAB

BT 161 **0-0-1-1**

PHYSICAL AND INORGANIC CHEMISTRY-1

CH 181 **2-0-0-2**

ORGANIC CHEMISTRY-I

CH 191 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-I

CH 171 **0-0-3-1.5**

INTRODUCTION TO FORENSIC SCIENCE AND CRIMINOLOGY

FS 101 **2-1-0-3**

Course Contents:

Unit I: Types of Crime and Criminal Behavior [9]

Definition: Crime, Criminal and Criminology; Criminology as Science, The field and scope of Criminology; Methods and Techniques in Criminology; Concept of a criminal and classification of criminals. Organized crime; White – collar crimes/ Occupational crimes; Murders; Sexual offences; Terrorism; Serial Crimes; Crime against women and children.

Unit II: Juvenile Delinquency and Punishment [10]

Definition, Types of Juvenile Delinquents ; Classification of Juvenile Delinquents; Factors in Juvenile Delinquency, Custody of juvenile delinquents; Juvenile courts procedure; behavior modification techniques; Preventive Programmes. Concept of punishment, kinds of punishments, Humanitarian approach to concept of punishment, capital punishment in India, Introduction to criminal Laws: IEA, IPC and CRPC

Unit III: Police Administration [10]

Role of police in regard to criminals; Police role in the society; Custodial crimes: Complaints against police personnel; Interrogation of suspects and offenders; interviewing the criminals; improving the Police force. Evidence Applicability in Court**;** Definition, Various types of evidences, the law of evidence, Expert's testimony and admissibility of scientific evidence in court of Law.

Unit IV: Introduction to FS and History [10]

Definition, description, principles, concept, needs and scope. History of Forensic Science and Forensic Science Labs; Progressive development and transformation of Forensic Science Labs. Forensic Science Laboratories: Main Authority, Organizational structure of Forensic Science Laboratory – roles and responsibilities, Sections/ Divisions, Services

Provided. Mobile forensic science laboratory – their distribution in India, functions, need and utility.

Text:

1. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

1. Ellis, L. and Walsh, Anthony, Criminology – A Global Perspectiven, Allyn and Bacon, Boston, 2000.
2. Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.
3. Abaadinsky, H., Organised Crime (2nd Edn.), Nelson – Hall, Chicago, 1998.
4. Adler, F., Mueller, G. O. W. and Laufer, W. S., Crminology, McGraw – Hill, Boston, 1991.
5. Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rd Edn.), Oxford University Press, Oxford, 2002.
6. Ahuja, R., Criminology, Rawat Publication, ND, 2000.
7. Bajpai, G. S., Development without Disorders. Vishwavidyala, Prakashan, Sagar (M. P.), 2002.
8. Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rd Edn.), Oxford University Press, Oxford, 2002.
9. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
10. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; an Introduction to Criminalitics, McGraw Hill, New York, 1983.
11. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
12. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
13. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida, 1999.

FOUNDATION COURSE IN ENGLISH

EL101 **2-0-0-2**

CRIMINAL LAW-IPC/CrPC/IEA

FS 131 **2-1-0-3**

Unit I: Indian Penal Code [13]
Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b) Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), Sections pertaining to poisons; General exceptions, Offences against person, Offences against property, Attempt to suicide, Sexual offences.

Unit II: Criminal Procedure Code [13]
Code of Criminal Procedure- Introduction, organization and powers of Criminal Law Courts in India, Police powers of arrest, search and seizure; Introduction and general idea of sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176.

Unit III: Indian Evidence Act [13]
Indian Evidence Act-Admissions, Confessions, Dying Declarations. Of Experts, Oral and Documentary Evidence; Introduction and general idea of sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159.

Text:

1. Criminology by Ram Ahuja

References:

1. Criminology and Penology by Prof Panjape N.V.
2. Introduction to forensic Science by Dr. B.S.Naber.
3. Synopsis of Forensic Medicine by Dr.K.S.Narayan Reddy.
4. Police and Polity in India by P.D.Sharma.
5. Karnataka Police Manual.
6. Criminal Major Acts Eastern Law Publications, Allahabad.

TRACE EVIDENCE ANALYSIS

FS 141 **2-1-0-3**

Course Contents:
Unit I: Introduction of Physical Evidences [9] Definition, Collecting, packaging, preservation and forwarding of evidences: biological fluids, chemicals, poisons, firearms, fingerprints and tool marks; Linking a Crime Scene with the suspect through field notes, witnesses and interrogation, Reconstruction of crime scene and associative/ corroborative evidences.
Unit II: Crime and Suspect [10] Search and seizure, privilege against self – incrimination, subpoenas deposition, Miranda rights, condemned of court, FIR, types of cognizable and non-cognizable offences; Expert's Testimony: the role of the expert as witness; Acceptance of evidence in the Court of Law; Mcnaughton Rule; child witness in the court, admissibility of scientific evidence; Expert Testimony: The role of the expert as witness; Acceptance of evidence in the Court of Law; Mcnaughton Rule; child witness in the court, admissibility of scientific evidence; Examination in the Court: Direct examination, cross – examination and re-examination of Prosecution lawyer and Defense lawyer and Court presentation, Law of evidence: testimonial and real evidence.
Unit III: Glass and Soil Examination [10] Glass: Composition, Comparing glass fragments, glass fractures. Examination of soil, Color, density, size distribution of soil particles, mineral analysis and chemical analysis of soil, collection of preservations of soil. Analysis Techniques-Physical, Chemical, instrumental
Unit IV: Forensic Paint Examination [5] Introduction, paint chemistry, forensic examination of household paints and automobile paints. Analysis Techniques-Physical, Chemical, instrumental
Unit V: Forensic Examination of Hair and Fiber [5] Examination of Hair; Importance, nature, location, collection, evaluation; Classification of fibers, preliminary examination, properties of fiber, microscopic and chemical examination of fibers. Analysis Techniques-Physical, Chemical, Instrumental

Text:

1. Saferstein, Richard, Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2. Sharma, B.R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd., New Delhi, 2001.

References:

1. Bodziak, W., Footwear Impression Evidence (2nd Ed.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
4. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
5. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida. 1999.
6. Heard, B. J., Handbook of Firearm and Ballistics, Wiley & Sons, Chichester, England, 1997.

7. James, S. H., and Nordby, J. J., (Edt), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

TRACE EVIDENCE ANALYSIS IN LAB

FS 151 **0-0-2-1**

1. Physical Analysis of Glass-Density
2. Physical Analysis of Glass-RI
3. Physical Analysis of Soil-Density
4. Analysis of Microscopic Glass Chip
5. Microscopic Examination of Hair
6. Microscopic Examination of Fiber
7. Fabric Count
8. Instrumental analysis of Paint Chip
9. Instrumental analysis of Paint Smear
10. Microscopic Examination of Paint Chip

SECOND SEMESTER

GENETICS

BT 152 **3-1-0-4**

PHYSICAL AND INORGANIC CHEMISTRY-II

CH182 **2-0-0-2**

ORGANIC CHEMISTRY

CH 192 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-II

CH 172 **0-0-3-1.5**

CONCEPTS OF PHYSICS IN FS

FS 102 **2-0-0-2**

Course Contents
Unit I: Motion & Force Definition of motion, position and displacement, average velocity, average speed, acceleration, acceleration of freely falling body, projectile motion, uniform circular motion, relative motion in one dimension and two dimension. Newtonian mechanics, Newton's Ist law, force, mass, Newton's II law, Newton's III law, friction, properties of friction, drag force and terminal speed.
Unit II: Kinetic Energy and Work Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, work done on system by external force, conservation of energy.
Unit III: Rotation The rotational variable, rotation with constant angular acceleration, relating linear and angular variables, kinetic energy of rotation.
Unit IV: Gravitation and Waves Newton's law of gravitation, gravitation near earth's surface, gravitation inside the earth. Types of waves, transverse and longitudinal waves, wavelength and frequency, speed of traveling wave, the wave equation, sound waves, speed of sound, intensity and sound level, the Doppler effect, shock waves.

Text:

1. Herbert Goldstein: Classical Mechanics, 2nd ed, 1980

References:

1. Amato, Joseph (December 1996). "The introductory calculus-based physics textbook". Physics Today 49 (12): 46–51.
2. Thomas Brody (1993.) "The Philosophy Behind Physics"pp 18–24 (Chapter 2)
3. Glimm, James; Jaffe, Arthur (1987), 'Quantum physics: a functionalintegral point of view'(2nd ed.), New York, [NY.]: Springer.

ENVIRONMENTAL STUDIES

MDC 003 **3-1-0-4**

CRIME SCENE INVESTIGATION

FS 132 **2-1-0-3**

Course Contents:
Unit I: Crime Scene [9] Defining a crime scene, Importance, problem, location and processing of Crime Scene and Crime scene Management.
Unit II: Types of Crime Scenes [8] Mobile, Indoor and outdoor crime scenes; various searching techniques used for locating physical evidences at scene of crime.
Unit III: Recording the Scene of Crime [5] Barricading of crime scene; Crime Scene Photography; Sketching; Notes making; Handling clues and evidences.
Unit IV: Crime scene reconstruction [5] Procedure and requirement for Crime Scene Reconstruction; Guidance from field notes; Modus operandii, role of Investigating Officer.
Unit V: Physical Evidences [12] Definition, types of physical evidences, Collection, packaging, preservation and forwarding of physical evidences, Chain of custody.

Text:

1. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

References:

1. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press,

CRIME SCENE INVESTIGATION PRACTICAL

FS 142 **0-0-4-2**

1. Crime Scene Processing
2. Crime Scene Searching
3. Indoor Crime Scene-Baseline Method
4. Outdoor Crime Scene-Baseline Method
5. Indoor Crime Scene-Triangulation Method
6. Outdoor Crime Scene-Triangulation Method
7. Outdoor Crime Scene- Polar Coordinate Method
8. Packing and Packaging of Evidence

THIRD SEMESTER

BIO-INSTRUMENTATION

BC 211 **3-1-0-4**

INSTRUMENTATION LABORATORY

BC 221 **0-0-2-1**

FOREIGN LANGUAGE-I

ORGANIC CHEMISTRY-III

CH 223 **2-0-0-2**

PHYSICAL CHEMISTRY-I

CH 291 **2-0-0-2**

INORGANIC CHEMISTRY-I

CH 213 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-III

CH 281 **0-0-3-1.5**

DNA PROFILING

FS 231 **2-1-0-3**

Course Contents:
Unit I: Introduction to DNA Fingerprinting [6] Definition, Importance of DNA Fingerprinting in Forensic Science., Structure of DNA, RNA, Chromosome, Nuclear DNA and Mitochondria DNA
Unit II: DNA Isolation Techniques [5] Collection and types of evidences for DNA fingerprinting, Different types of DNA Isolation techniques (Organic, Inorganic and Mechanical), FTA cards for isolation of DNA. DNA isolation from different evidences.
Unit III: Techniques for DNA Fingerprinting [10] Electrophoresis and Southern blotting, Polymerase Chain Reaction (Denaturation, annealing and extension, Detection of PCR products).
Unit IV: Types of DNA Fingerprinting Techniques [10] Mini satellites and Micro-satellites., VNTR and RFLP, STRs and Genotyping.
Unit V: Practical application of DNA Fingerprinting [8] Paternity testing and Personal identification. DNA databank, Limitations of DNA Fingerprinting; Legality of DNA Fingerprinting in India.

Text:

1. Sharma, B. R. (3rd Edition) Forensic Science in Criminal Investigation and Trials, Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

2. Norah Rudin and Keith Inman (2nd Edition) An Introduction to Forensic DNA Analysis, CRC Press, New York, 2002.

3. John M. Butler (1st Edition) Fundamentals of Forensic DNA Typing, Academic Press, 2005.

DNA PROFILING LAB

FS 241 **0-0-1-2**

1. Isolation of Plasmid and Genomic DNA
2. Restriction Digestion
3. DNA Fragment Size Détermination
4. PCR Demonstration and Principal
5. DNA Estimation through Spectroscopy
6. Isolation of Microbes through Soil, Air and Water Samples
7. Study of Bacterial Slides

FORENSIC ANTHROPOLOGY and PERSONAL IDENTIFICATION

FS 251 **2-1-0-3**

Unit I: Anthropology and Personal Identification [9] Definition, scope and application of Forensic Anthropology; and related sciences. Human and animal remains; Reconstruction Process: Superimposition, Facial reconstruction and its importance; Importance and need for personal identification, cases that will require personal identification. Documents proof, scars, professional marks, personal articles, Finger printings, dentures, sketches and photographs
Unit II: Victim Identification [10] Assessing and determining the time and cause of Death, Study of burned bones and bone fragments; Attribution of Sex, Estimation of Age and reconstruction of stature from long bones and their medico legal implication. Establishment of Partial and Complete identity of skeletal material and dead bodies; Craniometry: Identification of human skull, determining the age ,race and sex of the skull and its measurement;
Unit III: Odontology and Bite Marks [10] Odontology: Introduction to human dentition, structure of teeth, types and functions of different teeth, age and sex determination, identification in mass disasters; Bite Marks: Types of bite marks; collection and preservation of DNA samples, forensic importance of bite marks; identification - Case studies
Unit IV: Autopsy [10] Ante and Post – mortem examinations; external examination; internal examination; collection, preservation and packaging of viscera.

Text

1. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001
2. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References

1. Modi, A Text Book of Medical Jurisprudence & Toxicology.
2. Parikh, A Text Book of Medical Jurisprudence & Toxicology.
3. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
4. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
5. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

FORENSIC ANTHROPOLOGY PRACTICALS

FS 261 **0-0-2-1**

1. Estimation of height, weight using long bones
2. Determination of age, sex, using skull, pelvic bones, long bones, etc.

FOURTH SEMESTER

FORENSIC TOXICOLOGY

FS 232 **3-1-0-4**

Unit I: Toxicology and Drugs of Abuse [9] Definition, dosage, administration of poisons, Classification of poisons on analytical basis and medical basis; Sedatives, Narcotics, Stimulants and Hallucinogens, Drug Addiction and its signs and symptoms, Drugs and Crime; The role of drug recognition expert, Interpreting drug findings
Unit II: Toxicology of Alcohol [9] The fate of ethyl alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, analysis of blood for alcohol
Unit III: Metallic Poisons, Barbiturates and Corrosive Poisons [5] Arsenic, Mercury. Nature, administration, symptoms, postmortem findings, Detection and medicolegal aspects; Barbiturates: Classification, administration, symptoms, postmortem findings, detection and medico-legal aspects; Corrosives: HCl, H_2SO_4, HNO_3 Corrosive poisons-2: Alkalis; NaOH, KOH
Unit IV: Insecticides, Volatile Poisons [8] Organophosphorous compounds, Organochloro Compounds and Carbamates- Nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal findings; Volatile Poisons: Methyl alcohol, Chloroform. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings
Unit V: Miscellaneous Poisons [8] Animal poisons: Snake, Vegetable Poisons: Opium, Cannabis Dhatura, Oleander, Abrus precatrious, etc. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings.

Text:

1. Saferstein, Richard, Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

References:

1. Benjamin, D. M., Forensic Pharmacology. In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentic-Hall, Englewood Cliffs, New Jersey, 1993.
2. Caplan, Y. H., The Determination of Alcohol in Blood and Breath, In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, New Jersey, 1982.
3. James, S. H. and Nordby, J. J. (Eds)., Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. Karch, S. B., The Pathology of Drug Abuse. (2nd Edn.) CRC Press, Boca Raton, Florida, 1996.
5. Reject Paul. M.P, Forensic Toxicology, SSBT,New Delhi,2009

FORENSIC TOXICOLOGY PRACTICAL

FS 242 **0-0-2-1**

1. Analysis of metallic poison
2. Analysis of volatile and non-volatile poisons.
3. TLC of insecticides, Barbiturates and other drugs
4. Analysis of vegetable poisons
5. TLC of different kinds of inks
6. Lab Tests for Hallucinogens

PLANT AND ANIMAL BIOTECHNOLOGY

BT 242 **2-0-0-2**

TISSUE CULTURE LABORATORY

BT 252 **0-0-2-1**

FOREIGN LANGUAGE-II

ORGANIC CHEMISTRY-IV

CH 292 **2-0-0-2**

INORGANIC CHEMISTRY-II

CH 282 **2-0-0-2**

PHYSICAL CHEMISTRY-II

CH 272 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-IV

CH 262 **0-0-3-1.5**

FINGERPRINT SCIENCE

FS 252 **2-1-0-3**

Course Contents:
Unit I: History and Introduction [5] Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation.
Unit II: Class and Individual Characteristics [10] Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints.
Unit III: Classification of Fingerprints [10] Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC
Unit IV: Fingerprint Developmental techniques [7] Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.
Unit V: AFIS & Biometrics [7] AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications

Text:

1. Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.

References:

1. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
2. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
3. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
4. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
5. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

FINGERPRINT SCIENCE PRACTICALS

FS 262 **0-0-2-1**

1. Contact Prints
2. Rolled Prints
3. Analysis of Class and Individual Characteristics
4. Ridge Counting
5. Ridge Tracing
6. Identification based on Chance Prints
7. Fingerprint Lifting
8. Fingerprint Development: Iodine, Ninhydrin

FIFTH SEMESTER

FORENSIC SEROLOGY and BLOOD SPLATTER ANALYSIS

FS 371 **2-1-0-3**

Course Contents
Unit 1:Blood and its Properties [8] The nature of blood, collection, preservation and packing of blood evidence, procedures and precautions; Tests used in Blood Analysis: Identification of bloodstains by microscopic methods, Catalytic tests, crystal tests, Spectrophotometric method, chromatographic and immunological methods. Electrophoresis methods; Introduction to Body Fluids: Introduction to various body fluids, their nature and characteristics; Forensic analysis of Body Fluids: Forensic analysis of Semen, Saliva, Urine, Sweat etc.
Unit 2: Species of Origin& Grouping of Bloodstains [8] Determination of species of origin, Ring test, Immunoelectrophoresis, single diffusion, double diffusion, Crossed-Over electrophoresis, ABO system, Rh system and MN system; Techniques for the determination of blood groups.
Unit IV: Introduction to Bloodstain Pattern Analysis [10] Basic tenets of bloodstain pattern analysis, The purpose and function, history, application of basic scientific method, biohazards associated with bloodstain patterns, Characteristics of liquid blood and blood droplets under force, the effects of surface tension on individual droplets and pools of blood, the effects of terminal velocity on free falling droplets, characteristics of blood droplets on impact, effect of the volume, effect of target surface characteristics, limitations of determining distance fallen for individual droplets, relationship of angle of impact to stain shape.
Unit V: Recognition and Creation of Basic Stain Patterns [13] Passive Stains: a. Drip Patterns, Flow Patterns: Pools, saturation stains; Projected and Impact Spatter stains: Impact Patterns, splashes, cast-off patterns, arterial spurt and gush patterns, expired bloodstain patterns, transfer stains, wipe patterns, swipe patterns, transfer/contact patterns, void patterns, fly spot patterns, bubble rings, perimeter/skeletonized bloodstains. Point (Area) of Origin Determinations. Determine the impact angle, Determine directionality, determine point (area) of convergence, "stringing" and/or mathematical methods for point (area) of origin determinations, limitations

Text

1. Saferstein, R. (1998).Criminalistics, An Introduction to Forensic Science, 6th Ed. 6th Ed. Prentice –Hall

References

1. Eckert, W.G., & James S.H., Interpretation of bloodstain evidence at crime scene, CRC Press, Florida, 1989.
2. James, S.H. and Nordby, J.J. (Eds.), Forensic Science - An introduction to Scientific and investigative Techniques, CRC Press, London, 2003.
3. Kirk, P.L., Introduction in crime investigation (2nd), John Willey and, New York, 1974

SEROLOGY PRACTICALS

FS 381 **0-0-2-1**

1. Presumptive and Confirmatory tests for blood
2. Examination and Identification body fluids
3. Blood Splatter Analysis: Drop Direction, Force applied, Angle of Attack
4. Gel Immuno Diffusion tests for species origin
5. Blood Grouping

IMMUNOLOGY

MB 232 **3-1-0-4**

IMMUNOLOGY LABORATORY

MB 321 **0-0-2-1**

DIGITAL FORENSICS

FS 391 **2-1-0-3**

Course Content:

Unit 1: Cyber Crimes [8]

Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.

Unit 2: Basics of Computers [8]

Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations

Unit 3: Computer Forensics [10]

Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.

Unit 4: Forensic Tools and Processing of Electronic Evidence [13]

Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images

Text:

1. Fred Cohen, Digital Forensic Evidence Examination, Copyright (c) Fred Cohen 2009-2013 5th Edition

References:

1. C. Altheide& H. Carvey Digital Forensics with Open Source Tools, Syngress, 2011. ISBN: 9781597495868.
2. Cert-In Guidelines
3. Online Course management System: https://esu.desire2learn.com/

DIGITAL FORENSIC PRACTICAL

FS 313 **0-0-2-1**

1. Open Source Forensic Tools-Linux and Windows
2. Disk Forensics and Data Recovery
3. Anti-forensic techniques: TrueCrypt, Shredder
4. Steganography
5. Key loggers
6. Network monitors
7. Flowchart management
8. Algorithm designs
9. Registry Forensics

PROGRAMMING IN C++

FS 323 **2-1-0-3**

Course Contents:

Unit I: Introduction [10]

Introduction, Advantage, C and C++, Exception Handling, Object Oriented Programming, Standard Template Library, Types and declarations, Types, Booleans, Integer Types, Floating-Point Types, Sizes, Void, Enumerations, Declarations

Unit II: Pointers, Arrays and Structures [10]

Pointers, Arrays, Pointers into Arrays, Constants, References, Pointers to void, Structures, Expressions and Statements, A Deck Calculator, Operator Summary, Statement Summary, Comments and Indentation

Unit III: Functions [10]

Function Declarations, Argument Passing, Value Return, Overloaded Function Names, Default Arguments, Pointer to Function, Macros, Namespaces and Exceptions, Namespaces, Exceptions Source Files and Programs, Separate Compilation, Linkage, Using Header Files, Programs

Unit IV: Classes [9]

Classes, Access Control, Constructors, Member functions, Static members, Destructors, Memory allocation, Member initialization, Operator overloading, Introduction, Operator Functions, A Complete Number Type, Conversion Operators, Friends, Large Objects, Essential Operators, Subscripting, Functions Calls, Dereferencing, Increment and Decrement, A String Class, Derived class, Introduction, Derived Classes, Abstract Classes, Design of Class, Hierarchies, Class Hierarchies and Abstract Classes

Text:

1. Sumita Arora, "Introduction to C++"

References:

1. "C++ programming language" 3 rd edition by Bjarne Stroustrup.

PROGRAMING LAB IN C++

FS 333 **0-0-4-2**

1. Types and Declaration
2. Pointers
3. Arrays
4. Structures
5. Expression
6. Statement
7. Function
8. Classes
9. Derived Classes

FORENSIC PHOTOGRAPHY, DIGITAL IMAGING AND PORTRAIT PARLEY

FS 343 **3-1-0-4**

Course Contents:

Unit 1: Photography [10]

Basic principles and techniques of photography, cameras and lenses, exposing, developments and printing, Different kinds of developers and fixtures, modern developments in photography, linkage of cameras and film negatives, digital photography, digital water marking and digital imaging, photogrammetry, videography/ high speed videogaphy, crime scene and laboratory photography

Unit II: Digital Image Processing [20]

Digital image fundamentals - Digital Image through scanner, digital camera. Concept of gray levels. Gray level to binary image conversion. Sampling and quantization. Relationship between pixels. Imaging Geometry; Image

Transform; Image enhancement Point processing. Histogram processing. Spatial filtering; Image Segmentation; Image Processing

Unit III: Portrait Parley [15]

Composite Imagery: Graphic images composed of individually described characteristics of the human face; Image Modification/Identification: Methods of manipulation, enhancement and comparison; Demonstrative Evidence: Visual information used for court purposes; Reconstructive/Postmortem Drawings: Methods of identifying human remains in various conditions of decomposition

Text

1. Gonzales & Woods "Digital Image Processing" (3rd Addition) 2011

References:

1. Henry Horeustein, Colour Photography A Working Manual; Little Brow Company, Boston; (1995)
2. B.H.E. Jacobson, Sidney Ray GG Attridge, The Manual of Photograph Focal Press, London; (1998)
3. Jahne B; Digital Image Processing; Heidelberg Springer (1996)
4. Workinson, J; Art of Digital Video; Oxford Focal Press (1994)

DIGITAL IMAGING LAB

FS 353 **0-0-2-1**

1. Digitizing Image
2. Scaling Image
3. Filtering an Image
4. Image Normalization
5. Image Enhancement
6. Portrait Parley: Free Tools

SIXTH SEMESTER

INSTRUMENTATION IN FORENSIC SCIENCE

FS 372 **2-1-0-3**

Unit I: Spectroscopy [9]
Principal; Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection; Fluorescence and phosphorescence spectrophotometry: Atomic absorption spectrometry; Atomic emission spectrometry; X-ray spectroscopy, X-ray diffraction; Infrared spectrophotometry: Dispersive and Fourier Transform spectrophotometry, sample handling, quantitative analysis and interpretation of IR spectra;

Unit II: Centrifugation Techniques [10]
Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges

Unit III: Microscopy [10]
Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infrared Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

Unit IV: Mass Spectrometry [10]
Sample flow, Ionization methods, Mass Analyzer, Vaccum Systems, Correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS),

Text:

1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).

References:

2. Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993)
3. Skoog, Holler, Crouch, principles of instrumental analysis, 6th edition, 2007.
4. Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.
5. N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.

INSTRUMENTATION PRACTICAL

FS 382 **0-0-2-1**

1. Experiments in Stoichiometry
2. Molarity of Solution
3. Molality of Solution
4. Beer-Lambert Law
5. Qualitative Analysis using UV-Visible Spectrometer
6. Quantitative Analysis using UV-Visible Spectrometer
7. Sample Preparation for IR Spectrometer
8. IR Spectrometer Demonstration

WILDLIFE FORENSICS

FS 392 **2-1-0-3**

Course Contents:

Unit I: Wildlife Forensics [10]
Definition, introduction, gravity of the crime, endangered wild flora and fauna, various types of the evidences encountered their location, collection and packing; Introduction to forensic medicine and microbiology.

Unit II: Forensic Entomology [9]
Forensic importance of various insects, importance of various insect growth stages, Entomological evidences, their location, collection and packing, Determination of time since death from entomological evidences.

Unit III: Forensic Botany [9]
Introduction to Forensic Botany, Plants as Evidence, Evidence Collection and analysis, Moss as evidence, forensic microscopy, Palynology, phytoforensics, algae in forensics investigations, DNA methods in plant identification, Plant physiology and growth in forensic botany (gravesite analysis, time of deposition, geomorphology, Forensic Wood Science, Forensic mycology - spores, fruiting bodies, botanical decomposition, site conditions, commercial concerns.

Unit IV Forensic Biology [11]
Introduction, importance of various biological evidences (hair, fiber, pollens, wood), collection and evaluation in general, bite marks, human skeletal remains, importance and examination.

Text:

1. Wildlife Law News Quarterly (2007-2014), Center for Wildlife Law, University of New Mexico School of Law Wolfe, M. L. 1995. An overview of legal systems for managing wildlife, in J. A. Bissonette and P. A. Krausman (eds.) Integrating people and wildlife for a sustainable future.

References:

2. Anderson, G. S. 1999. Wildlife forensic entomology: determining time of death in two illegally killed black bear cubs. Journal of Forensic Sciences, 44:856-860.
3. Bowen, G. J., L I. Wassenaar and K. A. Hobson. 2005. Global application of stable hydrogen and oxygen isotopes to wildlife forensics. Oecologia 143:337-348.
4. Buck, S. J.. 2006. Ch 6: Managing Wildlife and Public Lands in Understanding Environmental Administration and Law, 3rd edition. Island Press.
5. Freyfogle, E. T. and D. D. Goble. 2010. Wildlife Law: A Primer. Island Press.
6. Manel, S., P. Berthier and G. Luikart. 2002. Detecting Wildlife Poaching: Identifying the Origin of Individuals with Bayesian Assignment Tests and Multilocus Genotypes.Conservation Biology 16:650-659.
7. Rawley, Edwin V. and LeeAnn Rawley. 1967. A brief history of the Utah Fish and Game: http://wildlife.utah.gov/about/history.php Utah Division of Wildlife Resources various Guide Books and publications. 2016/2017: http://wildlife.utah.gov/hunting-in-utah/hunting-information.html

MULTIMEDIA FORENSICS

FS 314 **2-1-0-3**

Unit I: Multimedia [13]
Various modalities of device fingerprints, Extraction and representation of device fingerprints, Enhancement of device fingerprints, Source device identification based on device fingerprints, Content/device linking based on device fingerprints, Content integrity verification based on device fingerprints, Source-oriented image/video clustering based on device fingerprints, Digital content hashing, Data hiding, Digital watermarking for copyright protection, Digital watermarking for content authentication, Steganography, Steganalysis

Unit II –Speech Recognition [13]

Introduction-Regular Expressions and automata-Words and transducers-N-grams Part of speech tagging-Hidden Markov and Entropy models, Speech-Phonetics-Speech synthesis-Automatic speech recognition-Speech Recognition advanced topics-Computational Phonology

Unit III – Speech Parsing and Semantics of Speech Recognition [13]

Formal grammar of English-Syntactic parsing-Statistical parsing-Features and Unification-Language and complexity, Semantics and Pragmatics-The representation of meaning-Computational Semantics-Lexical semantics- Computational lexical semantics-Computational discourse

Text:

1. Daniel Jurafsky and James Martin "Speech and Language Processing", 2nd edition, Prentice- Hall, 2008.

References:

1. Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, "Spoken Language Processing", Prentice- Hall, May 2001.
2. Paul Taylor,"Text-to-Speech Synthesis", Cambridge University Press, February 2009.
3. Samir Nanavati, Michael Thieme, Raj Nanavati "Biometrics – Identity Verification in a Networked World", WILEY- Dream Tech Edition 2009.(UNIT 1,2,3,4,)
4. Paul Reid "Biometrics for Network Security", Pearson Education.2009. (UNIT – V)
5. John D. Woodward, Jr. Wiley Dreamtech Biometrics- The Ul
6. Perry J. Gait analysis. Normal and Pathological Fuction. SLACK Incorporeted, 1992

QUESTIONED DOCUMENT EXAMINATION

FS 324 **2-1-0-3**

Course Contents:
Unit I: Introduction to Questioned Documents [8] Document and Questioned documents, Various types, Characteristic features of genuine handwriting/ signatures, Forgery and its types, characteristic components of forged documents and its examination, Disguise writings, features of disguised writings and its examination. Procedure adopted for collection of standards for comparison of documents, admitted signature/writing, specimen signature/writings.
Unit II: Principle of Handwriting Identification [8] Introduction of Handwriting, Principle of handwriting identification, Handwriting characteristics: Class and individual characteristics, Natural variations in handwriting, causes of variations, Tampered Documents: addition, alteration, obliteration, secret writing. Examination of the documents for the ink, paper, photocopies/ xerox, printouts and scanned documents.
Unit III: Various Questioned Documents Cases [10] Disputed documents - wills, deeds, cheques, suicide letters, anonymous letters, threatening letters, stamps fraud, fake currencies, fake paintings and printing, fake rubber stamps and seals, Tampered documents, charred documents, Computer generated/ electronic documents/ typed and photocopied documents.
Unit IV: Signature Verification [7] Handwriting characteristics, natural variations, principles of identifications, features encountered in forged handwriting/ signatures, characteristic features of disguised handwriting/ features, external and internal factors affecting handwriting.
Unit V: Instrumentation in Questioned Documents [6] Camera, Compound microscope, Stereo microscope, magnifying glasses, illuminated torch, Video Spectral Comparator, Docu-centre, color filters, Osborn's scale, geometrical requirements, Projectina, ESDA, Transmitted light apparatus, Oblique light, UV and IR radiations, TLC and Paper Chromatography.

Text:

1. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.

References:

1. Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998.
2. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
3. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.
4. Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
5. Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.
6. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
7. Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
8. Kurtz, Sheila, Grapholypes a new plant on handwriting analysis, Crown Publishers Inc., USA, 1983.
9. Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
10. Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.

QUESTIONED DOCUMENT EXAMINATION IN LAB

FS 334 **0-0-2-1**

1. Studying Individual Characteristics
2. Hiatus Calculation
3. Handwriting Comparison
4. Author Identification
5. Signature Verification
6. Free Hand Forgery
7. Transmitted Light Forgery
8. Auto-Forgery
9. Ink Identification

BIOINFOMATICS

BT 352 **2-1-0-3**

BIOINFOMATICS LAB

BT 314 **0-0-2-1**

FORENSIC BALLISTICS AND TOOL MARKS

FS 344 **2-1-0-3**

Course Contents:
Unit I: Arms and Ammunition [7] Definition, Indian Arms Act, Forensic Importance; Nature of firearms, parts of a firearm, classification of firearm; Ammunition: Types, Bullet comparisons, cartridge case examination, class and individual characteristics of identification.
Unit II: Analysis and Reconstruction [8] Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, and primer residues; Reconstruction of the sequence of events in a shooting case. Presentation of evidence in the court. accidental firing
Unit III: Firearm injuries [7] Terminal Ballistics, Entrance wound, exit wound and internal wound, evaluation of firearm injuries.
Unit IV: Tool Marks [8] Definition, nature, types, significance, decipherment of tool marks and techniques; Examination of tool marks
Unit V: Tyre marks, Footprints, Shoeprints and other Impressions [9] Definition, nature, its types, skid marks, tread marks, significance and examination; Introduction to Footprints and Shoeprints: Definition, nature, its types, significance and Examination; Miscellaneous impressions: Lip print, Bite marks and their examination

Text:

1. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

1. James, S. H. And Nordby, J. J. (Ed), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
2. Modi, A Text Book of Medical Jurisprudence & Toxicology.
3. Saferstein, Richard, Criminalistics - An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
4. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.
5. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
6. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
7. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
8. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

SUMMER INTERNSHIP

FS 370 **Credits: 4**

Each student will be given a short term lab attachment during the summer vacation after completing two years of the course. They are supposed to submit a project report based on the lab visit they conduct. The same shall be evaluated out of a maximum marks of 100 and the student may be evaluated on Content, Presentation and Viva.

The presentation should preferably be performed in front of a panel.

Mody University of Science & Technology

B.Sc. (Hons) Physics
Session 2017-2018

Curriculum Structure

B. Sc. (Hons.) Physics

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)

No. of Seats: 20

Objectives:

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The programme offers core skills in physics as well as maths, which instills in the knowledge about the fundamental aspects of physics. With this course, Mody University aims to open many doors for their students by offering Courses in Atomic and Molecular Physics, Electronics, Applied Electronics, Nuclear Physics, Nano sciences, etc. The student will be able to select various options for higher studies like M.Sc. in Physics, Applied Physics, and Electronics. In addition, the programme provides good combinations to create interest of undergraduate students towards M. Tech. in Allied Sciences including Electronics, Astrophysics, Material Science, Laser Technology, Nuclear Science, Opto- electronics and Nanoscience. Further, they have scope for absorption in research Labs.

The first batch of this programme in MUST/ Mody University proposed to be admitted in the session 2015-16.

Input Qualification:

A pass in 10+2 examination of CBSE, or its equivalent from any Board, in Science stream with Physics and Mathematics as subjects and adequate proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of MUST/ Mody University shall be followed.

B. Sc.(Hons.) Physics

Three-Year Programme

Academic Curriculum (2015 – 16 onwards)

First Year

First Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total	**20/19**	**-**	**7/8**	**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

Second Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total	**15/17**	**-**	**11/ 12**	**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

Third Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total	**21/21**	**1/1**	**7/8**	**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

Fourth Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special Theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢	**16/15**	**2/2**	**7/8**	**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry****<u>Or</u>* ***Computer Science*** *may only be opted in first four semesters.*

B.Sc. (H) Physics
Batch 2016-17 and onwards
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 323	**Statistical Mechanics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 333	**Fiber Optics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 343	**Computational Physics**	**2**			**2**	3	25	25	50
	PH 321	**Physics Laboratory V**			**4**	**2**	4	25	25	50
	PH 353	**Computational Laboratory**			**4**	**2**	4	25	25	50
	PH 363	**Project (Minor)**				**2**				
		Total Credits				**20**				
	GE 301	Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	**Elements of Nuclear Physics**	**2**	**-**	**-**	**2**	3	25	25	50
	PH 334	**Microwaves**	**4**	**-**	**-**	**4**	3	25	25	50
	PH 372	Basics of Nanoscience and Exotic Materials	3	-	-	3	3	25	25	50
	PH 332	**Physics Laboratory VI**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 344	**Electronic Laboratory**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 354	**Project (Major)**				**4**				
		Sub Total	**14**	**-**	**8**	**20**				
	GE 302	Proficiency (Non-Credit) #				**1**				

Course Description

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata

McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)
2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields
2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics

3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions

using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable [13]

coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application)

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:

4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation [4]

(Basic Concepts only).

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic [6]

Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.

2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension [12]

Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis. [10]

Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces. [9]

Inner Product Space: Inner produt space, norm of a vector, Orthogality. [8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant [14]

coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems

and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as [8]

Traversal, Insertion, Deletion, Searching.

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, “Operating Systems”, New Delhi
2. Ritchie, “Operating System”, BPB Publication , New Delhi
3. Dhamdhere D. M. “System Programming and Operating System”, TMH New Delhi
4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi

3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of

corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint

2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in

crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.

3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population [5]

growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their

differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid

and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

Mody University of Science and Technology

College of Arts, Science and Humanities

BSc PCM
2017-18

Department of Science

B. Sc. (PCM/PMC)
Physics, Mathematics, Computer Science/ Chemistry
Three-Year Programme
Academic Curriculum (2012 – 13 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[$]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total				**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total				**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total				**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢				**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry*** *<u>Or</u>* ***Computer Science*** *may only be opted in each semester.*

Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 321	Physics Laboratory-V	-	-	4	2	4	25	25	50
		Mathematics								
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 221	Database Management System	3	-	-	3	3	25	25	50
	CA 261	Database Management System Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	4			
		Sub Total				**20.5/18**				
		Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	Elements of Nuclear Physics	2	-	-	2	3	25	25	50
	PH 332	Physics Laboratory VI	-	-	4	2	4	25	25	50
		Mathematics								
	MS 312	Special functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 222	Computer Networks	3	-	-	3	3	25	25	50
	CA 262	Windows Programming Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry–VI	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	4			
		Sub Total				**21.5/19**				
		Proficiency (Non-Credit) #				**1**				

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

$ *Evaluation of internship would comprise project report and viva-voce.*

Optional Courses

§ -***Chemistry courses***

¢ -**Computer Science**

Note: **1**.*The Programme includes two different combinations:*

(i) PCM (Physics, Chemistry and Maths) &

(ii) PMC (Physics, Maths and Computer Science)

2. *In addition to the compulsory courses, either all courses of* ***Chemistry Or Computer Science*** *may only be opted in each semester*

Overall Credits: Physics: 41; Mathematics:40; Chemistry: 41: Computer Science: 36 (+5)

Total Credits (With Chemistry as optional) 135
Total Credits (With Computer Science as optional) 130

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)
2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields
2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics

2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz [12]

force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect.
Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics

2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for [8]

Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other

electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, **S**. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its [6]

Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points. [8]

Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates. [8]

Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. [8]

Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes. [8]

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems. [7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, [13]

Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

MS 112 Abstract Algebra 3-0-0-3

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition.	[11]
Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group	[10]
Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem.	[10]
Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation.	[8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.

   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines.	[4]
First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form.	[14]
Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters	[12]
Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only)	[9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.

D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972

J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation [8]

formulae, Sterling, Bessel Formula.

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985

   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi

4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.

5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, “Information Systems for Modern Management”, PHI, New Delhi
2. Jawadkar, “Management Information System”, TMH, New Delhi

Reference Books:

1. Sadagopan, “Management Information System”PHI, New Delhi
2. Parker, Case, Thomas, “Management Information System: Strategies and Action”, TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between

critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D.

Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and **[8]**

chemical reactions of cycloalkenes.

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law

of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised

Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998,

Prentice Hall.

2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, [6]

Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India.

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge

Publications, UK.

CH 291	**Physical Chemistry-I**	**2-0-0-2**
	Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition.	**[7]**
	Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.	**[8]**
	Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects.	**[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213	**Inorganic Chemistry-I**	**2-0-0-2**
	Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[6]**
	Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[5]**
	Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.	**[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic .

substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept [8]

and embryonic induction. Embryo sexing and ageing.

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.

4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass **[12]**

electrodes.

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides.

Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 **Laboratory Course in Chemistry-IV** **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

M.Sc. Biotechnology
Session 2017-2018

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2013 –14 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 511	Cytogenetics	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 531	General Microbiology	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 551	Microbiology and Cytogenetics Laboratory	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	1	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 512	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 522	Animal Biotechnology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3		-	3	3	25	25	50
	MB 532	Immunology	3		-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 552	Seminar	-	-	-	1	-	100		
	BT 514	Plant, Animal Biotechnology and Food Technology Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2013 – 14 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 621	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 641	Bioprocess Engineering	3	1	-	4	3	25	25	50
	BC611	Enzymology	3	-	-	3	3	25	25	50
	BT 661	Genetic Engineering and Environmental Biotechnology Laboratory	-	-	4	2	4	100		
	BT 613	Enzymology and Bioprocess Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**2**	**8**	**18**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				

Total Credits **83**

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Biotechnology)

BT 511 Cytogenetics 3-0-0-3

Cell Diversity: Cell as a basic unit of life, Cell theory, Cell size and shape. [2]

Cytology: Introduction to cell organelles (Structure and functions), Self-assembly and dynamic structure of cytoskeletal filaments and their cellular regulation, Molecular motors and cell behaviour, Microtubules motors and movement, Cell-cell interactions, Cell adhesion, Tight and gap junction, Plant cell adhesion and plasmodesmeta. [8]

Energy Metabolism: Chemotropic (mitochondria) and phototropic (chloroplast) energy metabolism of cell, Electron transport chain and proton pump, Evolution of electron transport chain. [5]

Membrane Biology: Structure, Chemistry and function of biological membrane, Transport across membrane- simple diffusion, facilitated diffusion, active transport, Energetics of transport, Signal transduction mechanism of cell-membrane potential, Action potential, Synaptic transmission, Messengers and receptors of signal transduction mechanism. [7]

Cellular Oncology: Cell cycle and its control, Molecular mechanism, Check points and cancer. [6]

Principles of Genetics: Introduction toMendelian and non-Mendelian genetics, Chromosomal theory of inheritance. Extra chromosomal inheritance. [4]

Linkage: Concept of linkage and crossing over, basic eukaryotic chromosome mapping, recombination of genes, two-point and three-point test cross, tetrad analysis, linkage maps, Interference. [4]

Mutation: Spontaneous and induced mutations, chromosomal aberrations, Cytological behavior and molecular basis. [4]

Population Genetics: The Sources of variation, Hardy Weinberg's Law, Genetic drift and change in gene frequency. [2]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean,median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean [6]

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, [9]

Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 531 General Microbiology 3-0-0-3

History and Scope of Microbiology: Spontaneous Generation vs. Biogenesis, Contributions of various scientists to the field of microbiology and development of microbiology as a scientific discipline. Avenues for microbiologists. [6]

Classification: Microorganisms and place of microbes in Whittakers' five kingdom classification, Eight kingdom classification, Phenetic and phylogenetic classification. Bergeys' manual for classification of bacteria, Structure and organization of Prokaryotic and Eukaryotic cells. Structure of bacterial cell wall-difference between Gram positive, Gram negative and archaebacteria, Cell membrane, Flagella, Pilli, Capsule, Endospore, Mesosome, Reserve food material. [10]

Microbial Growth: Bacterial growth curve, Factors affecting the microbial growth, One step growth curve of bacteriophages, Concepts of batch culture, Continuous culture, fed batch culture, synchronous growth and measurement of growth. [8]

Recombination in Bacteria and Viruses: Transformation, Conjugation and Transduction. [5]

Methods of Studying microorganisms: Microscopy- light microscopy (bright field, dark field, phase contrast, fluorescent) and electron microscopy (SEM & TEM), Pure culture techniques, Microbiological media (Liquid, solid, semi solid, defined, selective, maintenance, enrichment & differential), Sterilization, Disinfection, Aseptic techniques. [6]

General Properties of Microorganisms: Brief study of characteristics of viruses, algae, protozoa and fungi. Economic importance of microorganisms, Microbes as agents of diseases. [4]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates, [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, MichelisMenten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary electrophoresis. [6]

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 551 Microbiology and Cytogenetics Laboratory 0-0-4-2

Assignments based on BT 511 and MB 531 containing exercises on study of cell and its various structures and functions and general characteristics of microorganisms will be conducted.

BC 541 Biochemistry and Instrumentation Laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

BC 531 Biomolecules 3-0-0-3

Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [5]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates.Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway [8]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis,Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis. [7]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $–NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids.Classification of enzymes, MichelisMenten equation Km value, Linweaver-Burk equation. [8]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [6]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

BT 512 Plant Biotechnology 3-0-0-3

Plant Tissue Culture: Historical perspective, Tissue culture media, Totipotency, Organogenesis, Somatic embryogenesis- regulation and application, Artificial seed production, Micropropagation, Somaclonal variation, Androgenesis and its applications in genetics and plant breeding, Germplasm conservation and Cryopreservation. [5]

Protoplast Culture and Somatic Hybridization: Protoplast isolation, Culture and usage, Somatic hybridization-methods and applications, Cybrids and somatic cell genetics [6]

Agrobiology: *Agrobacterium*-plant interaction, Organization of virulence genes, Ti and Ri plasmids, Opines and their significance, T-DNA transfer mechanism, Disarming the Ti plasmid, *Agrobacterium* based vectors, Binary and shuttle vectors. [5]

Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co - integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Transgene stability and Gene silencing. [7]

Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance Plants as Biofactories. [8]

Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection. [8]

BT 522 Animal Biotechnology 3-0-0-3

Introduction: Brief account of animal tissue culture, Brief history and some established normal and transformed cell lines. [5]

Media formulations: Balanced salt solution, Semi-synthetic and synthetic media, Serum as a media supplement, Serum-free media, Feeder layers, Medium sterilization. [8]

Cell culture Methods: Disaggregation (mechanical, chemical and enzymatic), Primary culture, Secondary culture, Suspension and monolayer cultures, Immobilized cultures. [8]

Growth Characteristics of Animal Cells: Growth curve, Growth kinetics, Synchronization of cells, Differentiation of cells, Transformation, Bioreactors. [8]

Application of Animal Biotechnology: Tissue engineering, Production of monoclonal antibodies, Transgenic animals, Embryo culture and IVF, Gene therapy, Production of interferons and vaccines, Diagnostics. [10]

BT 592 Bioinformatics , Scientific Communication & Intellectual 3-1-0-4

Property Rights

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management.	6
Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions.	8
Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins.	8
Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index.	3
Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International)	7
Biotechnology and Intellectual Property Rights. Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy	7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 **Molecular Biology** **3-0-0-3**

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of

constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity**.** [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and

regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli*O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori* [10]
Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 552 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver

seminar on it.

BT 514 Plant, Animal Biotechnology and Food Technology Laboratory **0-0-4-2**

Assignments based on BT 514, BT 512 and BT 522 containing exercises on application of food microbiology and biotechnological techniques in animals and plants will be conducted.

BT 572 Molecular Biology and Immunology Laboratory **0-0-4-2**

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication **0-0-2-1**

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomycescereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

BT 621 Environmental Biotechnology 3-0-0-3

Agricultural Microbiology: Types of soils-physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere- general account, Microbial interactions- Study of positive and negative interactions among microbial populations, Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic (Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications, Biofertilizers, Biopesticides. [12]

Water Microbiology: Assessment of water quality- water purification, Potability standards, Major water borne diseases. [6]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles, Role of microbes in biodeterioration- Metal corrosion, Paper, Metal detoxification. [10]

Waste Treatment: Types of wastes-Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and Tertiary treatment), Trickling filter, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [10]

BT 641 Bioprocess Engineering 3-1-0-4

Microbial Growth and Product Kinetics: Microbial biomass, Enzymes and metabolites, Batch and Continuous culture, Feed back system, Comparison of batch and continuous culture, Fed batch system and its applications. [7]

Isolation, Preservation and Improvement of Industrially important Microorganisms: Enrichment culture technique, Storage at low temperature, Storage in Liquid nitrogen, Lyophlization, Strain improvement by mutation, Feed back inhibition and repression, Strain improvement by modifying the characteristics of inhibitor metabolite, Isolation of auxotrophic mutants, Resistant mutants, Revertant mutants, Use of Recombination methods and Improvement by modifying properties other than yield. [8]

Sterilization: Design of batch sterilization process, Calculation of Del factor, Holding time, Richard's rapid method for design of sterilization, scale up of batch sterilization process, Design of continuous sterilization process, Sterilization of air, Theory and design of depth filter. [5]

Mass Transfer in Microbial System: Fluid and its properties, Mass transfer co-efficient and its determination, Factor affecting mass transfer coefficient, Scale up and scale down. [7]

Downstream Processing: Introduction, Filtration, Product isolation and extraction– centrifugation, precipitation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, Drying, Crystallization and whole broth processing. [7]

Bioreactor and Control: Basic design of fermenter and control system: automatic and manual, off line and on line, Bioreactor– Packed bed, Fluidized bed, Tickle bed, CSTR, Plug flow reactor, Scale up of bioreactor. [5]

BC 611 Enzymology 3-0-0-3

Introduction: Units of activity, Specific activity of enzymes and methods of enzyme assay, Enzyme specificity, Uni substrate enzyme kinetics, Factors affecting the rate of enzyme catalyzed reaction, Derivation of Michelis-Menten equation, Significance of $V_{max}$and K_m, Enzyme inhibition- type of inhibition, Competitive non Competitive and uncompetitive kinetics. [5]

Enzyme Catalytic Efficiency: Factors associated with catalytic efficiency such as proximity, Orientation-distortion of strain, base nucleophilic catalysis with equation, Protein ligand binding co-operativity, Hill and Sat Chard plot protein sequencing. [6]

Immobilization: Immobilized enzymes and their industrial applications, Effect of partition on kinetics and performance with particular emphasis on change in pH and hydrophobicty. [6]

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

BT 661 Genetic Engineering and Environmental Biotechnology Laboratory 0-0-4-2

Assignments based on BT 611 and BT 621 containing exercises on genetic engineering and role of biotechnology in environment will be conducted.

BT 613 Enzymology and Bioprocess Laboratory 0-0-4-2

Assignments based on BC 611 and BT 641containing exercises on fermentation process and production of metabolites and role of enzymes in biotechnology will be conducted.

Mody University of Science & Technology

M.Sc. Forensic Science
Session 2017-2018

Curriculum Structure

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 501	Criminology, Criminal Law, Police Administration	2	1	-	3	3	25	25	50
	FS 511	Introduction to Forensic Science & Crime Scene Investigation (CSI)	2	-	-	2	3	25	25	50
	FS 521	Forensic Physics and Trace Evidences	2	1	-	3	3	25	25	50
	FS 531	Introduction to Digital Forensics	2	1	-	3	3	25	25	50
	FS 541	Forensic Ballistics	2	1	-	3	3	25	25	50
	FS 551	Statistics & Research Methodology	2	-	-	2	3	25	25	50
	FS 561	Forensic Practical I (CSI, Trace, DF, Ballistics)	-	-	8	4	4	25	25	50
		Foreign Language I	3	-	-	3	3	25	25	50
		Sub Total	**15**	**4**	**8**	**23**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 502	Elements of Forensic Medicine, Odontology	2	1	-	3	3	25	25	50
	FS 512	Instrumentation in Forensic Sciences (Chemical, Physical & Biological)	3	1	-	4	3	25	25	50
	FS 522	Introduction to Questioned Document Examination	2	-	-	2	3	25	25	50
	FS 532	Introduction to Forensic Chemistry, Toxicology & Pharmacology	2	-	-	2	3	25	25	50
	FS 542	Introduction to Forensic Biotechnology	2	-	-	2	3	25	25	50
	FS 552	Disaster Management and Victim Identification	2	1		3	3	25	25	50
	FS 562	Forensic Practical II (Instrumentation, Odontology)	-	-	6	3	3	25	25	50
		Foreign Language II	3	-	-	3	3	25	25	50
		Sub Total	**16**	**3**	**6**	**22**				

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 601	Fingerprinting and Forensic Photography	2	1		3	3	25	25	50
	FS 611	Applied Cognitive Psychology	2	1		3	3	25	25	50
	FS 621	Speech Analysis and Multimedia Forensics	2	1		3	3	25	25	50
	FS 631	Forensic Practical III (Fingerprinting, Photography, Multimedia Forensics)			6	3	4	25	25	50
	Elective A, or, **Specialization A: FORENSIC CHEMISTRY AND TOXICOLOGY**									
	FS 641	Advanced Forensic Chemistry	2			2	3	25	25	50
	FS 651	Advanced Forensic Pharmacology & Toxicology	2			2	3	25	25	50
	FS 661	Forensic Practical IV A(Chemistry, Pharmacology, Toxicology)			8	4	4	25	25	50
	Elective B, or, **Specialization B: FORENSIC BIOTECHNOLOGY and DNA PROFILING**									
	FS 671	Advanced Forensic Biology & Anthropology	2			2	3	25	25	50
	FS 681	Advanced Forensic Serology & DNA Profiling	2			2	3	25	25	50
	FS 691	Forensic Practical IV B(Forensic Biotechnology)			8	4	4	25	25	50
	Elective C **Specialization C: QUESTIONED DOCUMENT EXAMINATION**									
	FS 603	Advanced Questioned Documents Examination	2			2	3	25	25	50
	FS 613	Digital Image Processing	2			2	3	25	25	50
	FS 623	Forensic Practical IV C(QD and DIP)			8	4	4	25	25	50
		Sub Total	**10**	**3**	**14**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours
			L	T	P		
Spring Semester	FS 620	DISSERTATION				20	
		Sub Total				**20**	

‡ *Refer to the Foreign Languages Section*

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)

FIRST SEMESTER

CRIMINOLOGY, CRIMINAL LAW & POLICE ADMINISTERATION

FS 501 **2-1-0-3**

Course Contents:
Unit I: Introduction to Criminology [7] Criminology: Definition, Nature and Scope. Criminal Action and Criminal Behavior, Introduction of Victimology, Causes of crime: Social, Economic, Psychological, Political, Culture, and Geographical and their prevention, Juvenile Delinquency, Role of the Correctional Institutions.
Unit II: Theories of Criminology [8] Theory of Criminology: Theory of Criminology - Differential Association Theory, Self Concept and Containment theory, Labeling theory, Barrier Theory
Unit III: Type of Offences and Indian Courts structure [10] Criminal Offences, Nature and types, Framing of Charges, Terrorism, SexualOffences, White collar crime, Courts: Structure and types- criminal courts, Juvenile Courts.
Unit IV: Criminal Law [7] Criminal Law: Definition, Scope and development, Sections of I.P.C, Cr.PC related to Crime, Law of Evidences and Criminal Justice System in India: structural and functional process; Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b) Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), CrPC Sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176; IEA Sections: sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159.
Unit V: Police Administration system [7] Police duties and responsibilities, Structure of Police in India, role of Police in society, Police Investigation, Interrogation and Interviewing of criminals, maintenance of Law and order, Custodial crimes and death, Police and human rights.

Text:

1. Rama Ahuja: Social Problems in India

References:

1. Ahmad Siddique: Criminology Problems & perspectives.
2. Batuk Lal: Law of Evidence
3. Rao, S. Venugopal: Police Administration.

4. Nath, Trilok: Indian Police.
5. Mishra. S.C. : Police Administration in India
6. Government of India, Ministry of Home Affairs: Reports of National Police Commission
7. Sutherland and Cassey: Criminology

INTRODUCTION TO FORENSIC SCIENCE and CRIME SCENE INVESTIGATION

FS 511 **2-0-0-2**

Course Contents:

Unit I: Crime Scene Management [9]

Definition and causation of crime, Types of crime scene, Crime scene survey, protection of crime scene, searching of physical evidences, Recording, documentation and presentation in the court, processing and reconstruction of the crime scene.

Unit II: Introduction to Forensic Science and Quality Management (ISO/IEC 17025)] [8]

Introduction and History of Forensic Science, Basic principles and significance, Utilization of Forensic Science, Forensic Scientist at the scene of crime, Structure of Forensic Labs, General requirements for the competence of testing and calibration laboratories - Introduction, Scope, Management requirements: Organization, Quality System, Document Control, Service to the clients, Complaints, Corrective and preventive actions, Control of records, Internal Audits etc.

Unit III: Investigation and Interrogation [4]

Law related to interrogation, interviewing of the criminals; methods used by the police in getting information from the criminal; the ethical issues related to the same; Examination in the Court, Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; Direct examination, re-examination and cross – examination of prosecution lawyer and defense lawyer.

Unit IV: Divisions and Scope of Forensic Investigations [3]

Mobile Lab, CSI and its relevance, Toxicology, Forensic Chemistry, Arson, Explosives, NDPS, Scope, Serology, Forensic Biotechnology, Scope, DNA Profiling, Questioned Documents, Digital Forensics, Forensic Ballistics, Forensic Physics

Text:

- James, S.H., and Nordby, J.J., (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003

References:

1. Nabar, B. S., Forensic Sciene in Crime Investigation, Asian Law House, 2001.
2. Allison, R. , Investigation of Crime Scene, Global vision Publishing House, 2008.
3. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
4. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science - An Introduction to Criminalistics, McGraw Hill, New York, 1983.

5. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

FORENSIC PHYSICS and TRACE EVIDENCES

FS 521 **2-1-0-3**

Course Contents
Unit I:SOIL [7] Physical Evidence and Role of Probability**;** Formation and types of soil, composition of soil, particle size distribution, microscopic examination, density gradient analysis, interpretation of soil evidence, Discussion on important case studies related to soil evidence.
Unit II: GLASS [8] Types of glass and their composition, Forensic examination of glass fractures, determination of direction of impact: cone fracture, rib marks, hackle marks, colour and fluorescence, physical matching, refractive index, and interpretation of glass evidence.
Unit III: PAINT [7] Types of paint and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis, solubility test, pyrolysis chromatographic techniques, IR spectroscopy and X-ray diffraction, interpretation of paint evidence.
Unit IV: TOOL MARKS & RESTORATION OF ERASED / OBLITERATED MARKS [7] Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks . Method of making-cast, punch, engrave; methods of obliteration, method of restoration.
Unit V: SPEAKER IDENTIFICATION AND TAPE AUTHENTICATION [10] Vocal anatomy, Speech signal processing and pattern recognition – basic factors of sound in speech, acoustic characteristics of speech signal, Fourier analysis, analysis of audio-video signal for authenticity, Introduction to the techniques of pattern recognition and comparison.

Text

1. R. Saferstein, Forensic Science Handbook, Vols. I, II, (Ed), Prentice Hall, Eaglewood Cliffs, NJ; 1988.

References

1. B. Caddy, Forensic Examination of glass and paints analysis and interpretation, ISBN 078405749 2001.
2. Bengold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons, USA, 1999.

3. Bengold and Nelson Morgan,, Speech and Audio signal processing, John Wiley and sons, USA, 1999.
4. C.E. O 'Hara and J.W. Osterburg, An Introduction to Criminalistic, Indiana University Press, Blomington, 1972.
5. Denis Shaw, Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
6. F.W. Sears, M.W Zemansky, and H.D. Young, University Physics, Sixth Ed., Narosa, 1995.
7. Jenkins and White, Fundamentals of Optics, Mc Graw Hill, Fourth Ed, 1976.
8. Nickolls, L.C., Scientific Investigation of Crime, Bulterwest, London, 1956.

INTRODUCTION TO DIGITAL FORENSICS

FS 531 **2-1-0-3**

Course Content:

Unit 1: Cyber Crime in India [7]
Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.

Unit 2: Basics of Computers [8]
Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations

Unit 3: Incident Response Management [7]
Introduction to Incident Response Process, Preparing for Incident Response, detection of an Incident, IRM life cycle-preparation, Identification, Detection, Containment, Eradication, Recovery, lessons learnt, Investigations of Cyber Crime cases as per IRM cycles, opinion formatting for cyber-crime cases, court testimonies, case studies.

Unit 4: File Forensics [8]
Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.

Unit 5: Forensic Tools and Processing of Electronic Evidence [9]
Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images

Text:

1. Bernad Jahne: Digital Image processing, Springer Verlag (1993)

References:

1. James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
2. Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.
3. Tessarolo, A.A. and Marignani, A., Forensic Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.

FORENSIC BALLISTICS

FS 541 **2-1-0-3**

Course Contents:
Unit I: Introduction to Ballistics [10] Firearms, Indian Arms Act, Characteristic features of the firearms, various types of modern firearms, classification of firearms on different basis, bore characteristics.
Unit II: Ammunition (Cartridges and Bullets) [8] Definition, Classification and constructional features of different types of ammunitions (cartridges), types of primers and priming composition, propellants and their compositions, Various types of bullets and their compositional aspects, latest trends in their manufacturing and design, smooth bore and improvised ammunition.
Unit III: Arms and Ammunition Linkage (Cartridge Case and fired bullets) [7] Principles and practice of identification of firearms, different types of marks produced (class and individual characteristics) during firing process on cartridge case -firing pin marks, breech face marks, chamber marks, extractor and ejector marks, Different types of marks produced during firing process on bullet-number/direction of lands and grooves, width of lands and depth of grooves, angle and pitch of rifling, striation marks on lands and grooves, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics
Unit IV: Determination of Range of Firing [8] Ejecta, burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different methods employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system
Unit V: Explosives &Explosion Scene Investigation [6] Explosive Act, nature and classification, composition and characteristics of explosives, pyrotechnics, IEDs, Explosion process and affects, types of hazard, effect of blast wave on structures, human etc.Specific approach to scene of explosion, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residues in the laboratory

Text:

1. Gary J. Ordog, Management of Gunshot Wounds; Elsevier, New York, 1983.

References:

1. Brain J. Heard; Hand book of Firearms and Ballistics; John Willey, England, 1997.
2. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence; Stackpole Books, Harrisburg, PA, 1977.
3. D.A. Skoog, D.M. West and F.J. Holler; Analytical Chemistry: An Introduction; Saunders College Publishing, Philadephia, USA, (1994)
4. Dettean, J D; Kirk's Fire Investigation, 5th Ed, Prentice Hall, Eaglewood Cliffs, N.J (2002)
5. Working Procedure Manual: Chemistry, Explosives and Narcotics, BPR&D Pub (2000)

STATISTICS & RESEARCH METHODOLOGY

FS 551 **2-0-0-2**

Course Contents:
Unit I: Introduction to Research [7] Research– its definition and objectives, Types of Research, Research process, defining the research problem, research design.
Unit II: Sampling [8] Principles, methods: census and sample survey, sample design. Types of sampling, rationale for using a particular sampling procedure.
Unit III: Tools of Data Collection [7] Observation, interview schedule, questionnaire, Survey. case study methods
Unit IV: Statistics [8] Introduction, Descriptive Statistics: Frequency distribution, class intervals, graphical presentation: bar diagram, histogram, pie chart; Measures of Central Tendency: mean, median, mode; measures of dispersion: variance and std. deviation.
Unit V: Parametric and Nonparametric Statistics [9] Methods of correlation, skewness and Kurtosis variance, Types of correlation (Pearson r& Rho); Tests of significance. Level of significance, one sample, two samples and k-samples, Kruskall-Wallis ANOVA.

Text:

1. Creswell, John W. (2013). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. London: Sage

References:

2. Flick, Uwe (2009). An introduction to qualitative research. London:Sage.
3. Goertz, Gary & James Mahoney (2012). A tale of two cultures: qualitative and quantitative research in the social sciences.N.J. :Princeton University Press.
4. Hart, Chris (1998). Doing a literature review: releasing the social science research imagination. London: Sage.
5. Healey, J. F. (1993). Statistics: A Tool for Social Research.Belmont, CA: Wadsworth Publishing Company.
6. Scott, John (2000). Social Network Analysis: A handbook, London: Sage.
7. Yin, Robert (2009). Case study research: design and methods. London: Sage.

FORENSIC PRACTICAL-I

FS 561 **0-0-4-4**

1. Examination of physical properties of Soil.
2. Examination of physical properties of Glass.
3. Examination of physical properties of paints.

4. Physical examination of threads.
5. Comparison of different cloth pieces from crime scene.
6. Identification of fibers through chemical and instrumental analysis.
7. Sketching of the Indoor Crime scene (Indoor and Outdoor)
8. Sketching of the Indoor Crime scene
9. Photography of the Indoor crime scene
10. Photography of the Indoor crime scene
11. Collection, packaging and forwarding of trace evidences by Druggist Fold method.
12. Collection and preservation of various physical evidences (Fingerprint, blood, saliva, fiber, hair etc.).

SECOND SEMESTER

ELEMENTS OF FORENSIC MEDICINE, ODONTOLOGY

FS 502 **2-1-0-3**

Course Contents
Unit I: Introduction to Forensic Medicine [7] Definition of forensic medicine, Cause, manner and characteristics of death. Autopsy, Post mortem changes.
Unit II: Wounds and its medico legal significance [8] Basic injury production and healing mechanisms, Mechanical injuries (Abrasions, Bruises, Lacerations, Incised and stab wounds) and their medico legal significance.
Unit III: Causes and Manner of death [7] Deaths due to Asphyxia, Deaths due to fire, electrocution. Various Sexual offences including amendment in IPC
Unit IV: Forensic Odontology – I [8] Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification.
Unit V: Forensic Odontology – II [9] Bite marks: Types & forensic importance .Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law. Role of Forensic Odontology in mass disaster victim identification.

Text:

1. Modi's Medical Jurisprudence and Toxicology,23rd Edition, by K. Mathiharan & Amrit K. Patnaik, Third reprint, 2009, LexisNexis, Butterworth, New Delhi

References:

2. Essentials of forensic medicine, Dr. K. S. Narayan Reddy.
3. Forensic Medicine and toxicology, JB Mukherjee, Vol I & II.
4. Forensic Dentistry, Paul. G. Stimson & Curtis. A. Mertz, CRC
5. Forensic Odontology, Pramod .K. Dayal
6. Keith Simpson's , Forensic Medicine
7. Gleister's Medical Jurispridence and Toxicology, Churchill Livingstone Dental Anatomy Atlas, Whitaker

INSTRUMENTATION IN FORENSIC SCIENCE
(CHEMICAL, PHYSICAL and BIOLOGICAL)

FS 512 **3-1-0-4**

Course Contents:

Unit I: Chromatographic Techniques [10]

General principles, Paper chromatography, column chromatography, TLC, Adsorption chromatography, Partition chromatography, Gas chromatography, Gas- liquid chromatography, Ion-exchange chromatography, Exclusion (permeation) chromatography, Affinity chromatography, HPLC, HPTLC, Capillary Chromatography, Interfacing GC with IR spectrometry; High performance liquid chromatography, Electrospray ionization mass spectrometry Computer aided Analysis -Introduction, Computer organization - Hardware, Circuits for interfacing computers to Instruments, Computer Organization - software, Data representation, The Automated Laboratory.

Unit II: Spectroscopy [15]

Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection; Fluorescence and phosphorescence spectrophotometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods;
Atomic absorption spectrometry: Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis; Atomic emission spectrometry: Instrumentation and techniques, arc/spark emission, ICP-AES, comparison of ICP vs AAS methods, quantitative analysis, applications;
X-ray spectroscopy: X-ray absorption and fluorescence methods, X-ray diffraction, Auger emission spectroscopy (AES), electron spectroscopy for chemical analysis (ESCA);
Infrared spectrophotometry: Dispersive and Fourier Transform spectrophotometry, sample handling, quantitative analysis and interpretation of IR spectra;
Raman spectroscopy: Instrumentation, sample handling and illumination, structural analysis, polarization measurements and Dispersive & FT analysis; Radiochemical techniques: Basic principles and theory, introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis (NAA)

Unit III: Microscopy and Centrifugation Techniques [15]

Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges
Microscopy: Basic principles, Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infra red Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

Unit II: Mass Spectrometry [8]

Sample flow, Ionization methods, Mass Analyzer, Vaccum Systems, Data handling, Correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS), Ion Microprobe Mass Analyzer (IMMA), HR GCMS, LCMS, Secondary Mass Spectrometry, Laser Mass spectrometry, Fast Atom bombardment and liquid secondary Ion Mass spectrometry

Text:

1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).

References:

1. Lindsay S; High Performance Liquid Chromatography, Wiley & Sons NY (1992)
2. Handbook of TLC, 2nd Ed, Marcel Dekker; NY (1995)

3. Jarris, KE, A.L. Gray etal, Handbook of Inductively Coupled Plasma Mass Spectrometry, Glasgow Blockie, (1992)
4. Maclaffrty F.W. & F. Turecek; Interpretation of Mass spectra, 4th Ed., Mill Valley, CA Univ Science Books, (1993)
5. Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993)
6. Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.
7. N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.

INTRODUCTION TO QUESTIONED DOCUMENTS EXAMINATION

FS 522 **2-0-0-2**

Unit I: Introduction [6]

Nature and problems of document examination, classification of documents, procurement of standard admitted/ specimen writings, handling and marking of documents, preliminary examination of documents, Basis of handwriting identification – individuality of handwriting, natural variations, process of comparison, various types of documents – genuine and forged documents, holographic documents, various writing features and their estimation, general characteristics of handwriting, individual characteristic of handwriting, basic tools needed for forensic documents examination and their use.

Unit II: Author Determination [7]

Disguised writing and anonymous letters - identification of writer, Examination of signatures – characteristics of genuine and forged signatures, Examination of alterations, erasers, overwriting, additions and obliterations, Decipherment of secret, indented and charred documents, Examination of seal impression and other mechanical impressions.

Unit III: Examination of Photocopies [6]

Examination of black & white, colour Xeroxed copies, carbon copies, fax messages Forgeries and their detection - Various types of forgeries and their detection, Examination of built up documents – determination of sequence of strokes, Physical matching of documents, Identification of type writings– identification of typist, identification of printed matter – Various types of printing of security documents, Printing of currency notes, examination of counterfeit currency notes, passports, visa, stamp papers, postal stamps etc.

Unit IV: Determination of Age [7]

Determination of age of documents by examination of signatures – Paper, ink and writing/signatures etc. Examination of computer printout, identification of dot-matrix, ink-jet and laser printers, electronic typewriter, credit cards, Forensic stylistics, forensic linguistics, e- documents, digital signatures, An introduction to computer forensics, opinion writing, reasons for opinion.

Text:

1. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.

References:

1. Osborn, A. S. (1998). Classes of Questioned Documents. Questioned Documents, 2nd edition, First Indian reprint, Universal law publishing co. Pvt. Ltd., New Delhi.
2. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.

3. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
4. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
5. Cossidy, M.J., Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada, 1980.
6. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
7. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
8. Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
9. Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
10. Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.
11. Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
12. Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.

INTRODUCTION TO FORENSIC CHEMISTRY, TOXICOLOGY and PHARMACOLOGY

FS 532 **2-0-0-2**

Course Contents
Unit I: Introduction to Forensic Chemistry [5] Forensic Chemistry: Introduction, types of cases/exhibits, preliminary screening, presumptive test (colour and spot test), inorganic analysis, micro – chemical methods of analysis, Analysis of petroleum products.
Unit I: Toxicology of alcohol &Examination of Alcoholic Beverages [5] The fate of alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, Examination of alcoholic beverages; country made liquor, illicit liquor.Analysis of blood for alcohol.
Unit III: Drugs of Abuse [5] Introduction, classification of drugs of abuse, drugs of abuse in sports and doping, narcotics drugs and psychotropic substances, designers drugs and their forensic examination, Drugs and Cosmetic Act, Excise Act, NDPS Act.
Unit IV: Introduction to Toxicology [5] Definition, Law relating to poison, Classification of poisons. Action of poisons & factors modifying its action, routes of administration of poisons.
Unit V: Forensic Pharmacology [6] Pharmacology and toxicology of Psychotropic Drugs: Sedatives, Stimulants, Opiates and drugs of abuse. Extraction, Isolation of drugs from viscera, tissues and body fluids.

Text:

1. Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.

References:

1. A Burger; Medicinal Chemistry, Vol. II, Wiley Interscience, New York; (1970)
2. A.I Vogel; Textbook of Practical Organic Chemistry including Qualitative Organic Analysis; ELBS, Essex (1971)
3. Boudreau, JE et al – Arson & Arson Investigation, Survey & Assessment National Institute of Law Enforcement, U.S Deppt of Justice, US Govt. Printing Press (1977)
4. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
5. Gleason, M.N. et.al, Clinical Toxicology of Commercial products, Williams and Williams, Baltimore,

INTRODUCTION TO FORENSIC BIOTECHNOLOGY

FS 542 **2-0-0-2**

Course Contents
Unit 1:HAIR & FIBER [6] Structure of hair and its biochemical properties, Phases of hair growth, types of hair. Differences between animal and human hair, Forensic examination of different types of hairs. Different Types of fibers and their identification.
Unit 2 : INTRODUCTION TO BOTANICAL EVIDENCES & DIATOMS [5] Different botanical evidences of forensic significance: seeds, pollens etc .Diatoms: Classification, basic structure and morphology, forensic significance of diatoms.
Unit 3: INTRODUCTION TO FORENSIC ANTHROPOLOGY [5] Definition and scope of forensic anthropology, Human skeletal system and Types of bones. Estimation of age from skull and long bones, site and side determination. Estimation of Stature from skeletal remains. Determination of sex from skull, mandible and pelvis.
Unit 4:INTRODUCTION TO FORENSIC SEROLOGY [5] Definition and scope of forensic serology. Nature, composition and functions of blood and other fluids. Collection, preservation and packing of Biological fluids. Introduction to ABO, Rh, MN systems, Lectins – their forensic significance, Determination of secretor/ non secretor status. Antigens- Antibody reactions.
Unit 5:INTRODUCTION TO DNA PROFILING [5] Introduction to DNA , DNA biochemistry, Nuclear DNA and Mitochondrial DNA,. Significance of DNA profiling, Fundamental concepts and techniques applied in specific DNA tests, Scientific principles of forensic DNA typing. FTA cards, DNA extraction/isolation from different samples.

Text:

1. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References:

2. Pandey, B. P., Plant Anatomy; S. Chand, New Delhi, 1998.
3. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
4. Byrd, J. H. & Castner, J. L., Forensic Entomology, The Utility of Arthorpods in legal Investigation, CRC Press, USA, 2000.
5. Catts, E.P & Haskell N.H., Entomology and death: A procedural guide, Joyce's Print Shop, 1990.
6. Mauersberger, Herbert R., & Mathews, Textile Fibres – Their physical, Microscopic and chemical properties, John Wiley, New York, 1954.
7. Smith; DGV; A manual of Forensic Entomology Ithaca New York Camstock Univ. Press, USA, (1986)
8. Glaister's Book of Hairs Seta: Hair
9. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

DISASTER MANAGEMENT and VICTIM IDENTIFICATION

FS 552 **2-1-0-3**

Unit 1: Understanding Disasters [10]

Meaning, nature, characteristics and types of Disasters, Causes and effects, Disaster:
A Global View, Disaster Profile of India, The Disaster Management cycle, Geological and Mountain Area Disasters-Earthquakes, Volcanic Eruption, Landslides, Snow Avalanches; Wind and Water Related Natural Disaster-Floods and Flash Floods, Droughts, Cyclones, Tsunamis; Man Made Disasters-Understanding Man-Made Disasters, Fires and Forest Fires, Nuclear, Biological and Chemical disaster and Road Accidents.

Unit 2: Roles & Responsibilities of Different Agencies and Govt. [10]

Roll of Information, Education, Communication & Training, Role and Responsibilities of Central, State, District and local administration, Role and Responsibilities of Armed Forces, Police, Para Military Forces, Role and Responsibilities of International Agencies, NGO's, Community Based Org. (CBO's).

Unit 3: Technologies for Disaster Management [10]

Role of IT in Disaster Preparedness, Remote Sensing, GIS and GPS, Use and Application of Emerging Technologies, Application of Modern Technologies for the Emergency communication, Application and use of ICST for different disasters, Human Behaviour and Response: Psychological Response and Psychological Rehabilitation, Trauma and Stress Management, Rumour and Panic Management, Medical and Health Response to Different Disasters, Role of Information and Communication Technology in Response Management.

Unit 4: Relief Measures and Victim Identification [9]

Minimum Standard of Relief, Relief Management- essential components, Funding Relief- short term and long term, Disaster Site Management, Recovery, Victim Identification and Biometrics, Bite Marks, methodologies, DNA Analysis and techniques, Ear prints, methodologies and analysis, Lip Prints, Fingerprints from dead bodies.

Text:

1. Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi.

References:

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
3. Central Water Commission, 1987, Flood Atlas of India, CWC, New Delhi.
4. Central Water Commission, 1989, Manual of Flood Forecasting, New Delhi.
5. Government of India, 1997, Vulnerability Atlas of India, New Delhi.
6. Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.

FORENSIC PRACTICALS II

FS 562 **0-0-3-3**

1. Dental patterns and Recognition
2. Identification of individual teeth based on the morphological features.
3. Estimation of age from the teeth.
4. Living subject
5. Maxilla & mandible
6. Comparison and Identification of Individuals from bite marks
7. Autopsy
8. UV-Visible Spectrophotometer-working, sample preparation, analyzing graphs
9. IR Spectrophotometer- working, sample preparation, analyzing graphs
10. TLC of Ink Samples
11. Paper Chromatography

THIRD SEMESTER

FINGERPRINTING and FORENSIC PHOTOGRAPHY

Course Code: FS 601 **Credit Units: 2-1-0-3**

Course Contents
Unit I: Introduction to Photography [7] Introduction to forensic photography; Required equipments for photography – Camera, lens, shutter, depth of field, film; Importance of Forensic photography in a crime scene investigation.
Unit II: Types of Photography & Photo Prints [8] History and Development of Photography. Basic principles and techniques of Black & White and colour photography. Developing techniques and methods of photography, Different kinds of developers and fixers, modern developments in photography, linkage of cameras and film negatives.
Unit III: Introduction and Classification of fingerprints [7] Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation; Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints
Unit IV: Classification Systems and AFIS [8] Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC; AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications
Unit V: Fingerprint Developmental Techniques [9] Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.

Text:

1. Redsicker, D. R., The Practical methodology of Forensic Photography, CRC Press, London, 1994.
2. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

References:

1. Henry Horeustein; Colour Photography -A working Manual, Little Brown Co. Boston (1995)
2. B.H.E. Jacobson, Ray GG Attridge; The Manual of Photography, Focal Press, London (1988)
3. Jahne B; Digital Image Processing, Heidelberg Springer (1996)
4. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press (2002)
5. David R. Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press LLC (2001)
6. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

7. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

APPLIED COGNITIVE PSYCHOLOGY

FS 611 **2-1-0-3**

Unit 1: Cognitive Neuroscience [13]

Introduction, Philosophical antecedents, Emergence of Cognitive psychology, Approaches and key issues, Organization of Nervous system: Cognition in the Brain, Sensation, to representation, Theoretical approaches to perception, Deficits in perception. Attention and consciousness.

Unit 2: Memory [10]

Models, Processes, Practical Applications of Cognitive Psychology in improving memory processes, Representations and manipulation of Knowledge in: Images and Propositions: Spatial cognition and Cognitive Map.

Unit 3: Language [8]

Nature and Acquisition: Bilingualism and Multilingualism Reading: Bottom-up and Top-down processes, Comprehension, Neuropsychology of Language. Problem-solving and Creativity: Practical applications of cognitive psychology. Decision-making and reasoning: Deductive reasoning and inductive reasoning,

Unit 4: Intelligence [8]

Information possessing and intelligence, alternative approaches to Intelligence. Computer Simulation, improving intelligence.

Text:

1. Durso, F. T. (2007). Handbook of Applied Cognition (2nd Ed). New West Sussex : Wiley & Sons.

References

1. Esgate, A. et al. (2005). An Introduction to Applied Cognitive Psychology. Psychology Press: New York.
2. Sternberg, R. J. (Ed.) (2000). Handbook of intelligence. New York: Cambridge University Press.
3. Sternberg, R. J. (2009). Applied Cognitive Psychology: Perceiving Learning and Remembering. Australia:
4. Cengage Learning

SPEECH ANALYSIS and MULTIMEDIA FORENSICS

FS 621 **2-1-0-3**

Unit I: Speech [10]

Speech Anatomy, Mechanism of speech Production, Acoustic Properties of Vocal Tract, Uniqueness in person's voice, interspeaker and intraspeaker variation; Articulation- Manner & Place of Articulation, Phonemes, Vowel, Consonant and Glides; Phonetics in Speaker Identification, IPA (The International Phonetic Alphabets), Forensic Phonetics, Effect of context, Supra segmental (Prosodic features). Audio-enhancement, Sound Recording/Playback Devices: Analog Tape recorders, Digital recorder, Microphone types, Digital audio formats. Apex Court Judgments on Speaker Identification. Court presentation of report based on speaker identification.

Unit II: DSP [10]

Digital Signal Processing, A to D Conversion- Sampling, Quantization, Digital Audio Formats, Pulse Code Modulation, Coding and Decoding, Computer Representation of Speech Speaker Recognition: Principles of speaker recognition/identification, Methods on Speaker Recognition. Various approaches in Forensic Speaker Identification, Interpretation of result, Statistical interpretation of probability scale, Objective/Subjective methods, discriminating tests, closed test, open test, likelihood ratio calculation, Concept of test and error in Speaker Identification. Introduction to Pattern Recognition, Pattern Recognition application in Automatic Speaker Identification and Verification System, Different algorithm of automatic speaker identification.

Unit III: Audio Evidence [10]

Audio Evidence Examination: Handling of audio recording evidences, Procedure for preparation of working copies, Phonetic transcription, Analysis of linguistic & phonetic characteristics, Temporal measurement, Text-dependent and text-independent speaker recognition. Instrumental Analysis of speech sample: Verbatim, Clue words, IPA marking, CSL & Linear predictive coding technique, Fourier transformation, Examination using SPID, Vocal behaviors, alcohol speech relationships. Authentication of recorded audio: Type of alterations, Auditory Examination by Critical Listening. Waveform analysis, Speech Spectrographic analysis, Magnetic developing, Optical Method.

Unit IV: Video Evidence [9]

Introduction to video technology: Video standards, Recording formats- Analog and Digital, Introduction to video devices, Linear and Non-linear editing, Concept of video film production, Graphics and animation technique. Image perception, Colour space & representation, Storage, Image processing application. Introduction to image enhancement, Image restoration, Concept of digital water marking, Image compression, Retrieval of video files, Integrity of images, Facial image recognition. Forensic analysis of audio/video in video recording: Authentication of video recording, Visual examination technique on video frame sequence, Video image analysis- object, costumes, Facial image recognition from video frame image, Video signal analysis.

Text:

1. Philip Rose; Forensic Speaker Identification, Taylor and Francis, Forensic Science Series, ondon (2002)

References:

1. Arthur R Weeks Jr; Fundamentals of Electronic Image. SPIE Press, (2003)
2. Bengold & Nelson Moryson; Speech and Audio signal processing, John Wiley & Sons, USA (1999)
3. D.B. Fry; The Physics of Speech, Cambridge University Press. (2004)
4. David Cheshire; The Complete Book of Video Techniques Subjects Equipment, Dorling Kindersley, London (1992)
5. Des Lyver & Graham Swainson; Basics of Video Production, 2nd Ed. Focal Press (1999)
6. Dwight Bolinger et. al.; Aspects of Language, Third Edition, Harcourt Brace Jovanovich College Publishers, USA. (1981)
7. Gloria J. Borden et. al. Speech Science Primer (Physiology, Acoustics and perception of Speech), 6th Ed, a Wolters Kluwer Company, USA. (2011)
8. Harry Hollien; Forensic Voice Identification, Academic Press, London. (2001)
9. Harry Hollien; The Acoustics of Crime- The New Science of Forensic Phonetics, Plenum Press, New York and London (1990)
10. Husrev Taha Sencar, Nasir Memon; Digital Image Forensics: There is More to a Picture than Meets the Eye. Springer (2013)
11. John C. Russ; Forensic Uses of Digital Imaging CRC Press, (2001)
12. Martin Uren; BKSTS Illustrated Dictionary of Moving Image Technology, 4th Ed, CRC Press, (2013)
13. Oscar Tosi; Voice Identification-Theory of Legal Applications, University Park Press, Baltimore (1979)
14. O'Shaughnessy, Douglas; Speech Communication, Hyderabad Universities Press (2001)
15. Patricia Ashby; Speech Sounds, 2nd Ed. Routledge, London and New York (2005)
16. Randy Crane; A Simplified Approach to Image Processing, Prentice Hall. (1996)

17. Simon J. Godsill; Digital Audio Restoration, Springer, (1998)
18. Gary H. Anderson; Video Editing and Post-Production- A Professional Guide, 4th Ed,Focal Press, (1998)

FORENSIC PRACTICAL III

FS 631 **0-0-3-3**

1. Taking Photographs
2. Photography of Outdoor Crime Scene
3. Indoor photography including the laboratory
4. Presentation of Evidence through Photograph and charts.
5. Photography of documents and fingerprints (Transmitted light/Oblique light/U.V. Light Photography).
6. Taking of fingerprints on fingerprint chart.
7. Development of latent Finger Prints using powder methods.
8. Examination and comparison of security documents, fake currency and stamp papers.
9. Development of latent finger prints by Chemical methods and photography.
10. Development of latent finger prints by physical methods and photography.
11. Comparison of fingerprints, palm prints along on the basis of ridge characteristics and ridge details.
12. Recording of speech samples using tape recorder & digital recorders and measures for keeping it in the safe custody.
13. Speaker wise segregation of speech sample of recorded conversation spoken between two speakers.
14. Transfer of audio file from a digital media to other media using standard software and authentication of recorded speech.
15. Comparison of linguistic and phonetic features of audio recording voice samples of two speakers
16. Spectrographic analysis of voice samples of two speakers using voice spectrograph and comparison of their spectrographic features.
17. Video analysis and detection of tampered video files using Video analyzing tool.

ELECTIVES

Specialization A: Forensic Chemistry and Toxicology

ADVANCED FORENSIC CHEMISTRY

FS 641 **2-0-0-2**

Course Contents:
Unit I: Arson [5] Arson: Chemistry and Behavior of fire, origin and cause and their methods of investigation and evaluation of clue material, analysis of arson exhibits by various methods: Management of Arson cases.
Unit II: Motor Vehicle Fires [5] Causes, investigation, collection, preservation, packaging and analysis of evidences
Unit III: Analysis of Petroleum Products, Organic and Inorganic Substances [5] Examination of petroleum products: distillation and fractionation, various fractions and their commercial uses, standard methods of analysis of petroleum products for adulteration, Forensic analysis of organic and inorganic Industrial products, chemical fertilizers, insecticide, metallic and non-metallic products, consumer items.

Unit IV: Expert Witness [5] The role of Chemist as an expert witness. Presentation of the report in the court, Cross-examination of the expert
Unit V: Explosives [6] Classification, composition and characteristics of explosives, pyrotechnics, IEDs, systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, Explosives Act.

Text:

1. James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

References:

1. Carper, K. (ed.), Forensic Engineering, 2nd Edn. CRC Press, Bocarida, Florida, 2001.
2. Field, J., and Carper, K., Construction Failure, 2nd Edn. John Wiley and Sons, New York, 1996.
3. SAE Handbook, Vol. 4, On-Hghway and Off-Highway Machinery, Society of Auto mobile Engineers, 2000

ADVANCED FORENSIC PHARMACOLOGY & TOXICOLOGY

FS 651 **2-0-0-2**

Course Contents:
Unit I: Pharmacology-I [5] Sites and mechanisms of action of drugs, Dose-effect relationships; agonists, partial agonists and antagonists. Factor that modify drug actions; side effects, overdose, idyosincratic and allergic reactions; teratogenesis and foetal toxicity. Drug interactions.
Unit II: Pharmacology-II [5] The movement of drug molecules across cell membranes, the blood-brain barrier and the placental filter. Routes of administration and drug adsorption. Binding to plasma proteins. Drug distribution, metabolism and elimination. Drug bioavailability and half-life.
Unit III: Toxicology and Isolation techniques of toxins [5] Definition of Toxicology, Principle of Toxicology, Isolation of Toxic substances from viscera and other relevant materials. The role of drug recognition expert.
Unit IV: Different Toxins-I [5] Nature, administration, sign & symptoms, Fatal dose, postmortem findings, Detection and medicolegal aspects of- **a) Metallic poisons** Arsenic, Mercury **b) Vegetable poisons** Abrus Precatorius, Calotropis Gigantia,Castor ,Oleander, Aconite.
Unit V: Different Toxins-II [6] • **Insecticides** Organophosphorous compounds, Organochloro Compounds and Carbamates

- **Volatile Poisons** Methyl alcohol, Chloroform,
- **Asphyxiants** Cyanide, Carbon monoxide
- **Animal Poisons** Snake venom, Cantharide, Insect bite.

Text:

1. Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986

References:

1. Text book of pharmacology, Lawrence
2. A. Stolemen, Progress in Chemical Toxicology: Acad. Press, New York, 1963.
3. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
4. Gleason, M.N. et.al, Clinical Toxicology of Commercial products, Williams and Williams, Baltimore, USA, 1969.
5. Modi, Jaishing P, Textbook of Medical Jurisprudence & Toxicology, M.M. Tripathi Pub.2001.
6. Working Procedure Manual – Toxicology, BPR&D Publication, 2000

FORENSIC PRACTICAL IV A

(Chemistry, Pharmacology, Toxicology)

FS 661 **0-0-4-4**

1. Isolation techniques of different toxic substances.
2. TLC of insecticides, Barbiturates and other drugs.
3. Analysis of volatile and non-volatile poisons.
4. Analysis of vegetable poisons.
5. Spot test of nitrates, nitrites, carbonates, sulphates, sulphites, chlorates.
6. Spot test of mercury, iron, copper, Aluminum and cadmium and zinc and other metallic poisons

Specialization B: Forensic Biotechnology and DNA Profiling

ADVANCED FORENSIC BIOLOGY & ANTHROPOLOGY

FS 671 **2-0-0-2**

Course Contents
Unit I: Introduction to Wild Life Forensics [5] Introduction to wildlife forensics, Examination of pug marks, horn, skin, fur, hair, nail and teeth. Identification of some endangered species of plants and animals.. Wildlife life protection Act.
Unit II: Forensic Entomology & Forensic microbiology [5] Collection of insects, Shipment of collected insects, Identification of insect and its stage of growth. Determination of the postmortem interval or "time since death" in homicide investigations, forensic entomotoxicology. Introduction to forensic microbiology
Unit III: Forensic Anthropology [5]

Somatometry, osteometry & Craniometry. Identification of individuals from skeletal remains, Collection, Handling, preservation of skeletal remains of forensic science and report writing.
Unit IV: Forensic Taphonomy, Forensic Radiology [5] Forensic Taphonomy. Fire modification of bones .Assessment of antemortem and postmortem skeletal trauma. Artefacts in the skeletal remains. Application of radiology in forensic anthropology
Unit V:, Super Imposition &Facial Reconstruction [6] .Superimposition techniques. Facial reconstruction; three dimensional and computer assisted facial reconstruction

Text:

1. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References:

1. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
2. Byrd, J. H. & Castner, J. L., Forensic Entomology, The Utility of Arthorpods in legal Investigation, CRC Press, USA, 2000.
3. Encyclopedia of Forensic Sciences, Volume, I, II, II & IV, Edited By Jay A. Siegel, Geoffrey C. Knupfer & PekkaSaukko,AcamicPress,2000
   A laboratory manual on Biological Anthropology, Anthropometry, Indera P. Singh, M.K. Bhasin,: Kamla Raj Enterprises,1989
4. Advances in Forensic Taphonomy: Method, Theory, and Archaeological Perspectives ,William D. Haglund , Marcella H. Sorg, CRC Press; 1 edition, 2001
5. Brogdon's Forensic Radiology, Second Edition, Edited by Michael J. Thali, Mark D. Viner, B.G. Brogdon, Published November 22nd 2010 by CRC Press – 654 pages

ADVANCED FORENSIC SEROLOGY & DNA PROFILING

FS 681 **2-0-0-2**

Course Contents
Unit 1:Forensic Characterization of Blood Catalytic tests & crystal tests, Spectrophotometric method, chromatographic method, immunological methods, electrophoresis methods. Typing of blood antigens from dried stains. Lattes test, Absorption Elution, Absorption Inhibition, Mixed agglutination
Unit 2: Forensic Characterization Body Fluids Forensic characterization of semen, saliva, urine, faeces, milk and other biological fluids. Their identification and examination.
Unit 3: Determination of Species of Origin Determination of species origin. Extraction of species specific antigens from blood stains, and other body fluids .Tube technique (Precipitin test/Ring test), Diffusion methods; single diffusion, double diffusion,

and crossed-over electrophoresis, rocket electrophoresis.
Unit 4: Serogenetic Markers Introduction to isozymes and Polymorphic proteins. Typing of isozymes, like Phospho Glucomutase (PGM), Glyoxylase I(GLO), Esterase D(EsD), Adenylate Kinase (AK) .Typing of polymorphic serum proteins like Haptoglobin(Hp) &Transferrin (Tf) Introduction to Human Leucocyte Antigen. HLA Classification, HLA typing, Mol.based HLA typing.
Unit 5: DNA Profiling RFLP analysis, analysis of STR, SNP and Mitochondrial DNA, YSTRs, PCR amplifications, FTA cards, DNA chips. Forensic applications of DNA profiling, limitations of DNA profiling

Text:

1. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References

1. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
2. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
3. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida, 1999.
5. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
6. Blood grouping on man R.R. Race and Sanger. Blackwell Scientific Publications, Oxford, England. 1950.
7. Boorman K, Dodd B, Lincoln P. Blood group serology: Theory and Techniques: Practical Applications. 5th ed.

FORENSIC PRACTICAL IV B

FS 691 **0-0-4-4**

1. Determination of species of origin from blood &other biological evidences using precipitin test
2. Extraction /Isolation of Diatoms from water/soil, tissues &Identification
3. Identification of bones based on its morphology and anatomical planes
4. Sex Determination from Skull, Mandible, Pelvis & long bones
5. Presumptive and Confirmatory tests for blood
6. Examination and Identification body fluids
7. Microscopic Examination of Hair for the determination of species
8. Gel-Immuno Diffusion tests for species origin
9. Blood grouping from dried stains by Absorption Inhibition or Absorption Elution
10. Craniometry & Osteometry
11. Somatometry & Somatoscopy
12. Stature estimation from bones
13. Age Estimation from Skull, Mandible, Long bones

14. Sexing from Barr Bodies
15. Isolation of DNA from various sources-plants, bacteria and blood
16. PCR
17. RFLP and DNA Sequencing
18. DNA Estimation through Spectroscopic Methods
19. ImmunoElectrophoresis
20. Radial Immuno diffusion
21. ELISA
22. Double Diffusion Assay
23. Quantification of RNA

Specialization C: Questioned Document Examination

ADVANCED QUESTIONED DOCUMENT EXAMINATION

FS 603 **2-0-0-2**

Unit I: Graphology and Psychological Autopsy [5]

Police Psychology, Victimology, Criminal Profiling, Cognitive Psychology and Applications, Uses, Graphology: Introduction, Writing Systems, Graphology Learning Systems, Criminal Profiling through Handwriting, Lie Detection through Handwriting, Behavioral Estimations through Handwriting

Unit II: Stylistics and Linguistics [5]

Writing Systems, Historical Linguistics, Field Linguistics, Linguistic Phonetics, Phonology, Morphology, The Lexicon, Syntax, Generative Grammar, Functional Linguistics, Typology, An Introduction to Formal Semantics, Pragmatics: Language and Communication, Discourse Analysis, Linguistics and Literature, First Language Acquisition, Linguistics and Second Language Acquisition, Multilingualism, Natural Sign Languages, Sociolinguistics, Neurolinguistics, Computational Linguistics, Applied Linguistics, Educational Linguistics, Linguistics and Reading, Clinical Linguistics

Module III: Automated Signature/Handwriting Recognition Systems [5]

Introduction, Latest Trends in Automated System Development, Image Acquisition, Image Processing, Feature Quantification, Feature Extraction, Feature Processing, Comparison, Behavioral Biometrics, Introduction, Verification and Identification, Basic working of Biometric Matching, Accuracy, False Match Rate, False Non-match Rate, Failure to Enroll Rate.

Module IV: Advanced Detections of Forgeries [5]

Handwriting comparisons using Individual Characteristics, Fractured/cut edge comparisons (paper, tape, postage stamps, dryer sheets), Plastic bag comparisons, Printing process examinations (document authentication/typewriting classification), Charred and liquid soaked document preservation, Indented writing examinations, Alternate light source examinations (ink discrimination, alterations, enhancements), Office machine artifact comparisons; Database queries (Anonymous Letter File, Automated Counterfeit Identification Database, Bank Robbery Note File, Testimony in legal proceedings

Module V: Art Forgery [3]

Introduction, History, Artist Forgers, Dealer Forgers, Examination, Carbon Dating, White Lead Dating, X-Ray based Techniques, Dendrochronology, Stable Isotope Analysis, Thermo-luminescence, Craquelure, Digital Authentication, Morellian Analysis, Atomic Absorption Spectrophotometry, Inductively Coupled Plasma, Mass Spectrometry, Wavelet Decomposition, Photographic Forgery, Victorian Waifs, The Rospigliosi Cup Case Study, Etruscan Terracotta Warriors Case Study, Flower Portrait, Michelangelo's "Cupid" Case Study, Samson Ceramics, Getty Kouros, Copying vs. Forging, Pastiche, Association Research into Crimes against Art, Racketeer Influenced and Corrupt Organizations Act, Postal Fraud, Archaeological Forgery, Archaeoraptor, Neutron Activation Analysis

Module VI: Electronic Document Analysis [3]

Data and Evidence Recovery, Computer and cyber forensic basics, Cell Phones / Mobile Forensics, Bluetooth, Computer Ethics and Application Programs, Data and Evidence Recovery- Formatted Partition Recovery, Data Recovery Tools, Data Recovery Procedures and Ethics, Fine Transfer Protocol (FTP), Preserve and safely handle original media, Recover Internet Usage Data, Recover Swap Files/Temporary Files / Cache Files

Text:

1. Roy A Huber, A.M. Headrick; Handwriting Identification- Facts and Fundamental, CRC Press (1999)

References:

1. Rev ED, Ordway Hilton; Scientific Examination of Questioned Documents, Elsevier, NY (1982)
2. Albert S. Osborn; Questioned Documents, 2nd Ed., Universal Law Pub., Delhi (1998)
3. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998)
4. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971)
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001)
6. Hard less H.R; Disputed Documents, Handwriting and Thumbs – Print Identification, profusely illustrated, Law Book, Allahabad (1988)
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001)
8. Kurtz Sheila; Grapholypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983) w.e.f. 2005-2006
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001)
10. Mcmenamin, Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington, D.C. (2002)
11. Ellen David; Questioned Documents- Scientific Examination, Taylor & Francis, Washington (1997)
12. Andrea McNichol, Jeffrey A, Nelson; Handwriting Analysis-Putting It to Work for You, Jaico Books, Delhi (1994)
13. Vacca John R; Computer Forensics, Computer Crime Scene Investigation, Firewall Medial, An imprint of Laxmi Pub. (2002)
14. Casey Eoghan; Handbook of Computer Crime Investigation, Forensic Tools & Technology, Academic Press (2002)

DIGITAL IMAGE PROCESSING

FS 613 **2-0-0-2**

Unit I: Introduction and Fundamentals [5]

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain; Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit II: Image Enhancement in Frequency Domain [5]

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.

Unit III: Image Restoration [5]

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit IV: Registration and Segmentation [5]

Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements. Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit V: Feature Extraction [6]

Representation, Topological Attributes, Geometric Attributes, Boundary-based Description, Region-based Description and Relationship. Object Recognition; Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

Text:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.

References:

1. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
2. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ

FORENSIC PRACTICAL IV C

FS 623 **0-0-4-4**

1. Image enhancement
2. Image compression
3. Color image processing
4. Image segmentation
5. Image morphology
6. Image Restoration
7. Edge detection
8. Comparison of forged (disputed) signature with the specimen signatures.
9. Comparison of disguised (disputed) signature with specimen signatures.
10. Examination and comparison of disputed anonymous letter with specimen of suspect/suspects.
11. Identification of altered/added/obliterated/erased/handwriting on cheques and deeds.

FOURTH SEMESTER
DISSERTATION: RESEARCH WORK BASED PROJECT

FS 620 **Credits: 20**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curriculae where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

1. A short account of the activities that were undertaken as part of the project;
2. A statement about the extent to which the project has achieved its stated objectives;
3. A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
4. Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
5. Any problems that have arisen and may be useful to document for future reference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

Title or Cover Page

The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.

Acknowledgement(s)

Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.

Abstract

A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.

Conclusion(s) & Recommendations

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:

1. Did the research project meet its aims (check back to introduction for stated aims)?
2. What are the main findings of the research?
3. Are there any recommendations?
4. Do you have any conclusion on the research process itself?

Implications for Future Research

This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.

Appendices

The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References

References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples:

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect* , **8** (suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

The Layout Guidelines for the Project File & Project Report:

1. A4 size Paper
2. Font: Arial (10 points) or Times New Roman (12 points)
3. Line spacing: 1.5
4. Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following ***assessment objectives:***

1. Range of Research Methods used to obtain information
2. Execution of Research
3. Data Analysis (Analyze Quantitative/ Qualitative information)
4. Quality Control
5. Conclusions

Assessment Scheme:
Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.

Mody University of Science & Technology

MSc Maths

Session 2017-2018

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M. Sc. Mathematics

(Session 2016-2017 Onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20

Objectives: The proposed PG programme in Mathematics is a highly interesting and promising with broader opportunity for absorption in teaching, research and industry for students. The M.Sc. Mathematics programme offers core fundamental skills in Mathematics which incorporate the ideas of applied mathematical knowledge as well as provide platform to the student's regarding research oriented programmes in various interdisciplinary areas of mathematics.

Scope: The programme will generate interest of students towards fundamental mathematical research and will be able to qualify eligibility test for various fellowships.. Student will be able to select various options for higher studies like doctoral programmes in Computational numerical analysis, Advanced graph and pebbling theory, Algebraic and numerical topology, Approximation theory, Optimization techniques , Economics Fluid dynamics, Financial mathematics, Theory of computation and artificial intelligence, Mathematical modeling and simulation etc. Further, they have scope for absorption in research Labs in India like BARC, IISc, TIFR, IITs, ISRO, DRDO etc. as well as may get opportunity for doctoral or post doctoral research in India and abroad.

Input Qualification:

Bachelor's Degree in Science from any recognized university with Mathematics as a core subject for three years/six semesters, with 50% of aggregate marks and adequate proficiency in English.

Evaluation Procedure: All the Rules and Regulations as a provided in the Ordinance and regulations of the Undergraduate/postgraduate programmes of Mody University shall be followed. The first batch of this programme is proposed to be admitted in the session 2016-2017.

	M.Sc. Mathematics									
	Two-Year Programme									
	Academic Curriculum(Session 2016-2017 onwards)									
	First Year									
Autumn Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 511	Computer Based Advanced Numerical Analysis	3	1	-	4	3	25	25	50
	MS 521	Discrete Mathematics	3	1	-	4	3	25	25	50
	MS 531	General Topology	3	1	-	4	3	25	25	50
	MS 541	Operations Research	3	1	-	4	3	25	25	50
	MS 551	Statistics and Probability -I	3	1	-	4	3	25	25	50
	MS 561	Ordinary Differential Equations	3	1	-	4	3	25	25	50
		Sub Total	**18**	**6**	**-**	**24**				
		Foreign Language-I** (Non-Credit)	3	-	-	3	3	25	25	50
Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 512	Advanced Abstract Algebra	3	1	-	4	3	25	25	50
	MS 522	Complex Analysis and Integral Transform	3	1	-	4	3	25	25	50
	MS 532	Mathematical Modeling and Simulation	3	1	-	4	3	25	25	50
	MS 542	Partial Differential Equations	3	1	-	4	3	25	25	50
	MS 552	Statistics and Probability - II	3	1	-	4	3	25	25	50
	MS 562	Modeling and Simulation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**5**	**4**	**22**				
		Foreign Language-II **(Non-Credit)	3	-	-	3	3	25	25	50

** Refer to Foreign Language Section.

M.Sc.(Mathematics)

Two-Year Programme (2016- 17 and onwards)

Second Year

Autumn Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 611	Advanced Linear Algebra	3	1	-	4	3	25	25	50
MS 621	Advanced Graph Theory and Combinatorics	3	1	-	4	3	25	25	50
MS 631	Real Analysis and Measure Theory	3	1	-	4	3	25	25	50
MS 641	Special Functions and Integral Equations	3	1	-	4	3	25	25	50
	Elective-I	3	1	-	4	3	25	25	50
	Sub Total	**15**	**5**	**-**	**20**				

Spring Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 612	Functional Analysis	3	1	-	4	3	25	25	50
MS 622	Inequality and Continued Fractions	3	1	-	4	3	25	25	50
MS 632	Basics of MATLAB	-	-	4	2	4	100		
	Elective-II	3	1	-	4	3	25	25	50
MS 642	Dissertation	-	-	-	8		100		
	Sub Total	**9**	**3**	**4**	**22**				

Total Credits: 88 (I Year +II year)

Elective- I	**Elective- II**
MS 651 Magneto Hydrodynamics	MS 652 Viscous Fluid Dynamics
MS 661 Sequence and Series	MS 662 Summability and Approximation Theory
MS 671 Tensor Analysis	MS 672 Mechanics and Calculus of Variations
MS 681 Reliability Theories	MS 682 Fourier Analysis
MS 691 Advanced Number Theory	MS 692 Differential Geometry

* CW (Course work): It would include attendance, assignments, class /quiz test.

Note: Combinations of electives are: MS 651 & MS 652; MS 661 & MS 662; MS 671 & MS 672; MS 681 & MS 682; MS 691 & MS 692.

(Above II year is taken from AC 30, syllabus in AC 30 minutes)

MS 511 Computer Based Advanced Numerical Analysis 3-1-0-4

1. Algebraic and Transcendental Equations: General iterative methods, Newton-Raphson method for finding multiple roots, system of non linear equations, convergence of Newton-Raphson method, Graeffe's root squaring method, Muller's method , Bairstow iterative method. **[08]**

2. System of Linear Equations: Existence of solution, ill-conditioned system, Gauss elimination with pivoting, Gauss-Jordan method, triangular factorization method, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. **[08]**

3. Boundary Value and Eigen Value Problems: Solution of Eigen values problems by power method, Jacobi method, finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method. **[08]**

4. Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations. **[09]**

5. Difference Equations and Curve Fitting: Homogeneous difference equations with constant coefficients, particular solutions of a difference equations, curve fitting and regression, least square method, fitting of straight line and second order polynomials. **[06]**

Text Books:

1. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
2. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.
3. Jain M.K. and Iyenger S.R.K.(2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.

MS 521 **Discrete Mathematics** **3-1-0-4**

1. Relation and Function: Definition of set, different forms, properties and operations, principle of inclusion and exclusion, partition of a set, definition and types of a relation, composition, properties, graphical representation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice, different forms, properties, definition and kinds of a function, composition and properties of functions, recursively defined functions. **[10]**

2. Logics and Proofs: Propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, notion of a proof and methods for constructing proofs, normal forms (disjunctive and conjunctive), proof methods and strategy, statements of Fermat's last theorem, the $(3x + 1)$ conjecture and Godel's incompleteness theorem, program correctness. **[10]**

3. Induction and Counting: Mathematical induction, strong induction and well-ordering, recursive definitions and structural induction, recursive algorithms, basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

4. Graphs and Finite Automata: Graph and digraphs,, Konigsberg bridge problem, finite and infinite graphs, incidence and degree, isolated vertex, pendant vertex, and null graph, isomorphism, sub graphs, walk, path and circuits, connected graphs, disconnected graphs and components, Euler graphs, operation on graphs, Hamiltonian paths and circuits, traveling salesman problem, types and properties of tree, matrix representation of graphs; deterministic and non-deterministic finite automata, transition table and transition diagram, Mealy and Moore machines, minimization of finite automation. **[10]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International.

Reference Books:

1. Tremblay(1997), Discrete Mathematical Structures with Application to Computer Science, 35th reprint 2008,Mc Graw Hill Education,
2. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd ed., Mc Graw Hill Education, New Delhi.
3. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.

MS 531 **General Topology** **3-1-0-4**

1. Metric and Topological Spaces: Definition and examples of metric spaces, open sets, closed sets, convergence, completeness and Baire's theorem, continuous mappings, spaces of continuous functions, Euclidean and unitary spaces, definition and examples of topological spaces, elementary concepts, open bases and open subbases, weak topologies, function algebras. **[08]**

2. Compactness: Compact spaces, products of spaces, Tychonoff's theorem and locally compact spaces, compactness for metric spaces, Ascoli's theorem. **[08]**

3. Separation: T_1 – spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohn's lemma and the Tietze extension theorem, Urysohn's imbedding theorem, Stone – Cech compactification. **[08]**

4. Connectedness: Connected spaces, the component of spaces, totally disconnected spaces, locally connected spaces. **[08]**

5. Approximation: Weierstrass approximation theorem, Stone-Weierstrass theorems locally compact Hausdrorff spaces, extended Stone-Weierstrass theorems. **[07]**

Text Books:

1. George F. Simmons (2015), Topology and Modern Analysis, reprint ed., McGraw Hill Education, New Delhi
2. Sharma J. N. and Vashistha A. R.(2010), Topology, 37th ed., Krishna Prakashan Media, Meerut.
3. Adams (2008), Introduction to Topology: Pure and Applied, 3rd reprint ed., Pearson.

Reference Books:

1. Cain L.(2012), Introduction to General Topology,1st impression. Pearson.
2. Armstrong (2014), Basic Topology, reprint ed., CBS Publication.
3. Seymour Lipschutz(1965), Schaum's Outline of Theory and Problems of General Topology, 1st ed.,McGraw Hill Education.

MS 541 **Operations Research**

3-1-0-4

1. Linear Programming: Dual simplex method, parametric linear programming, game theory, two person zero sum game, game with mixed strategies, graphical solution, solution by linear programming. **[10]**

2. Inventory and Replacement Models: Deterministic models purchase and manufacturing models, probabilistic models, replacement of items that deteriorate and whose maintenance and repair costs increases with time. **[10]**

3. Job Sequencing and Queuing Theory: N jobs two machines, N jobs three machines, two jobs N machines; elements of a queuing system, Kendall's notation, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞) models. **[10]**

4. Dynamic Programming and PERT-CPM: Bellman's principal, employment smoothing problem, cargo loading problem; project planning and scheduling using PERT-CPM. **[09]**

Text Books:

1. Gupta Prem Kumar and Hira D.S.(2007), Operations Research,4th ed., S. Chand & Company Ltd., New Delhi.
2. Kanti Swarup, Gupta P.K. and Man Mohan (2006), Operations Research, 3rd ed., Sultan Chand & Sons, New Delhi.
3. Hillier F.S. and Lieberman G.J. (2005), Introduction to Operations Research, 8th ed., McGraw Hill, New Delhi.

Reference Books:

1. Taha H.A. (2010),Operations Research-An Introduction, 9th ed., Macmillan Publishing Co., Inc., New York.
2. Hadly G.(1964), Nonlinear and Dynamic Programming , 2nd ed., Addison-Wesley, Reading Mass.

MS 551 **Statistics and Probability - I** **3-1-0-4**

1. Introductory Ideas: Recapitulation of basic probability theory, law of addition and multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[06]**

2. Random Variables: Theorems on random variables, distribution function, properties of distribution, discrete random variable, probability mass function (pmf), discrete distribution function, continuous random variable, probability density function (pdf), cumulative distribution function(cdf), moments, covariance, moments generating function, two-dimensional random variables (discrete and continuous), transformation of random variables. **[12]**

3. Distributions: Discrete-binomial, Poisson, geometric, uniform distributions, continuous-uniform, exponential, gamma, weibull, normal distributions. **[12]**

4. Correlation and Regression: Simple and partial correlations, linear and non-linear regressions, regression coefficients, properties, angle between two lines of regression, standard error of estimate rank, regression curve correlation. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
4. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
4. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

1. Second Order Differential Equations: Review of the general solution of the second order homogeneous differential equations, use of a known solution to find another solution, homogeneous equations with constant coefficients, method of undetermined coefficient and method of variation of parameters. **[08]**

2. Non-Linear Ordinary Differential Equations: Two dimensional autonomous systems and phase space analysis- critical points, proper and improper nodes, spiral points and saddle points, definition of stability, Lyapunov function, stable, unstable and center subspaces, Riccati's equation-general solution and the solution when one, two or three particular solutions are known. **[10]**

3. Total Differential Equations: Different forms and solutions, necessary and sufficient condition, geometrical meaning of equation containing three and four variables, total differential equations of second degree. **[07]**

4. Power Series Solutions: Review of power series, series solutions of first order equations (Taylor series method), second order linear equations, solution near a regular singular point (method of Forbenius) for different cases, particular integral and the point at infinity. **[08]**

5. Existence and Uniqueness of Initial Value Problems: The existence and uniqueness of solutions, method of successive approximations, Picard's theorem, solution of initial-value problems by Picard method. **[06]**

Text Books:

1. Deo S. C., Lakshmikantham and Raghvendra V.(2000), Text book of Ordinary Differential Equations, 2nd ed.,Tata Mc-Graw Hill.
2. Dennis G. Zill, Michael R Cullen (2009), Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.
3. M. Rama Mohana Rao (1980), Ordinary Differential Equations: Theory and Applications, 2nd ed., Affiliated East-West Press Pvt. Ltd., New Delhi.

Reference Books:

1. Birkhoff and Rota G., G.C. (1978) , Ordinary Differential Equations , 4th ed., John Wiley and Sons Inc., NY.
2. Boyce, W.E. and Diprima, R.C.(1986), Elementary Differential Equations and Boundary Value Problems ,4th ed., John Wiley and Sons Inc., NY.
3. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations , 18th ed.,S. Chand Limited.

MS 512 **Advanced Abstract Algebra** **3-1-0-4**

1. Groups: Introduction and preliminaries (equivalence relation, integers modulo n), group definition and basic axioms, examples (dihedral, symmetric, matrix, quaternion groups), subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, centralizers and normalizers, nilpotent groups, direct products. **[10]**

2. Homomorphism and Group Actions: Definition and examples, isomorphism theorems, groups acting on themselves by left multiplication (Cayley's theorem), groups acting on themselves by conjugation (the class equation), automorphisms, Sylow p-groups and Sylow theorem. **[10]**

3. Ring: Basic definitions, examples (polynomial rings, matrix rings, group rings), ideals, ring homomorphism, integral domains and fields, maximal and prime ideals, Euclidean domain, principal ideal domains, unique factorization domains, polynomial rings over fields, introduction to modules (vector space as a special case). **[10]**

4. Field: Basic theory of field extensions, algebraic extensions, splitting fields and algebraic closures, separable and inseparable extensions, finite fields, field automorphisms, fundamental theorem of Galois theory, Galois groups of polynomials, cyclotomic extension. **[09]**

Text Books:

1. Fraleigh J. B. (2003), Abstract Algebra, 7th Edition, Pearson.
2. Dummit and Foote(1991), Abstract Algebra,3rd ed., John Wiley & Sons, Inc.
3. Khanna and Bhambri (2009), A Course in Abstract Algebra , 3rd ed., Vikas Publishing.
4. Herstein I. N.(1996), Topics in Algebra, 3rd Edition, Wiley India.

Reference Books:

1. Thomas W. Hungerford (2012), AbstractAlgebra, 4th Edition, Springer.
2. Vashistha, Modern Algebra(2011), 4th ed., Krishna Prakashan Mandir, Meerut.
3. Artin(2012), Algebra, 7th Edition, PHI.

MS 522 **Complex Analysis and Integral Transform** **3-1-0-4**

1. Basics of Complex Analysis: Complex numbers, complex function and its derivative, basic transcendental functions, power series of functions, integration in the complex plane, residues and their use in integration. **[10]**

2. Laplace Transforms and Stability of Systems: Laplace transform and their inversion, introduction of stability, Nyquist stability criterion, generalized functions, Laplace transforms and stability. **[10]**

3. Mellin Transform: Definition and properties of Mellin transform, evaluation of Mellin transform complex variable method and applications. **[09]**

4. Hankel Transform: Elementary properties, inversion theorem, transform of derivatives of functions, transform of elementary functions, Parseval's relation, relation between Fourier and Hankel transforms, use of Hankel transform in the solution of partial differential equations, dual integral equations and mixed boundary value problems. **[10]**

Text Books:

1. David Wunsch A.(2009), Complex Variables with Applications, 3rd Edition, Pearson.
2. H.K. Pathak(2004), Complex Analysis , 3rd ed., Shiksha Sahitya Prakashan, Meerut.
3. Gupta and Vashistha(2010), Integral Transform,4th ed., Krishna publication Media, Meerut.
4. Ian N. Sneddon(1972), The Use of Integral transforms by, 2nd Printing Edition, McGraw Hill.

Reference Books:

1. Ahlfors(1987), Complex Analysis,3rd ed., McGraw Hill Education.
2. Rudin(2006), Real and Complex Analysis,2nd reprint , McGraw Hill Education.
3. Andrews & Shivamoggi(2007) , Integral Transforms for Engineers,3rd ed., PHI Learning.

MS 532 **Mathematical Modeling and Simulation** **3-1-0-4**

1. Introduction to Simulation and Modeling: System concepts and theories, attributes and types of systems, discrete and continuous, deterministic and stochastic, open and closed, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, developing system dynamic equations - first order (+ve, -ve) systems, pure second order (+ve, -ve) systems and general feedback systems, simulation of equations for different systems. **[14]**

2. Random Numbers and Random Variates: Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods. **[10]**

3. Discrete Event Simulation: Concepts, event scheduling versus time advance scheduling, list processing. **[05]**

4. Verification and Validation of Simulation Models: Introduction, input modeling, identifying the distribution of data, parameter estimation, goodness of fit tests, model building, , verification calibration and validation of models, output analysis- measures of performance and their estimation. **[10]**

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2013), Discrete- Event System Simulation , 5th ed.,, Pearson, 2013.
2. Averill M. Law(2006), Simulation Modeling and Analysis, 4th ed., McGraw Hill Education.
3. V.P. Singh (2009), System Modeling and Simulation, 3rd ed., New Age International Publishers.
4. Frank L. Severance (2009) System Modeling and Simulation: An Introduction , 4th ed., Wiley.

Reference Books:

1. Taha(2012), Operations Research: An Introduction, 15th Indian reprint, PHI.
2. Geoffrey Gordon (2012), System Simulation, 2nd ed.,, PHI.
3. J.N. Kapoor (1994), Mathematical Modeling, 2nd ed.,Wiley Eastern Limited, Fourth reprint.

MS 542 **Partial Differential Equations** **3-1-0-4**

1. Second Order Partial Differential Equations: Preliminaries of partial differential equations, review of the classification of second order partial differential equations to hyperbolic, elliptic and parabolic forms, reduction of linear and quasi-linear equations in two independent variables to their canonical forms, characteristic curves. **[06]**

2. Laplace equation: Solution by method of separation of variables, mean value property, weak and strong maximum principle, Poisson's formula, Dirichlet's principle, solution of Laplace equation in cylindrical and spherical polar coordinates. **[06]**

3. Heat Equation: Solution by method of separation of variables, initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results. **[06]**

4. Wave Equation: Solution by method of separation of variables, uniqueness, D'Alembert's method, solution by spherical means and Riemann method of solution. **[06]**

5. Green's Functions: Introduction, Green's function for Laplace equation, method of images, eigenfunction method, Green's function for the wave and diffusion equations, Helmholtz theorem. **[08]**

6. Laplace and Fourier Transforms: Basics of Laplace transform solutions of diffusion and wave equations, basics of Fourier transform solution of diffusion, wave and Laplace equations. **[07]**

Text Books:

1. Sankara Rao K. (2003), Introduction to Partial Differential Equations , 4th ed., PHI Pvt. Ltd.
2. Asmar(2010), Partial Differential Equations and Boundary Value Problems with Fourier series, 2nd ed., Pearson.
3. Sundarapandian(2012), Ordinary and Partial Differential Equations, 3rd ed.,McGraw Hill Education, New Delhi.
4. Bhamra (2013), Partial Differential Equations: An Introductory Treatment with Applications ,4th ed., PHI Learning.

Reference Books:

1. Raisinghaniya M.D. (2008) , Ordinary and Partial Differential Equations , 3rd ed.,S. Chand Limited.
2. Zauderer(E. 1989), Partial Differential Equations of Applied Mathematics , 2nd ed., John Wiley and Sons, New York.
3. L Debnath(2007), Nonlinear PDE's for Scientists and Engineers , Birkhauser, Boston.
4. Sneddon I.N. (1957) , Elements of Partial Differential Equations, 2nd ed., McGraw Hill Book Company.

MS 552 **Statistics and Probability -II** **3-1-0-4**

1. Tests of Hypotheses: Simple hypothesis versus simple alternative, composite hypotheses, sampling from the normal distribution, tests on the mean and variance, tests on several means and variances, Chi-square tests, tests of hypotheses and confidence intervals, sequential tests of hypotheses. **[10]**

2. **Sampling and Sampling Distributions:** Sampling-inductive inference, populations and samples, distribution of samples, statistics and sample moments, sample mean and variance, law of large numbers, central limit theorem and its applications, sampling from the normal distributions, role of the normal distribution in statistics, sample mean, Chi-square distribution, F distribution, student's t distribution. **[10]**

3. Random Processes: Basics of random process, random process concept, continuous and discrete, statistics of random process, classification of random process, stationary and evolutionary random processes, cross-correlation, Markov process and Markov chain, binomial, Poisson, normal, Ergodic, random telegraph , sine wave random processes. **[11]**

4. Time Series Analysis: Introduction, characteristics movements in a time series, time series models, measurement of trends, secular trend, seasonal movements, cyclical movement, irregular movements, long cycles and applications. **[08]**

Text Books:

5. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
6. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
7. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
8. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

5. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
6. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
7. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
8. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

MS 562 **Modeling and Simulation Laboratory** **0-0-4-2**

Modeling and Simulation Laboratory related to Course Code MS 532 (Mathematical Modeling and Simulation).

(BELOW FROM 34TH PGRPC

MS 611 **Advanced Linear Algebra** **3-1-0-4**

1. Vector Spaces and Linear Equations: Fields, vector spaces, subspaces, bases, dimension, span, coordinates, row reduced echelon matrices, invertible matrices, row and column space, system of linear equations, direct sum, determinants. **[08]**

2. Linear Transformations: Definition of linear transformations, kernel, range, rank-nullity theorem, algebra of linear transformations, representation of transformations by matrices, eigenvalues, eigenvectors, diagonalization, invariant subspaces, invertibility and isomorphisms, linear functional, transpose of a linear transformation, dual spaces. **[08]**

3. Inner Product Space and Norms: Definition of an inner product and its properties, (including the Cauchy Schwartz inequality), orthogonality, Gram-Schmidt orthogonalization process, orthogonal projections, minimization problem (least squares), adjoints. **[08]**

4. Operators on Inner Product Spaces: Unitary and orthogonal operators and their matrices, normal and self-adjoint operators, bilinear and quadratic forms on inner product spaces, spectral theory. **[08]**

5. Rational and Jordan Forms: Cyclic subspaces and annihiliators, Jordon canonical form, minimal polynomial, block matrices and matrix factorization, SVD and pseudoinverse. **[07]**

Text Books:

1. Friedbeg, Insel, Spence (2011) Linear Algebra, 4th Edition, PHI.
2. David C. L. (2002) Linear Algebra and its Applications, 3rd Edition, Pearson.

Reference Books:

1. Kumaresan S. (2000) Linear Algebra: A Geometric Approach, PHI.

2. Charles. W. C. (2012) Linear Algebra: An Introductory Approach, 3rd Edition, Springer.
3. RomanS. (2008) Advanced Linear Algebra, 3rd Edition, Springer.
4. Cheney, Kincaid (2012) Linear Algebra: Theory and Applications, 2nd Edition, Jones and Bartlet.

MA 621 Advanced Graph Theory and Combinatorics 3-1-0-4

1.Preliminaries: Graphs(undirected and directed), sub graphs, degree-sum formula, graphic sequences, matrix representations of a graph, path and circuits, bipartite graphs, graph isomorphism, decomposition,Euler graph and its properties,operations on graphs, Hamiltonian paths and circuits, traveling –salesman problem. **[08]**

2. Trees, Cut-Sets and Cut-Vertices: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's and Prim's algorithms, cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism. **[08]**

3. Planarity, Matching, Coloring and Covering: Combinatorial versus geometric graphs, geometric and combinatorial duals of a graph, planar embeddings, Euler's formula, triangulation, Kuratowski's theorem, dual graphs, factors and matching (in bipartite and non-bipartite graphs), Hall's matching theorem, chromatic number, chromating partitioning, chromatic polynomial, matching, coverings, the four color problem. **[08]**

4.Pebbling on Graph: Pebbling on undirected graph with properties, pebbling number, cover pebbling, the staching theorem, pebbling on directed graph with properties, pebbling on isomorphic graphs, pebbling of cyclic graph, alternating wheel graph, alternating fan graph and alternating complete graph with their properties, extension of graph pebbling. **[08]**

5. Advance Counting Techniques: Recurrence relations, solving linear recurrence relations, divide-and-conquer algorithms and recurrence relations, generating function, inclusion-exclusion with applications. **[07]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science,

PHI.
2. Chartland G., Zhang P. (2006)Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. Yerger C.R.(2005) Extensions of Graph Pebbling, Thesis.
4. Ore O. (1991) Theory of Graphs, Volume 38, American Mathematical Society, Colloquium Publications.
5. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.
6. Kenneth H R. (2007) Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7thEdition, Mc Graw Hill Education.

MS 631 **Real Analysis and Measure Theory** **3-1-0-4**

1. Metric Spaces: Review of the real number system (supremum, infimum, field, order and completeness axioms, extended real number system, basic notions of sets, relation and functions), finite, countable and uncountable sets, open and closed sets, adherent and accumulation points, Bolzano-Weistrass theorem, Heine-Borel covering theorem, compactness in R^n and in general metric spaces, connectedness. **[08]**

2. Limits and Continuity: Convergent sequences, Cauchy sequences, complete metric spaces, limit of a function, continuous functions, uniform continuity, convergence of series, rearrangements, Abel's and Dirichlet's theorem, sequence of functions, point wise and uniform convergence, sequential compactness, Ascoli-Arzela theorem, real power series, Weistrass theorem. **[08]**

3. Differentiation and Riemann Integration: Algebra of derivatives, the chain rule, differentiation of monotone functions (leading to the mean value theorem and intermediate value theorem), upper and lower integrals, oscillations, integrality of continuous functions, fundamental theorem of calculus, interchange of limit and integration operations, vector valued differentiation and integration. **[08]**

4. Measure Theory: Indicator functions, fields and σ-fields, definition and fundamental properties of a non-negative measure, measurable sets, measure zero sets, positive Borel measures,Lebesgue measure,algebra of measurable functions, almost everywhere convergence, convergence in measure. **[08]**

5. Integration Theory on General Measure Spaces: The Lebesgue integral, Fatou's Lemma, the monotone and dominated convergence theorems, continuous functions with compact support, Tonelli and Fubini's theorems, comparison of proper and improper Lebesgue and Riemann integrals. **[07]**

Text Books:

1. Rudin W.(1976)Principles of Mathematical Analysis, 3rd Edition, TMH.
2. Bartle R. G., Donald R. S. (2011)Introduction to Analysis, 2nd Edition, Wiley and Sons.

Reference Books:

1. Royden H.L. (2017)Real Analysis , 2nd Edition, PHI
2. Apostle (1997)Mathematical Analysis , 2nd Edition, Narosa Publishing House,
3. Carothers N. L. (2000) Real Analysis, 2nd Edition, Cambridge University Press.
4. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.

MS 641 **Special Functions and Integral Equations** **3-1-0-4**

1. Hypergeometric Functions: Definition, convergence, gamma and beta functions, Gauss hypergeometric function and its properties, series solution of Gauss hypergeometric equation, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, Kummer's confluent hyper geometric function and its properties, integral representation. **[10]**

2.Bessel and Legendre Functions: Definition, connection with hypergeometric function, differential and pure recurrence relations, generating function, integral representation, orthogonal properties. **[10]**

3.Linear Integral Equations: Definition and classification, conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions, solution of homogeneous and general Fredholm integral equations of second kind with separable kernels. **[10]**

4.Solution of Integral Equations: Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations, Resolvent kernel and its results, conditions of uniform convergence and uniqueness of series solution, solution of Volterra integral equations of second kind with convolution type kernels by Laplace transform. **[09]**

Text Books:

1. Kanwal R.P. (1971)Linear Integral Equations: Theory and Techniques,Academic Press, New York.
2. Miller LieW. Jr. (1968)Theory and Special Functions,Academic Press, New York and London.

Reference Books:

1. Rainville E.D. (1960) Special Functions, Macmillan Company, New York.
2. Wazwaz A. M. (2011)Linear and Non Linear Integral Equations: Methods and Applications,Higher Education Press, Springer.
3. Banerjee P.K., Goyal M.C. (2003) Special Functions and Calculus of Variations, Ramesh Book Depot. Jaipur, India.
4. Swarup S., Singh S. J. (2014) Integral Equation, 22nd Edition, Krishna Prakashan Meerut.

MS 612 **Functional Analysis** **3-1-0-4**

1. General Theory: Introduction of topological vector spaces, separation properties, linear mappings, finite-dimensional spaces, metrization, boundedness and continuity, seminorms and local convexity, quotient spaces, completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

2. Completeness and Compactness: Completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

3.Duality in Banach Spaces and Applications I: The normed dual of a normal space, adjoints, compact operators, continuity theorem, closed subspaces of Lp-spaces, the range of a vector-valued measure, **[10]**

4.Duality in Banach Spaces and Applications II: Generalized Stone-Weierstrass theorem, two interpolation theorems, Kakutani's fixed point theorem, Haar measure on compact groups, uncomplemented subspaces, sum of Poisson kernels, two more fixed point theorems. **[09]**

Text Books:

1. Rudin W. (2006) Functional Analysis, McGraw Hill Education (India).
2. Limaye B.V.(2013)Functional Analysis, 3rd Edition, New Age International.

Reference Books:

3. Somasundaram D. (2014) First Course in Functional Analysis, 1 Edition, Narosa Book Distribution Pvt. Ltd.
4. Corlson, Robert (2006) Concrete Introduction to Real Analysis, Vikas publishing House Pvt. Ltd.
5. Kreyszig E. (2007) Introductory Functional Analysis with Applications John Wiley & Sons.

MS 622 **Inequality and Continued Fractions** **3-1-0-4**

1. Inequalities: Definition and important properties**,** maximum and minimum values of algebraic functions and expressions with and without constraints, some important inequalities, Weirstrass inequality, Schwarz's or Cauchy's inequality,Tchebychef's inequality, important proofs and theorems. **[10]**

2. Continued Fractions I: Definition and different form of continued fractions, simple, infinite or non terminating and terminating continued fractions, continued fractions with positive quotients, conversion of fraction into continued fraction, successive convergent, law of formation of successive convergent of simple continued fraction. **[10]**

3. Continued Fractions II: Difference between the fraction and its convergent, equivalent numbers and periodic continued fractions, some special quadratic surds, recurring continued fraction. **[10]**

4. Continued Fractions III: Different theorems based on odd and even convergent, limits to error in convergent for the continued fraction, series of fractions and approximation. **[09]**

Text Books:

1. Hardy G. H., Littlewood J. E., Polya G. (1952) Inequalities, Cambridge University Press.
2. Hardy G. H., Wrihgt E.M. (1979) An Introduction to Theory of Numbers, 5th Edition, Oxford, University Press.

Reference Books:

1. Niven, Zuckerman H. S., Montgomery H. L. (2004) An Introduction to the Theory of Numbers, 5th Edition, John Wiley and Sons, Inc., New York.
2. Bruce C. B. (2005)Ramanujan's Note Books Volume-1 to 5, Springer.
3. ApostolT. M. (2013)Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi.

MS 632 **Basics of MATLAB** **0-0-4-2**

1. Introduction: MATLAB interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. **[08]**

2. Functions and Files: Elementary mathematical functions, user defined functions, additional functions, working with data files. **[06]**

3. Decision-Making Programs: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[06]**

4. Advanced Plotting and Model Building: *xy* Plotting functions, additional commands and plot types, interactive plotting, function discovery, regression, basic fitting interface, three dimensional plots. **[06]**

Text Books:

1. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.
2. William J. Palm III (2012), A Concise Introduction to MATLAB, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.
2. Stormy A. (Edition 4), MATLAB: A Practical Introduction to Programming and Problem Solving, BH Publication.

MS 651 **Magneto Hydrodynamics** **3-1-0-4**

1. Fundamental Equations of MFD: Electromagnetic field equations(charge conservation equation, constitutive equations, Maxwell's equations, generalized Ohm's law),fluid dynamics field equations(equation of state, equation of motion, equation of energy), MFD approximation, magnetic field equation, magnetic Reynolds number, Alfven's theorem, magnetic energy, electromagnetic stresses, force free magnetic fields. **[10]**

2. Basic Equations of MHD Flow: Boundary conditions, flow between parallel plates, Hartmann flow, Couette flow with velocity and temperature distributions, flowin a tube of rectangular cross section, pipe flow, flow in a annular channel, flow between two rotating coaxial cylinder. **[10]**

3. Boundary Layer Approximation: Two dimensional boundary layer equations for flow over a plane surface for fluids of large electrical conductivity, flow past a semi infinite rigid flate plate in an aligned and transverse magnetic field, two dimensional thermal boundary layer equations for flow over a plane surface, heat transfer in MHD boundary layer flow past a flate plate in an aligned magnetic field. **[10]**

4. Magneto Hydrodynamics Waves: Waves in an infinite fluid of infinite electrical conductivity, Alfven waves, waves in a compressible fluid, waves in the presence of dissipative effects, stationary plane shock waves in absence of magnetic field. **[09]**

Text Books:

1. Cramer R.K., Pai S.I.(1973) Magnetofluid Dynamics for Engineers and Physicists, Scripta Publishing Company, Washington D. C.
2. Charlton P.(1985) Text Book on Fluid Dynamics, CBS Publications, Delhi.

Reference Books:

1. Shereliff J.A. (1965) Magneto Hhydrodynamics, Pergamon Press, London.
2. Rathy R.K. (1976)an Introduction to Fluid Dynamics Oxford and IBH Publishing Company, New Delhi.

MS 652 **Viscous Fluid Dynamics** **3-1-0-4**

1. Fluid Motion: Introduction and continuum hypothesis, constitutive equations for Newtonian fluids, viscosity, Navier Stoke's equation for viscous compressible flow, vorticity and circulation, equation of energy, flow between two concentric rotating cylinders, stagnation point it two dimensional flow, flow due to plane wall suddenly set in motion(Stoke's first problem). **[10]**

2. Temperature Distribution: Physical importance of non-dimensional parameters. Renold's number, Prandtl number, Mach number, Froude Number, Nusselt number , plane couette flow, plane poisseullecouette flow, plane poissuille flow, Haigen poissuille flow in a circular pipe, Stoke's equation of very slow motion, Stoke's stream function, flow past a sphere. **[10]**

3. Laminar Flow: Two dimensionalincompressible boundary layer equation, Blasuis Topfer solution of boundary layer on a flat plate, wedge flow, flow in a convergent channel, flow in the wake of flat plate, two dimensional plane jet flow. **[10]**

4. Boundary Layer Theory: Thermal boundary layer in two dimensional incompressible flows, Crocco's integrals, forced convection in laminar boundary layer on a flat plate, free convection from a heated vertical plate, Karman momentum and kinetic energy integral equations. **[09]**

Text Books:

1. Schliching H., Boundary Layer Theory, McGraw Hill.
2. Pai, S.I, Nostrand D.V. (1956) Viscous Flow Theory, Vol.I, Laminar Flow, Company, New York.

Reference Books:

1. BansalJ.L. (2004)Viscous Fluid Dynamics, Oxford and IBH.
2. Frank M. W. (1991)Viscous Fluid Flow,2nd edition, McGraw Hill.

MS 661 **Sequence and Series** **3-1-0-4**

1. **Real and Complex Numbers:**Introduction, field and order structures, bounded and unbounded sets with supremum and infimum, completeness, absolute value, limit points, closure, countable and uncountable sets,complex number system, triangle inequality, functions of single variable. **[12]**

2. Sequences: Sequences of real and complex numbers, limit points, limits, convergence and non-convergence, Cauchy's general principle of convergence, algebra of sequences, monotonic, point wise convergence, uniform convergence on an interval, tests for convergence, properties, Weierstrass approximation theorem. **[11]**

3.Infinite Series I: Introduction, series of real and complex numbers, positive term series, comparison, Cauchy's root, D'Alembert's ratio, Raabe's, Logarithmic, integral, Gauss's tests, series with arbitrary terms, rearrangement of terms. **[08]**

4.Infinite Series II: Properties of uniform convergent series, power series, properties of functions expressible as power series, Abel's theorem, Taylor's and Lauren's series with convergence. **[08]**

Text Books:

1. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.
2. Rudin W.(1976) Principles of Mathematical Analysis, 3rd Edition, TMH.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trignometric Series, Vol. 1, Cambridge University Press.
3. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.
4. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
5. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 662 **Summability and Approximation Theory** **3-1-0-4**

1. Transformation and Summability Means: Matrix and linear transformation, definition of summability, Norlund means and its regularity condition, Cesaro means (C, 1) means, Cesaro and holders matrices, consistency of methods, examples and related theorems. **[15]**

2.Convergence of Fourier Series: Convergence of Fourier series, Dirichlet's integral, Riemann-Lebesgue theorem, (C, 1) summability of Fourier series, Fejer theorem, Fejer-Lebesgue theorem. **[08]**

3. L_p Space: Definition of L_2space, L_p space, Bessel's inequality, Holders inequality and Minkowski inequality. **[08]**

4.Approximation Theory: Best approximation in normed space, linear operators, Weierstrass's approximation theorem, Stone Weierstrass theorem, Chebyshev polynomials, trigonometric polynomials, error approximation function, Bernstein polynomial. **[08]**

Text Books:

1. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
2. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trigonometric Series, Vol. 1, Cambridge University Press.
3. PetersonG. M (1966) Regular Matrix Transformation, Mc-Graw Hill.
4. Boss J. (2000) Classical and Modern Methods in Summability, Oxford University Press.
5. Mursaleen M. (2014) Applied Summability Methods, Springer.
6. Hrushikesh N., Haskar M, Pai D.V. (2000) Fundamentals of Approximation Theory, Narosa Publishing House.
7. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 671 **Tensor Analysis** **3-1-0-4**

1. Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors. **[10]**

2. The Tensor Concept: Zeroth-order tensors, first-order tensors, second-order tensors, higher-order tensors, transformation of tensors under rotation about a coordinate axis, invariance of tensor equations, curvilinear coordinates, tensors in generalized coordinate systems. **[10]**

3. Tensor Algebra: Addition of tensors, multiplication of tensors, contraction of tensors, symmetry properties of tensors, reduction of tensors to principal axes, invariants of tensors, pseudotensors. **[10]**

4. Vector and Tensor Analysis: Field concept, Gauss, Green And Stokes theorem, scalar fields, vector fields, second-order tensors fields, the operator ∇ and related differential operators. **[09]**

Text Books:

1. Vector and Tensor Analysis by A. I. Borisenko and I. E. Tarapov, Dover, 1979.
2. Introduction to Vector and Tensor Analysis by R. C. Wrede, Dover, 1972.

Reference Books:

1. DavisH. F., SniderA. D. (1995) Introduction to Vector Analysis, 7thEdition, Brown Publishers.
2. Schey H.M. (1997) Div, Grad, Curl and All That: An Informal Text on Vector Calculus, 2nd edition, W.W. Norton.
3. Bourne D.E., KendallP.C. (1977) Vector Analysis and Cartesian Tensors, Nelson.
4. Tensor Calculus by J. L. Synge and A. Schild, Dover, 1978.

MS 672 **Mechanics and Calculus of Variation** **3-1-0-4**

1. Generalized Coordinates: Holonomic and non holonomic systems, Scleronomic and Reonomic systems, generalized potential, Lagrange's equations of first kind, Lagrange's equations of second kind, uniqueness of solution, and energy equation of conservative fields. **[10]**

2. Hamilton's Variables: Donkin's theorem, Hamilton canonical equations, cyclic coordinates, Routh's equation, Poisson's bracket, Poisson's identity, Jacobi- Poisson theorem. **[10]**

3. Calculus of Variations: Motivating problems of calculus of variations, Brachistochrone problem, isoperimetric problem, geodesic, fundamentals lemma of calculus of variations, Euler's equation of one dependent function and its generalization to (i) 'n' dependent functions, (ii) higher order derivatives, conditional extremum under geometric constraints and integral constraints. **[10]**

4. Hamilton-Jacobi Theory: Hamilton's principal, principal of least action, Poincare Cartan integral invariant, Whittaker's equations, Jacobi's equations, statement of Lee Hwa Chung's theorem, Hamilton-Jacobi's equation, Jacobi's theorem, method of separation of variables. Lagrange's bracket and Poisson brackets, invariance of Lagrange's bracket and Poisson brackets under canonical transformations. **[09]**

Text Books

1. Ramsey A.S.(1941)Dynamics Part II, Cambridge University Press.
2. Goldstein H. (2002) Classical Mechanics, 3rd edition, Narosa Publishing House.

Reference Books:

1. Loney S.L. (2016) An Elementary Treatise on Statics, First paperback edition, Cambridge University Press.
2. Louis N. H., Janet D. F.(1999)Analytical Mechanics, Cambridge University Press.
3. Gelfand I M., Fomin S.V., Richard A. S. (2000) Calculus of Variations PHI.
4. Tiwari R.N., Takhur B.S. (2007) Classical Mechanics: Analytical Dynamics, PHI.

MS 681 **Reliability Theory** **3-1-0-4**

1. Basic Concepts of Reliability: Introduction, reliability and quality, failure and failure modes, causes of failures and unreliability, maintainability and availability, reliability analysis, mathematical models and numerical evaluation, designing for higher reliability, redundancy techniques, equipment hierarchy, reliability and cost. **[07]**

2. Reliability Mathematics: Random experiments and probability, random variables, discrete distribution (Binomial and Poisson) and Continuous distributions (uniform, exponential, Rayleigh, Weibull, gamma, normal, log normal, truncated normal, inverse Gaussian), numerical characteristics of random variables and Laplace transform. **[08]**

3. System Reliability and Hazard Models: Component reliability from test data, mean time to failure, time-dependent hazard models, stress-dependent hazard models, derivation of reliability function using Markov model, treatment of field data, system with components in series and parallel, k-out-of-m systems,non series-parallel systems, system with mixed-mode failures, fault-tree technique. **[08]**

4. System Design and Reliability Redundancy: Component versus unit redundancy, weakest-link technique, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy, maintainability and availability concepts with two-unit parallel system with repair, preventive maintenance. **[08]**

5. Reliability Testing Demonstration and Acceptance: Problem of life testing, estimation of parameters and reliability using standard probability models using complete and censored samples, properties of these estimators, probability plotting and graphical procedures for estimating the parameter and testing validity of model by some standard statistical tests, life test acceptance sampling plans in exponential case, sequential life test in exponential case, accelerated life tests. **[08]**

Text Books:

1. Ebeling C. E. (2015), An Introduction to Reliability and Maintainability Engineering, Eighteenth reprint, McGraw Hill Education.

Reference Books:

1. Balagurusamy E. (2008) Reliability Engineering, Sixth reprint, TMH.
2. Srinath L.S., Reliability Engineering, Fourth Edition, EWP.

MS 682 **Fourier Analysis** **3-1-0-4**

1. Fourier Series: Recapitulation about piecewise continuous functions, odd and even functions, periodic and non-periodic functions, orthogonal and orthonormal functions, orthonormal sets, Dirichlet's conditions, Fourier series, change of interval, Fourier cosine series, Fourier sine series, complex form of Fourier series, convergence of Fourier series, generalized Fourier series, practical harmonic analysis,Fourier–Bessel series, Fourier – Legendre series. **[10]**

2. Fourier Integral and Applications: The Fourier integral formula, Dirichlet's integral, Fourier integral theorem, cosine and sine integrals, Eigen value problems on unbounded intervals, superposition of solutions, steady temperature in a semi-infinite strip, temperature in a semi-infinite solid, temperature in an unlimited medium. **[10]**

3.Fourier Transform and Applications I: Definition and properties of Fourier transform, Fourier cosine and sine transforms, complex Fourier transform, convolution theorem, Parseval's identities, finite Fourier transforms, solution of some partial differential equations. **[10]**

4. Fourier Transform and Applications II: Discrete Fourier Transform (DFT), approximation of Fourier coefficients of a periodic function, inverse DFT, properties of DFT, cyclical convolution and convolution theorem for DFT, Parseval's theorem for DFT, matrix form, N-point inverse DFT, fast Fourier transform(FFT). **[09]**

Text Books:

1. Ward Brown J., ChurchillR. V. (2015) Fourier Series and Boundary Value Problems, McGraw Hill Education.
2. Davis H.F. (1989) Fourier series and Orthogonal Functions, Dover Books on Mathematics.

Reference Books:

1. Spiegel (2015) Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series), McGraw Hill Education.
2. Jain R.K., Iyengar S.R.K. (2003) Advanced Engineering Mathematics, Narosa Publishing House.
3. Tolstov G.P. (1976) Fourier series, Dover Books on Mathematics.
4. JamesI.F. (2002) A Student's Guide to Fourier Transform with Applications in Physics and Engineering, 3rd edition, Cambridge.

MS 691 **Advanced Number Theory** **3-1-0-4**

1. Divisibility Theory and Factorization: Prime numbers and their distribution, greatest common divisor and the Euclidian algorithm, linear Diophantine equation, sieve of Eratosthenes, Mersenne primes and perfect numbers, sums of two squares. **[08]**

2. Theory of Congruences: Basic properties of congruences, linear congruences and the Chinese remainder theorem, Fermat's little theorem and pseudoprimes, $\varphi(n)$ (Euler's phi function), Euler generalization of Fermat's theorem, Wilson's theorem. **[08]**

3. Primitive Roots and Quadratic Reciprocity: Multiplicative orders of integers modulo$n$, primitive roots of primes and composites, Legendre and Jacobi symbols, quadratic reciprocity and quadratic congruences with multiple moduli. **[08]**

4. Special Functions and Recent Applications: Fermat numbers, amicable numbers, the Mobius inversion formula, sums of more than two squares, public key cryptosystems, primalty testing and factorization, Diffie-Helman key exchange, finite fields, cyclotomic polynomials, Gaussian integers, continued fractions, Pells equations, valuations, Deedkind domain, the Riemann zeta(ζ) function, modular (quadratic) forms, quadratic number fields. **[15]**

Text Books:

1. BurtonD.M. (2011) Elementary Number Theory, 2nd Edition, Tata Mc Graw Hills.
2. Telang S.G. (1996) Number Theory, 6th Edition, Tata Mc Graw Hills.

Reference Books:

1. Murty V. K. (1998) Contemporary Mathematics (Number Theory), Wald Schmidt AMS Society.
2. Lang S. (1994) Algebraic Number Theory, 2ndEdition, Springer Textbooks.
3. LandauE. (1966)Elementary Number Theory, 2nd Edition, AMS.
4. Frohlich, Taylor, Taylor (1991) Algebraic Number Theory, 2nd Edition, Cambridge University Press.
5. Niven I., Zuckerman (1991) Introduction to Theory of Numbers, 5th Edition Montgomery, Wiley.

MS 692 **Differential Geometry** **3-1-0-4**

1. Space Curves I: Definition of space curves, arc length, natural equation of a line, and intersection of curves, intersection of curve and surface, order of contact, tangent, normal, osculating plane. **[10]**

2. Space Curves II: Principal normal and binormal at a point of a curve, curvature, torsion, Frenet – Serret formulae, plane curves, osculating circle and osculating sphere, fundamental theorem for space curves, helices, evolutes and involutes. **[10]**

3. Surfaces I: Definition of a surface, tangent plane and normal at a point of a surface, surfaces of revolution, conicoids and helicoids, envelopes and developable surfaces, ruled surfaces. **[10]**

4. Surfaces II: First fundamental form(metric), metric potentials, direction coefficients and angle between two curves on a surface, second fundamental form, lines of curvatures, principal curvatures, Meusnier's theorem, Euler's theorem, Dupin's indicatrix, means curvature, Gaussian curvature. **[09]**

Text Books:

1. Hsiung C. C. (1997) A First Course in Differential Geometry, International Press, and Cambridge, MA.
2. Willmore T.J. (1964) An Introduction to Differential Geometry, Oxford University Press,

Reference Books:

1. Carmo M. P. D. (1976) Differential Geometry of Curves and Surfaces, Prentice-Hall, Englewood, NJ.
2. Abate M., Tovena F. (2012) Curves and Surfaces, Springer.
3. PetersA. K. (2010) Differential Geometry of Curves and Surfaces, Ltd., Natick, Mass.
4. Struik D.J. (1988) Lectures on Classical Differential Geometry, 2nd Edition, Addison-Wesley.

Mody University of Science & Technology

MSc Microbiology
Session 2017-2018

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.- Microbiology

Two-Year Programme

Academic Curriculum (2013 – 14 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Autumn Semester	MB 511	Bacteriology and Phycology	3	-	-	3	3	25	25	50
	MB 521	Virology and Mycology	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 541	Laboratory Course in Study of Microorganisms	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**1**	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Spring Semester	MB 512	Microbial Physiology and Metabolism	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3	-	-	3	3	25	25	50
	MB 532	Immunology	3	-	-	3	3	25	25	50
	MB 631	Microbial Genetics	3	-		3	3	25	25	50
	MB 542	Seminar	-	-	-	1	-	100		
	MB 524	Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section.

M.Sc.-Microbiology
Two-Year Programme
Academic Curriculum (2013 – 14 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	MB 611	Medical Microbiology	3	1	-	4	3	25	25	50
	MB 681	Environmental and Agricultural Microbiology	3	1	-	4	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	MB 651	Medical, Environmental and Agricultural Microbiology Laboratory	-	-	4	2	4	100		
	MB 671	Genetic Engineering and Fermentation Technology Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**3**	**8**	**19**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	MB 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				
		Total Credits				**84**				

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Microbiology)

MB 511 Bacteriology and Phycology 3-0-0-3

General Concepts of Microbiology: History and development of Microbiology as a discipline of science, spontaneous generation vs biogenesis, Koch's postulates Basic features of microscopy-Compound, fluorescence, dark field, phase contrast, SEM and TEM, Staining methods-simple, differential and sample preparation for electron microscopy. [6]

Morphology and Ultrastructure of Bacteria: Basic ultrastructure, morphological types, cell walls of gram positive, gram negative and archeobacteria, cell wall biosynthesis, cytoplasmic membrane-structure, composition and functions, L-forms, Ultrastructure and types of flagella, capsule and its function, pilli. [8]

Cultivation of Bacteria: Aerobic and anaerobic cultivation, Nutrient media-selective and differential, Nutrient types of bacteria, Growth curve and kinetics of growth, Batch culture, fed-batch culture and continuous culture, synchronous growth, Factors affecting growth, Control of bacteria-physical and chemical agents. [10]

Classification: Bacterial classification, Hackle's three kingdom, Whittaker's five kingdom, Eight kingdom classification, Phenetic and phylogenetic classification, Outlines of Bergeys manual, Use of molecular approaches for classification of bacteria. [7]

Algae: General Characteristics, Classification, Nutrition, Reproduction, Algal ecology, Economic importance of Diatoms, Rhodophyta and Green algae. [8]

MB 521 Virology and Mycology 3-0-0-3

General Concepts of Viruses: Discovery of viruses, Distinctive features, Morphology and Ultrastructure, Envelope and its properties, Virus related agents (Viroids and Prions). Classification-General properties, Nomenclature and classification of bacterial, plant and animal viruses. [5]

General Methods of Diagnosis of Viruses: Cultivation methods-embryonated eggs, experimental animals, cell cultures (Primary and secondary), Serological methods- heamagglutination, complement fixation, immunofluoresecnce, ELISA and RIA, infectivity assay (end point method); Role of electron microscopy in study of viruses. [8]

Bacterial and Plant Viruses: Bacteriophage structure- general characteristics, Life cycle- Lytic and Lysogeny, One step growth curve, Regulation of lytic cycle, brief details of M13, Mu, Lambda and T4, Effect of viruses on plant appearance, histology, cytology, Transmission of plant viruses- Vector(insects, nematodes) and without vector, Common diseases of Paddy, Cotton, Tomato and Sugarcane, Life cycles- TMV, CMV and Potato Virus X. [10]

Animal Viruses: Life cycle and pathogenecity of RNA viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota and HIV, Oncogenic viruses, DNA viruses- Pox, Herpes, Adeno, SV 40, Hepatitis viruses, Basic concepts of viral vaccine. [8]

General Concepts of Mycology: General features of fungi, Classification of fungi, Life cycles of *Aspergillus*, *Saccharomyces*, *Deuteromycetes*, Mycorrhiza: Ecto, endo and VAM, Lichens- general features, Fungal diseases- Systemic and Sub cutaneous Mycoses, Candidiasis, Dermatomycosis. [8]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Molarity and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance. [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates. [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, Michelis Menten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary [6]

electrophoresis.

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean, median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean [6]

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis [9]

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 541 Laboratory Course in Study of Microorganisms 0-0-4-2

Assignments based on MB 511 and MB 521containing exercises on staining and isolation of different microbial types on the basis of cultural and microscopic methods will be conducted.

BC 541 Biomolecules and Instrumentation laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

MB 512 Microbial Physiology and Metabolism 3-0-0-3

Transport Mechanisms: Basic features of transport- Role of cell membrane in transport, Thermodynamics of transport, Types of transport- passive diffusion, facilitated diffusion, active transport, group translocation, uniport, symport and antiport, Transport of siderophores. [8]

Respiratory Metabolism: Glucose Metabolism- Reactions and control of Glycolysis, Pentose Phosphate Pathway, Gluconeogenesis, Citric acid cycle, Oxidative and Substrate level phosphorylation, Glyoxylate cycle, Homo and heterolactic fermentation, Pasteur effect. [10]

Photosynthesis: Brief account of photosynthetic and accessory pigments- Chlorophyll, Bacteriochlorophyll, Carotenoids and Phycobiliproteins, Details of Oxygenic and Anoxygenic photosynthesis, Major groups of photosynthetic bacteria, Fixation of CO_2- Calvin cycle, C3 and C4 pathway; Photorespiration. [10]

Nitrogen and Lipid Metabolism: Nitrogen cycle, Assimilation of nitrogen, Biosynthesis of amino acids, Nitrogen fixation- basic concepts, nitrogenase enzyme, Fatty acid oxidation- □-oxidation, Fatty acid biosynthesis. [6]

Sporulation and Morphogenesis: Endospore formation- structure, properties and germination; Dormancy in selected microbes [5]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori* [10]

Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 592 Bioinformatics , Scientific Communication & Intellectual Property Rights **3-1-0-4**

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management. 6

Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions. 8

Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins. 8

Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index. 3

Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International) 7

Biotechnology and Intellectual Property Rights.
Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy 7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 Molecular Biology 3-0-0-3

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity. [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 631 Microbial Genetics 3-0-0-3

Mutations: Basic concepts of mutation, Molecular nature of mutations, Spontaneous mutation, Reverse mutation, Frameshift mutation, Site directed mutagenesis- deletions, insertions, localized point mutation, Mutations by synthetic oligonucleotides, Evolutionary role of mutation. [8]

Gene Transfer: Transformation, Transduction- specialized and generalized, Conjugation- interrupted mating, Transfection. [8]

Vectors: Plasmids, Colicins and col factors, Plasmids as vectors for gene cloning, Transposons and their use in genetic analysis, Mechanisms of antibiotic resistance by transposons. [6]

Bacteriophage Genetics: Life cycle and uses of following phages in microbial genetics- Lytic phages- T4 and T7, Lysogenic phages- P1, M13, ΦX174, fd [9]

Gene Expression: Gene expression in eukaryotes and prokaryotes and its regulation [8]

MB 542 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver seminar on it.

MB 524 Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory 0-0-4-2

Assignments based on MB 512 MB 514 and MB 592 containing exercises on microbial physiology, genetics and metabolisms of microorganisms and their role in food production and spoilage will be conducted.

BT 572 Molecular Biology and Immunology Laboratory 0-0-4-2

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication 0-0-2-1

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

MB 611 Medical Microbiology 3-1-0-4

Normal Flora of Human Body: Skin, Oral cavity, Gastrointestinal tract, Respiratory tract, Urinogenital tract, Concept of opportunistic pathogens. [3]

Infection: Sources of infection for man, Vehicles or reservoirs of infection, Vertical and horizontal transmission of infection, Pathogenesis of infecting microorganisms-Virulence factors (adhesions, enzymes-coagulases, fibrinolysins, mucinases, lipase, proteases, nucleases, collagenase, neuraminidase). Toxins-endotoxins and exotoxins as agents of disease. [5]

Microbial Strategies for Evading Immune Response: Evading phagocytosis, Survival in phagocytes, Immunosuppression, Induction of ineffective antibodies, Antigenic variation, Avoiding induction of immune response. [5]

Bacterial Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of bacterial diseases caused by- *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Vibrio, Yersinia, Mycobacterium, Treponema, Mycoplasma, Campylobacter, Helicobacter, Rickettsiae and Chlamydiae.* [9]

Viral Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of viral diseases- Pox viruses (Small pox), Herpes viruses (HSV, Epstein-barr virus), Adenoviruses, Picorna viruses (Polio, Rhinoviruses), Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, RSV), Arboviruses (Dengue, Yellow fever,), Rhabdoviruses (Rabies), Hepatitis viruses, Rubella, Reovirus, Rotavirus, Viral Haemorrhagic Fevers, HIV, Oncogenic Viruses. [9]

Fungal and Protozoan Diseases: Pathogenesis, laboratory diagnosis and treatment of fungal and protozoan (Malaria, Kala Azar) diseases. [5]

Antimicrobial Agents: Mode of action of important antibacterial, antifungal, antiviral and antiprotozoan agents. [3]

MB 681 Environmental and Agricultural Microbiology 3-1-0-4

Aerobiology: Droplet nuclei, aerosols, Assessment of air quality- solid, liquid impingment, Air borne transmission of microbes [3]

Types of Soils- physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere [3]

Water Microbiology: Fresh water and marine habitats- general characteristics, Types of microbes, Microbial activity, Eutrophication and its effects, Assessment of water quality- water purification, Potability standards. [7]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles; Role of microbes in biodeterioration- Metal corrosion, Paper; Metal detoxification, Biopesticides. [10]

Microbes in Waste Treatment: Types of wastes- Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and

Tertiary treatment), Trickling filter, Biocontactor, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [8]

Nitrogen Fixation: Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic(Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications. [8]

MB 641 Industrial Microbiology and Fermentation Technology 3-0-0-3

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feed back repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (□-lactam, aminoglycosides). [12]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids. [5]

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomyces cereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

MB 651 Medical, Environmental and Agricultural Microbiology laboratory 0-0-4-2

Assignments based on MB 611 and MB 621 describing role of microorganisms in disease causing and prevention and their positive and negative role in environment and agriculture will be conducted.

MB 671 Genetic Engineering and Fermentation Technology laboratory 0-0-4-2

Assignments based on MB 641and BT 611 containing exercises on genetic engineering of microorganisms and their role in industrial production of various metabolites like antibiotics, vitamins and enzymes will be conducted.

Mody University of Science & Technology

M.Sc. Food and Nutrition
Session 2017-2018

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc-Food & Nutrition
Two Year Programme
Academic Year (2016-17) and onwards

Intake: 10

The specialists in F& N play a vital role in promoting the quality of life of individuals and communities, which contributes significantly to the economic and overall development of the nation. This achieved through a blend of academics, research training and extension as well as industrial applications. The post graduate programme in this discipline has been designed to provide the students intensive and extensive theoretical and experimental learning. The programme allows flexibility in the choice of thrust areas, which students can select, based on their career goals. It is envisaged that the current scenario at the regional and national level require trained professional in areas such as Public Nutrition, Dietetics and clinical Nutrition, Institutional Food administration as well as food science and quality control. Alternatively a broad-based programme covering several varied aspects in this discipline is also possible.

Objectives

The curriculum integrating several courses to provide professionally competent manpower for:

1. Academic and research institutions.
2. Hospital, food service intuitions and industry
3. Managerial roles in agencies and intuitions-both government and NGO sector
4. Planning & monitoring health programme
5. Ensuring food safety and quality for consumers
6. Entrepreneurial ventures
7. Advocacy and consultancy.

Careers

Nutritionists and dieticians could find employment in hospitals, health and recreation clubs, canteens, nursing care facilities; teach the science of nutrition and dietetics in colleges and universities, catering departments of star hotels, research labs of food manufacturers, in health departments of government etc. Moreover they could find openings in the mass media where top priority is given to disseminating vital information on healthy living. The main fields in which a dietician or nutritionists can work is in Food service field, Institutional Catering, Health Care field, Research & Development and Social Welfare. Food service field include food Catering service, Restaurants etc where professionals can do menu planning, monitoring the food preparation etc. Institutional Catering is another field where Nutrition and dietetics professionals are needed to plan, supervise and prepare nutritious and well-balanced meals for schools, colleges, factories or office cafeterias etc. Their work may also include the estimation and purchase of food supplies and equipment; receiving, checking and taking inventories of provisions etc. In Health Care field, people suffering from certain diseases such as diabetics, heart diseases, obesity etc, need to take extra care of their eating habits and the kind of food they eat. Research and Development involves conducting research on various food items to ensure their quality as well as studying the effects of various types of diet on the body chemistry in labs.

Eligibility

Pass with 50% aggregate marks in Bachelor's degree (Sciences, Medical and Applied Medical Sciences, Health and Allied health/Agriculture/ Food Sciences/ Bio-Sciences) or equivalent.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Post graduate Programmes of MITS shall be followed.

Resource Requirement:

One or two faculty of F&N specialist (depends on intake)
Consumables: Rs. 5 Lakhs per year

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2016 –17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FN 511	Basic Principle of Ayurvedic Diet	1	-	-	1	2	20	-	80
	FN 521	Basics of Human Physiology	3	-	-	3	3	25	25	50
	FN 531	Human Nutrition	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	FN 541	Basic Research Methodology	2	-	-	2	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	-	-	100
		Sub Total	**18**	1	**4**	**21**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BC 522	Nutritional Biochemistry	3	-	-	3	3	25	25	50
	FN 512	Food Packaging and Quality Control	3	-	-	3	3	25	25	50
	FN 522	Women Nutrition and Health	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	FN 532	Nutrition For Health And Fitness	3	-	-	3	3	25	25	50
	FN 542	Nutraceuticals & Functional Foods	3	-	-	3	3	25	25	50
	FN 552	Seminar	-	-	-	1	-	-	-	100
	FN 562	Food and Nutrition Laboratory -I	-	-	4	2	4	-	-	100
		Sub Total	**18**	**-**	**4**	**21**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2016 –17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	FN 611	Public Health and Nutrition	3	1	-	4	3	25	25	50
	FN 621	Institutional Food Administration	3	1	-	4	3	25	25	50
	FN 631	Clinical and Therapeutic Nutrition	3	1	-	4	3	25	25	50
	FN 641	Food Service Management	3	-	-	3	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	FN 651	Food and Nutrition Laboratory -II	-	-	4	2	4	100		
		Sub Total	**15**	**3**	**4**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	-	-	**20**				
		Total Credits				**80**				

$Evaluation of proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Dissertation and presentation will carry 50% weightage each.

FN 511 BASIC PRINCIPLES OF AYURVEDIC DIET 1-0-0-1

History of Ahara Nutrition, Vedic and Madhyayugin diet and its processing, Basic Principle: Ayurveda and Aharashastra, Ayurvedic components, Ritucharya (Seasonal regimen) [4]

Ayurvedic Principles: Lokpurushasamya (Doctrine of Macrocosm and Microcosm), Karyakarana Siddhanta (Principles of Caouse and Effect), Samanya-Vishesh Siddhanta (Principles of Similarity and Dissimilarity), **Panchamahabhoota Siddhanta** (Theory of Five Elements), Swabhavoparmvada Siddhanta (Theory of Healing)- in relation with diet and its importance [5]

Fundamentals of Dosha-Dhatu-Mala: Doshavigyana Dhatuvigyana - Tissue/ Cell metabolism, Malavigyana – Excretary, Vigyana Strotovidyana – Systematic circulation, Dhatusharta - Cell replenishing, Prakriti – Constitution, Dosha-Dhatu-Mala vigyana – The importance of diet in physiological process. [4]

Text Book:

1. Tripathi B. (2007) (Ed.) Acharya Charaks' Charak Samhita, Chowkhamba Surbharati Prakashan Varanasi.
2. Panda S.K. (2006) Basic Principles of Kriya Sharira, Chaukhamba Orientalia, New Delhi.

References:

3. Lochan Kanjiv (2007). Astanga Hridayam, (Sutrasthana), Chowkhamba Sanskrit Bhawan Varanasi
4. Srikanthamurthy K.R. (2005), (Ed.) Acharya Vagbhatas' Ashtanga Samgraha, Chaukhamba Orientalia, Varanasi.
5. Lochan Kanjiv, Dietary Rules & Prohibitions in Different Diseases, Chowkhamba Sanskrit Bhawan Varanasi. 2004
6. Sushruta, Sushruta Samhita (1994) 5th Edition, Motilal Banarasidas , New Delhi.
7. Brahmavarchas (2005) Ayurved Darshan,Vedmata Gayatri Trust, Shantikunj, Haridwar.
8. Radhakrishnan Sarvapalli (1999) Indian Philosophy, Vol.1, Oxford University Press, London.

FN 521 BASICS OF HUMAN PHYSIOLOGY 3-0-0-3

Cell structure and function

Levels of cellular organisation and fucntion-organelles, tissues, organs and systems-Brief review. Cell membrane, transport across cell membrane and intercellular communication. Regulation of cell multiplication. [4]

Nervous system [4]

Review of structure and function of neuron, conduction of nerve impulse, synapses, role of neurotransmitters.

Organisation of central nervous system, structure and function of brain

and spinal cord, afferent and efferent nerves, Blood brain barrier, CSF. Hypothalamus and its role in various body function-obesity, sleep, memory.

Endocrine system [4]

Endocrine glands-structure, function, role of hormones, regulation of hormonal secertion. The neuroendcrime axis.Disorders of endocrine glands. Emphasis on physiology of diabetes and stress hormones.

Sense organs [3]

Review of structure and function. Role of skin, eye, ear, nose and tongue in preception of stimuli.

Digestive System [4]

Review of structure and function. Secretory, Digestive and absorptive functions. Role of liver, pancreas and gall bladder and their dysfunction. Motility and hormones of GIT

Respiratory system [4]

Review of structure and function. Role of lings in the exchange of gases. Trasport of oxygen and CO_2. Role of haemoglobin and buffer sstems. Cardio-respiratory response to excercise and physiological effects of training.

The circulatroy system [3]

Structure and function of heat and blood vessel. Regulation of cardic output and blood pressure, heart failure, hypertension.

Blood formation, compsotion, blood clotting and haemostasis [3]

Formation and function of plasma proteins. Erythropoesis. Blood groups and histocompatibility. Blood indices. Use of blood for investigation and diagnosis of specific disorders. Anemia.

The excretory system [2]

Structure and function of nephron. Urine formation. Role of kidney in maintaining ph of blood. Water, electrolytes and acid base balance, diuretics

The Musculo-skeletal system [2]

Structure and function of bone, cartilage and connective tissue. Disorders of the skeletal system. Types of muscles, structure and function.

Immune System [3]

Cell mediated and humoral immunity. Activation of WBC and production of anitbodies. Role in inflammation and defence.

Reproduction [3]

Menstrual cycle, spermatogenesis, physiological changes in pregnancy

Text Book:

1. Jain A.K. (2010) Textbook of Physiology, Vol. I and II, Avichal publishing co., New Delhi.

2.

References:

1. Applied Physiology, MFM 001 Course, Indira Gandhi National Open University
2. Vander A.J., Sherman J.H., Luciono D.S. (2000) Human Physiology. 7th edition, New York, McGraw Hill
3. Guyton A.C. and Hall J.B. (1996) Textbook of Medical Physiology. 9th edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.

FN 531 HUMAN NUTRITION 3-0-0-3

Energy: Energy content of foods. Physiological fuel value-review. Measurment of energy expenditure: BMR, RMR, Thermic effects of feeding and physical activity, methods of mesaurment. Estimating energy requirments of individuals and groups. Regulation of energy metabolism: control of food intake, digetio, absorption and body weight. [4]

Carbohydrates: Types, calssification, digestion and transprt-review, dietry fibre, fructo-oligosaccharides, resistant strach-chemical copmposition and physilogical effects. Glycemic index of food. Sweeteners-nutritive and non-nutritive. [5]

Proteins: Classification, digestion, absorption and transport – review. Metabolism of proteins: Role of muscle, liver, and gastro intestinal tract. Protein quality, metods of evaluating protein quality. Protein and amino acid requirements. Therapeutic applications of specific amino acids: Branched chain, glutamine arginine, homocysteine, cysteine, taurine. [4]

Lipids: Classification, digetion, absorption, transport-review. Functions of EFA. Role of n-3, n-6 fatty acids in health and disease. Requirements of total fat and fatty acids. Trans fatty acids. Prostaglandins. [6]

Water: Regulation of intra and extra cellular volume. Osmolality, water balance and its regulation. [7]

Minerals: (Note: For each nutrient sources, bioavailability, metabolism, function, requirements, RDI/ESDDI, deficiency and toxicity, interactions with other nutrients are to be discussed).

Macro minerals: calcium, phosphorus, magnesium, sodium, potassium and chloride.

Micro minerals: Iron, copper, zinc, manganese, iodine, fluoride.

Trace minerals: selenium, cobalt, chromium, vanadium, silicon, boron, nickel.

Vitamins: Historical background, structure, food sources, absorption and transport, metabolism, biochemical function, assrssment of status. Interactions with other nutrients. Physiological, pharmacological and therapeutic effects, toxicity and deficiency with respect to the following: [7]

a) *Fat soluble:* Vitamins A,D, E & K.
b) *Water soluble:* Thiamine, riboflavin, niacin, biotin, pyridoxine, folic acid, pantothenic acid, ascorbic acid, cyanocobalamin, choline, inositol.

Non-nutritive food components with potential health effects: Polyphenols, tannins, phytate, phytoestrogens, cyanogenic compounds, lectins and saponins. [6]

Nutritional regulation of gene expression.

Nutrition management in special conditions: Space travel, high altitudes, low temperatures, submarines.

Text Book:

1. Bamji M.S., Rao N.P., Reddy V. Eds. (2009). Textbook of Human Nutrition. 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.

References:

2. ICMR (1990). Nutrient Requirements and Recommended Dietary Allowances for Indians.
3. FAO/WHO/UNU (2004). Human Energy Requirements. Report of a Joint Expert Consultation.
4. WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.
5. Nutrition in Developmental Transition. (2006). NFI-WHO (SEARO) Symposium. NFI
6. ICMR. A Manual of Laboratory Techniques.
7. Gibney M.J., Margetts B.M., Kearney J.M., Arab L. (2004). Public Health Nutrition. The Nutrition Society. Blackwell Publishing, Oxford, UK.
8. Sundararaj P. and Siddhu A. (2006). Qualitative tests and quantitative procedures in Biochemistry- A Practical Manual. Third edition. Elite Publishers, New Delhi.
9. AOAC (1997). Official Methods of analysis. 16th edition. Association of official Analytical Chemists.

FN 541 BASIC RESEARCH METHODOLOGY 2-0-0-2

Research Methodology- Meaning, objectives and Significance of research. Types of research, research approaches and scientific methods. Research process and criteria of good research [2]

Definition and identification of a research problem- Selection of research problem, Justification, development of hypothesis, basic assumptions. Limitations and delimitations of the problem, Methods of data collection [4]

Research design- Meaning and needs, Different research designs- exploratory, descriptive and diagnostic (epidemiology and clinical trials). Pilot studies. Qualitative vs quantitative research [5]

Sampling design- Steps in sampling design, Criteria for selecting a sampling procedure, Different types of sampling techniques- Merits and demerits of sampling [5]

Basic principles and regulations in humans and animal research. [3]

Report writing – Significance of report writing, Different steps in writing report, Types of reports, Mechanics of writing reports and precautions to be taken while writing research reports [7]

Text Book:

1. Kothari C.R. (2004) Research Methodology, Methods & Techniques, 2nd ed. New Age International Publishers.

References:

2. Best J.W. and Kahn J.V. (1992) Research in Education.6th ed. New Delhi, Prentice Hall of India Pvt. Ltd,
3. Goode W.J. and Hatt P.K. (1981) Methods in Social Research, McGraw Hill International Editions, Sociology Series.
4. Kerlinger F.N. (1983) Foundations of Educational Research. 2nd ed.
5. Marjory L. Joseph, William D Joseph (1996) Research Fundamentals in Home Economics / Human Ecology. Plycon Press.
6. WHO (2001) Health Research Methodology – A Guide for Training in Research Methods.
7. Stennberg R. J. (1991) The Psychologist's Companion: A Guide to Scientific Writing for students and Researchers. Cambridge: CUP.
8. Scrimhshaw N.S. and Gleason G.R. (2009) Rapid Assessment Procedures, Qualitative Methodologies for Planning and Evaluation of Health Related Programmes. International Nutrition Foundation for Developing Countries, Boston.

BC 522 NUTRITIONAL BIOCHEMISTRY 3-0-0-3

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements. Specific dynamic action of proteins. [5]

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions. [10]

Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. [5]

Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins. [5]

Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing. [10]

Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. [2]

Obesity – Definition, Genetic and environmental factors leading to obesity [2]

Text Book:

1. Devlin T M. (2002) Text Book of biochemistry with Clinical Correlations 5th ed. John Wiley and Sons.

References:

2. Berg J M, Tymoczko J L and Stryer L. (2002) Biochemistry 5th ed. W.H. Freeman.
3. Horton R. H., Moran L. A., Ochs R. S., Rawn J. D. and Scrimgeour.(2002) Principles of Biochemistry 3rd ed. Prentice Hall.
4. Murray R.K., Granner D.K., Kayes P.A. and Rodwell V.W.(2003) Harper's Illustrated Biochemistry. 26th ed. McGraw-Hill. Asia.
5. Voet D. and Voet J.G. (2004) Biochemistry. 3rd ed. John Wiley and Sons.

FN 512 FOOD PACKAGING AND QUALITY CONTROL 3-0-0-3

[6]

Packaging- Concepts, Definition, Significance, Classification.
Packaging-development, Unit/Retail.
Packaging of food(s)- fresh and processed, general characteristics & food preservation.

Primary Packaging Media- Properties and applications

a) Paper boards, metals, plastics, wood & plywood, glass, flexible etc.

b) Labels, caps & closures & wads, adhesives, inks & lacquers, cushioning materials, reinforcements etc.

Testing & evaluation of packing media – retail packs (including shelf life evaluation) and transport packages. [9]

Packaging systems and methods for food products- vacuum packaging, gas flush. Packaging, CAP & MAP, Aseptic & retort packing, Bag-in Box etc.

Food products- General classification and packing types, varieties and trends.

Storage, handling and distribution of packages (foods) – including palletisation & Containerizetion.

Food marketing and role of packaging.

Packaging Aesthetic & graphic design.

.

Packaging – Laws & Regulations - FDA, PFA, Packaging commodity Rules, Weight & Measures Act etc [3]

Introduction to quality assurance and food safety assurance. Current concepts of quality control.

Quality assurance programme: Quality plan, documentation of records, product standards Product and purchase specifications, process control and HACCP hygiene and housekeeping, corrective action, quality and programme and total quality process.

Quality costs: Measurement and analysis.

[10]

Product Evaluation: [11]

- Sampling for product evaluation and line control.
- Statistical quality and process control.
- Specifications and food standards. International, national-Mandatory, Voluntary.
- Sample Preparation.
- Reporting results and reliability of analysis.
- Tests for specific raw food ingeredients and processed. Foods including additives:
  a) Proximate principles
  b) Nurient analysis
  c) Quality parameters and test of adulterants.

Consumer protection.

Text Book

1. Joshi, V.K. and Pandey, A. Ed. (2009). Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.

References

2. Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford. Crueger, W. and Crueger A. 1984.
3. Knorr, D. 1982. Food Biotechnology. Marcel Dekker, New York.
4. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
5. Pomeranz, Y. and MeLoan, C.E. (1996): Food Analysis: Theory and Practice, CBS Publishers and Distributor, New Delhi.

FN 522 WOMEN NUTRITION AND HEALTH 3-0-0-3

Role of women in National Development.

Women in Family and Community

- Demographic Changes, menarche, marrige, fertility, morbidity, mortality, life-expactancy, sec ratio, aging and wodowhood, female-headed families.

Women and Work

- Environmental stress, production activities, nutrition, health and gender, living conditions, occupational health, health facilities.

Women's nutritional requirements and food needs.

Women and Society

- Women's role, their resoures and contribution to family and community and effect on nutritional status.
- Effect of urbanisation on women.
- Impact of economic policies, industrializzation, and globlization on women.

Women and Health

- Health facilities
- Disease patterns and Reproductive health
- Gender and health
- Health seeking behaviour
- Women- pregnancy and lactation

Safe motherhood

Care of at-risk mothers

Family planning

Women and aging- Special concerns in developed and developing societies: Menopause, osteoporosis, chronic degenerative diseases, neurological problems.

Women and AIDS

Women and Nutrition

- Situation of women in global, national and local context. Improving the nutritional and health status. Intervantions throughout the life cycle.

Policies and Legislations

- CEDAW (Convention on elimination of all forms of Discrimination Against Women), Women's Right to Life and Health (WRLH).

Empowerment of Women-Role of Education and various national schemes

Text Book:

1. Gopalan, C. and Kaur, S (Eds) (1989): Women and Nutrition in India, Nutrition Foundation of India

References

2. ACC/SCN Policy Discussion papers.
3. Wallace, H.M. and Giri,K. (1990): Health care of women and children in developing countries, Third party Publishing Co., Oakland, California.
4. UNICEF: The Urban Poor and Household Food Security, UNICEF
5. NGO committee on UNICEF (1997): Women and children in Urban Poverty-What Way Out?
6. Census Reports, Government of India.
7. UNICEF-State of the world children.
8. International Nutrition Foundation-Micronutrient Initiative (2010): preventing Iron Deficiency in Women and Children; Technical Consensus on Key issues.

MB 514 FOOD TECHNOLOGY 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]

Microbial starters for food fermentations.

Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.

Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,

Single cell protein, Mushroom cultivation

Spoilage and Preservation: [10]

Factors affecting microbial growth in foods- extrinsic and intrinsic,

Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,

Spoilage detection and characterization.

Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).

Food Borne Infections and Intoxications: Microbial toxins in food- [10]
Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori*

Packaging and Quality Control: [9]

Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane.

Detection of food pathogens- Culture methods, Rapid detection using PCR

Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,

Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)

Disposal and treatment of food industry waste

Text Book:

1. Prescott L.M., Harley J.P., Klein D.A. (2008) Microbiology. 6th ed. WMC Brown Publishers

References

2. Banwart G.J. (1987) Basic Food Microbiology. CBS Publishers and Distributors.
3. Frazier W.C., Westoff D.C. (1998) Food Microbiology. 4th ed. Tata McGrawHill Publishing Co. Ltd.
4. Garbutt John (1997) Essentials of Food Microbiology. Arnold London.

5. Jay J.M., Loessner D.A., Martin J. (2005) Modern Food Microbiology. 7th ed. Springer
6. Pelczar M.J., Chan E.C.S., Krieg N. (1993) Microbiology. 5th ed. Tata McGraw-Hill Publishing Co. Ltd.

FN 532 NUTRITION FOR HEALTH AND FITNESS 3-0-0-3

Definition, components and assessment criteria of age: Specific fitness and health status. [8]

Holisitic approache to the management of fitness and health: Enrgy input and output. Diet and exercise. Effect of specific nutrient on work eperformance and physical fitness. Nutrition, exercise, physical fitness and health inter-relationship

Review of fifferent energy system for endurance and power activity: Fuel and nutrients to support physical activity. Shifts in carbohydrates and fat metabolism. Mobilization of fat stores during exercise. [6]

Nutrition in sports: Sports specific requirments. Dient manipulation. Pre-game and post game meals. Assessment of different nutragenic aids and commercial supplements. Diets for persons with high enrgy requirments, stress, fractures and injury.

Water and electrolytesbalances: Losses and their replenishment during excerse and sports events, effects of dehydration, sports drinks. [7]

Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer**.**

Nutrition and exercise regimes for management of obesity: Critical review of various dietary regimes for weight and fat reduction. Prevention of weight cycling. [8]

Definign nutriitonal goals.guidelines approporiate to health, fitness and prevention and management of the above chronic degenerative disorders.

Nutrition and exercise regimes for pre-post-natal fitness: Alternative systmes for health and fitness lile ayurveda, yoga, meditation, vegetarianism and traditional diets. [10]

Text Book:

1. Mahan L.K. & Ecott-Stump S. (2000): Krause's Food, Nutrition and diet Therapy, 10th Edition, W.B. Saunders Ltd.

References:

2. Sizer F. & Whitney E. (2000): Nutrition-Concepts and controversies, 8th Edition, Wadsworth Thomson Learning.
3. Whitney E.N. & Rolfes .R. (1999): Understanding Nutrition, 8th Edition, West/Wadsworth, An Internation Thomson Publishing Co.

4. Parizkova J. Nutrion, Physical activity and health in early life, Ed. Wolinsky, I., CRC press.
5. Ira Wolinsky (Ed) (1998): Nutriton in Exercise and sports, 3rd Edition,CRC Press

FN 542 NEUTRACEUTICALS AND FUNCTIONAL FOODS 3-0-0-3

Nutraceuticals: Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases. [4]

Definition, Classification, food and non food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [8]

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [9]

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [8]

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India. [10]

Text Book:

1. Geoffrey P. Webb. (2006). Dietary supplements and functional foods. Blackwell Publishing.

References:

2. Losso, J.N. (2007). Angi-angiogenic functional and medicinal foods. Press.
3. Cupp, J and Tracy, TS. (2003). Dietary supplements: Toxicology and C Pharmacology. Humana Press.
4. Manson, P. (2001). Dietary supplements (2nd Ed) Pharmaceutical Press.
5. Campbell, JE and Summers, JL. (2004). Dietary Supplement Labeling Compliance .
6. Shi, J.(2007). Functional Food Ingredients and Nutraceuticals: Processing Technologies. Taylor & Francis Publ. CRC Press.

7. Goldberg, I (1994). Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall.
8. Robert E.C. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

FN 562 FOOD AND NUTRITION LABORATORY -I 0-0-4-2

Practical exercises related to BC 522, MB 514 and FN 542

FN 641 FOOD SERVICE MANAGEMENT 3-0-0-3

UNIT-I [9]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel.

UNIT-II [5]

Theories about approaches to food service management -
Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules.

UNIT-III [5]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques

UNIT-IV [6]

Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-V [5]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance.
Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of kitchen records

UNIT-VI [4]

Financial management – Budgeting, costing and cost control, accounting

UNIT-VII [5]

Marketing and advertising, Changing food trends and marketing-influencing factors: Life style changes: economic, socio-cultural, psychological influences and marketing influences, Compatibilities/Challenges in Food Storage and its commercialization, Means of Marketing, National and International measurements

Text Book

1. Sethi, M. (2005): Institution Food Management New Age International Publishers.
2. Taneja S and Gupta SL (2001) Entrepreneurship development, Galgotia Publishing

Reference

3. Bessie, W.B. and Levelle, W. (1988): Food Service in Institutions 6th Edition Revised By Hargar FV, Shuggart SG, &Palgne Palacio June,

Macmillian Publishing Company New York.

4. Kazarian, E. A. (1977): Food Service facilities Planning 3rd Edition Von Nostrand Reinhold New York
5. Kotas Richard and Jayawardardene. C (1994) Profitable Food and Beverage Management Hodder& Stoughton Publications
6. Kotler Philip Marketing management (2001) Millennium Edition Prentice Hall of India

FN 611 PUBLIC HEALTH AND NUTRITION **3-1-0-4**

UNIT-I [9]

Concept of public nutrition - Relationship between health and nutrition, role of public nutritionists in the health care delivery system. Population dynamics- Demographic transition, population structure, population policy, fertility behaviour, nutrition and quality of life interrelationship. Nutritional status -methods for assessing nutritional status – Indirect methods – demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR) - Direct – anthropometry, biochemical, clinical, dietary and functional methods of assessments.

UNIT-II [4]

Nutrition during life span – pregnancy, lactation, infancy, preschool age, school going and adolescents, adults and old age.

UNIT-III [9]

Assessment and surveillance of nutritional status in emergency affected populations- Scope for malnutrition assessment, indicators and simple screening methods. Organization for nutritional surveillance. Nutritional relief and rehabilitation- Assessment of food needs, food distribution strategy, targeting food aid, mass and supplementary feeding, special foods/rations for nutritional relief, organization for mass feeding/food distribution, transportation and storage, feeding centers, sanitation and hygiene and public nutrition approach to tackle nutritional and health problems in emergencies, ethical considerations.

UNIT-IV [8]

Approaches and strategies for improving nutritional status and health - Programmatic options – their advantages and demerits. Intervention Programmes – Health based interventions, Food – based interventions including fortification and genetic improvement of foods, supplementary feeding. Malnutrition and Health economics - Its impact on productivity and national development. Cost management.

UNIT-V [9]

Information Education Communication approaches to improve health and nutrition: Concepts – Scope- Elements- Models of communication - Communication Process - Approaches and Barriers to communication, Communication for Extension Education and Development - Introduction to IEC Aims and Objectives, Importance

of IEC, relevance to programmes - Nutrition education for behaviour change – Rationale, Planning Execution and evaluation of Department of Food Science and Technology.

Text books

1. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.

Reference

2. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
3. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Bamji, M.S., Rao, P.N., Reddy, V (Eds) (2003): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

FN 621 INSTITUTIONAL FOOD ADMINISTRATION 3-1-0-4

UNIT-I [3]

Review of different types of institutional food service operations, canteens, hotels, restaurants and hospitals.

UNIT-II [7]

Meal planning, Food preparation and Service: Basic factors in successful institutional meal planning, considerations with regard to religion, region, availability of food and season, food habits, personnel, equipment, physical plant and financial resources. Procedures involved in constructions of recipes in large scale cooking. Processes of food preparation in large quantities. Type of food service in different institutions: Formal and informal food service.

UNIT-III [4]

Management: Definition, functions, tools of management-organization chart, job description, job specification, work sheet. Work improvement and work simplification.

UNIT-IV [8]

Personnel Management: Personnel and leadership qualifications for food service administrator, responsibilities and importance of good human relationship in organization. Criteria for selection of staff personnel, employment conditions, employee-training, role of employee unions, welfare provisions for labour.

UNIT-V [9]

Management of Resources: Budget, records and book keeping. Food cost control and Labour cost control: Factors affecting cost-menu, types of service, methods of purchasing, serving and pricing, maintenance of standard portions, waste, and meals for employee, wages. Physical plant: Its location, floor plans, space allowances for food preparation activities, storage units, service units and washing units.

UNIT-VI [8]

Importance of food standards, criteria for good quality products, hazards of adulteration and poor quality, quality control, specifications for quality in food products, food laws regarding quality and adulteration.

Labour laws regarding health and safety of employees, health examination, sanitary working conditions, labour regulations, welfare policies.

Text Book

1. West BB, Wood, L. Harger, V.F. and Shugert, G.S. 1977, Food Service in Institutions. John Wiley and Sons, NewYork
2. Sethi, M and Malhan, S. 1993. Catering Management – An integral approach, Wiliey Eastern Limited, New Delhi.

Reference

3. R. Kinton und V. Ceserani 2000. The theory of catering. Aufl., Seiten, Abb., Tab. Verlag Edward Arnold Ltd, London 1
4. Weiss H. and Edith. 2000. Catering Handbook /9780471284277; Publisher: Wiley
5. Mizer and Porter, 2010. Food Preparation for the professionals. Eich Drummond. New York: John Wiley & Sons, Inc
6. Crusius, V.C. 2001: Quantity Food Management. Minneapolis, Minn. Burgess, (c)1981

FN 631 CLINICAL AND THERAPEUTIC NUTRITION **3-1-0-4**

UNIT-I [6]

Nutritional screening and assessment of nutritional satus of hospitalized and outdoor patients.identification of high risk patiets. Assessment of patient needs based interpretation of patient data-clinical, biochmecial, biophysical, personal etc. Newer trends in delivery of nutritional care and dietary counselling

UNIT-I [10]

Diet nutrient and drug interaction. Effect of drugs on ingestion, digestion, absorption and metabolism of nutrients, effect of foods, nutrients and nutritional status on drug dosage and efficacy.

Nutritional support-recent advances in techniques and feeding substrates

UNIT-I [18]

Etiopathophysiology, metabolic and clinical aberrations, complications, prevention and recent advances in the medical nutritional management of:

Weight imbalances

Cardio vascular disorders

Diabetes mellitus and other metabolic disorders

GI tract disorders

Liver and gall bladder, pancreatic disorders

Renal disorder

Stress and trauma

Cancer

Neurological disorders

Musculo-skeletal disorders

Immuno-deficiency disorder
Genetic disorders
Infection and AIDS
Respiratory problems

UNIT-I [5]

Childhood problems/disorders including inborn errors of metabolism and their nutritional management.

Text Book

1. Mahan, L.K. and Escott-Stump, S. (2000): Krause's Food Nutrition and DietTherapy, 10th Edition, W-13 Saunders Ltd.
2. Shills, M.E., Olson, J.A, Shike, M and Ross, A.C. (2003): Modern Nutrition in Health and Disease, 9th Edition, A. Vaiiiams and Willdns.

Reference

3. Williams, S.R. (2003): Nutrition and Diet Therapy, 7th Edition, Times Mirror/Mosby Collage Publishing.
4. Chandra, R.K. (eds) (2002): Nutrition and Immunology, ARTS Biomedical. St. John's Newfoundland.
5. Sareen, S, James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition, Thomson Wordsworth Publication, USA.

MB 641 INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY 3-0-0-3

UNIT-I

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feedback repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

UNIT-I

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

UNIT-I

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

UNIT-I

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (β-lactam, aminoglycosides). [12]

UNIT-I [5]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids.

Text Book

1. Crueger and Crueger (2003): Biotechnology: a textbook of industrial microbiology, 2nd Edition. Panima publications.
2. Stanbury, P.F. and Whitaker, A. (2016): Principles of fermentation technology. Pergamon press.

Reference

3. Taylor and Francis (2007): Fermentation microbiology and biotechnology. El-mansi. 2nd Edition.
4. Scragg (1991) :Bioreactors in Biotechnology: A Practical approach. Latest Ed.
5. Mansi, E. T., Bryce, C. A, Demain, A. L. and Allman A. R. (2011):Fermentation Microbiology& Biotechnology. 3rd Edition.

FN 651 Food and Nutrition Laboratory-II 0-0-4-2

Practical exercises related to FN 611, FN 621 and FN 631

Mody University of Science & Technology

M.Sc. Chemistry
Session 2017-2018

Curriculum Structure

MASTER OF SCIENCE IN CHEMISTRY
M. Sc. – Chemistry
(2014-2015 onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20
M Sc First Year curriculum will be common for ALL specialization

History:

There has been rapid increase in demand of Chemical science professionals. Considering such a requirement, it is proposed to start a new postgraduate programme namely Master of Science in Chemistry with aim of acquiring the knowledge and developing the skills to plan, design and build complex applications which are highly valued in all sectors like pharmaceutical, fertilizer, education, chemical, biotechnology etc.
The first batch of the programme in MITS is proposed to be admitted in the session 2010-2011.

Input Qualification:

Bachelor's degree with Chemistry as a subject for three years / six semesters/ B. Sc. Applied Chemistry / B. Sc. Biochemistry / B.Sc. Industrial Chemistry with 50 % of marks.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of Postgraduate Programmes of MITS shall be followed.

M. Sc.-Chemistry
Academic Curriculum (2014-2015 onwards)
First Year-Common to ALL Specialization

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 511	Inorganic Chemistry-I	3	-	-	3	3	25	25	50
	CH 513	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 531	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH 523	Spectroscopy-I	3	-	-	3	3	25	25	50
	CH 551▲/ CH 561▲▲	Mathematics for Chemists▲/ Biology for Chemists ▲▲	3	-	-	3	3	25	25	50
	CH 571	Inorganic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 581	Organic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 591	Physical Chemistry Laboratory -I	-	-	4	2	4	25	25	50
		Sub Total	**15**	-	**12**	**21**	-	-	-	-
		Foreign Language –I ‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 512	Inorganic Chemistry-II	3	-	-	3	3	25	25	50
	CH 514	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH 532	Physical Chemistry-II	3	-	-	3	2	25	25	50
	CH 524	Spectroscopy-II	3		-	3	3	25	25	50
	CH 534	Colloids and Surface Chemistry	3		-	3	3	25	25	50
	CH 562	Inorganic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 572	Organic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 582	Physical Chemistry Laboratory -II	-	-	4	2	4	25	25	50
		Sub Total	**15**		**16**	**21**	-	-	-	-
		Foreign Language-II‡	3	-	-	3	-	25	25	50

Total Credits 42

▲ *For students without Mathematics in B. Sc.*

▲▲ *For students without Biology in B. Sc.*

‡ *Refer to Foreign Language Section*

M. Sc.-Chemistry
(Specialization in Organic Chemistry)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 611	Photochemical Reactions	3	-	-	3	3	25	25	50
	CH 621	Bioorganic Chemistry	3	-	-	3	3	25	25	50
	CH 631	Organic Synthesis-I	3	-	-	3	3	25	25	50
	CH 641	Separation Techniques and Data Analysis	3	-	-	3	3	25	25	50
	CH 651	Environmental and Green Chemistry	3	-	-	3	3	25	25	50
	CH 661	Advanced Organic Chemistry Laboratory-I	-	-	4	2	4	25	25	50
	CH 671	Advanced Organic Chemistry Laboratory-II	-	-	4	2	4	25	25	50
	CH 681	Advanced Organic chemistry Laboratory-III	-	-	4	2	4	25	25	50
		Sub Total	**15**	**-**	**12**	**21**	**-**	-	-	-

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 612	Organic Synthesis-II	3	-	-	3	3	25	25	50
	CH 622	Heterocyclic Chemistry	3	-	-	3	3	25	25	50
	CH 632	Chemistry of Natural Products	3	-	-	3	3	25	25	50
	CH 642	Medicinal Chemistry	3	-	-	3	3	25	25	50
	CH 652	Dissertation[#]	-	-	-	10	-	100		
		Sub Total	**12**	**-**	**-**	**22**	**-**	-	-	-
		Total Credits				**87**				

[*] *Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.*

[#] *Student will perform project work for a period of 2 months and submit two copies of Dissertation report to the department. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

COURSE DESCRIPTION
M. Sc. (Chemistry)

CH 511 **Inorganic Chemistry-I** **3-0-0-3**

Stereochemistry and Bonding in Main Group Compounds: Walsh diagrams (tri-atomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. [9]

Metal-Ligand Equilibria in Solution : Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. [8]

Reaction Mechanism of Transition Metal Complexes : Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. [15]

Metal-Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. [7]

Suggested Books:

1. Advanced Inorganic Chemistry; F.A. Cotton and G. Wilkinson, 6th Edn. John Wiley & Sons.
2. Inorganic Chemistry; James E. Huheey, 4th Edn. Addison-Wesley Pub. Co.
3. Physical Methods in Inorganic Chemistry; R. S. Drago, International Edn. East-West Press.
4. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.

CH 513 **Organic Chemistry-I** **3-0-0-3**

Nature of Bonding in Organic Molecules: Delocalized chemical bonding, conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. [6]

Stereochemistry: Conformational analysis of cycloalkanes, Decalines. Chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. [10]

Reaction Mechanism, Structure and Reactivity: Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation. [8]

Aliphatic Nucleophilic Subsitution: The SN2, SN1 mixed SN1 and SN2 and SET mechanism. Neighbouring group participation mechanism by σ and π bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The SN i mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Ambident nucleophile, regioselectivity. [5]

Aliphatic Electrophilic Substitution: Bimolecular mechanisms SE2 and SEi, The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving groups and the solvent polarity on the reactivity. [6]

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction. [4]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, 5th Edition. John Wiley & Sons.
2. A Guide book to Mechanism in Organic Chemistry; Peter Sykes, 6th Edition, Orient Longman Ltd..
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Organic Chemistry; R.T. Morrison and R.N. Boyd, Prentice- Hall of India.

6. Organic Reactions and Their Mechanisms; P.S. Kalsi, New Age International Publication.

CH 531 Physical Chemistry-I 3-0-0-3

Quantum Chemistry:

A. Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

C.Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

D. Molecular Orbital Theory: Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

[15]

Thermodynamics:

A. Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; Partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems, second order phase transitions.

B. Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translational, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics; distribution Law and application to helium.

C. Non Equilibrium Theromodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity

relations, electrokinetic phenomena, diffusion, electric conduction. [15]

Symmetry and group theory in chemistry: Symmetry elements and symmetry operations, definitions of group, subgroups, relation between orders of a finite group and its subgroup, similarity transformation and classes, point groups, Schonflies symbols, representation of groups by matrices(representation for the Cn, Cnv, Cnh, Dnh, etc. groups to be worked out explicity), character of a representation, the great orthogonality theorem (without proof) and its importance, character tables and their use. [9]

Suggested Books:

1. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
2. Chemical Kinetics; K. J. Laidler, Harper & Row.
3. Physical Chemistry; P. W. Atkins, Oxford University Press.
4. Physical Chemistry; I.N. Levine, Tata McGraw Hill Pub. Co. Ltd.
5. Kinetics and Mechanism of Chemical Transformations; J. Raja Ram and J.C. Kuriacose, MacMillan Indian Ltd.
6. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.

CH 523 Spectroscopy-I 3-0-0-3

Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, applications [8]

Vibrational Spectroscopy: Symmetry and shapes of AB2, AB3, AB4, AB5 and AB6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins. [8]

Raman Spectroscopy: Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS). [8]

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. [7]

Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of
(1) Bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin.
(2) Sn^{+2} and Sn^{+4} compounds; nature of M-L bond, coordination number, structure.

(3) Detection of oxidation state and inequivalent MB atoms. [8]

Suggested Books:

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. NMR, NQR, ESR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
3. Physical Methods in Chemistry, R.S. Drago, Saunders College.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
5. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
6. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.

CH 551 **Mathematics for Chemists** **3-0-0-3**

Vectors and Matrix Algebra: A. Vectors: Vectors, dot, cross and triple products etc The gradient, divergence and curl, Vector Calculus.

B. Matrix Algebra: Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

[12]

Differential and Integral Calculus: Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus.Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar).

[8]

Elementary Differential equations: Exact First-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc, second order differential equation and their solutions.

[10]

Permutation and Probability: Permutations and combinations, probability and probability theorems, average, root means square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc) with a general polynomial fit.

[9]

Suggested Books:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemists, Doggett and Suiclific, Longman.
3. Mathematical preparation for Physical chemistry: F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Bararnte, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.

CH 561 **Biology for Chemists** **3-0-0-3**

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP - the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules. [8]

Carbohydrates: Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides; cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway. [8]

Lipid: Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-β-oxidation of fatty acids. [8]

Amino-acids, Peptides and Proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. Force responsible for holding of secondary structures. α- helix, -β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure, Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical / enzymatic / mass spectral, racemization / detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH). [8]

Nucleic Acids: Purine and pyrimidine bases of nucleic acids, base pairing via H -bonding. Structure of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside [7]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 571 Inorganic Chemistry Laboratory - I 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $VO(acac)_2$
b) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
c) $Na[Cr(NH_3)_2(SCN)_4]$
d) $Mn(acac)_3$
e) $K_3[Fe(C_2O_4)_3]$
f) Prussian Blue, Turnbull's Blue

II. Qualitative and Quantitative Analysis; Two metal ions in cationic/ anionic forms.

Rare elements: Tl, W, Se, Mo, Ti, Zr, Ce, Th, V, U, Li
Insolubles: Oxides, sulphates and halides

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experimens, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 581 Organic Chemistry Laboratory - I 0-0-4-2

Qualitative Analysis: Separation, purification and identification of compounds of binary mixture (one liquid and one solid / two liquids / two solids) using TLC and Column Chromatography, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis:

a) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
b) Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol
c) Grignard reaction : Synthesis of triphenylmethanol from benzoic acid
d) Aldol condensation: Dibenzal acetone from benzaldehyde.
e) Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.

CH 591 Physical Chemistry Laboratory - I 0-0-4-2

a) To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
b) To determine the electron polarization and electron polarizability of a liquid refractometrically.
c) To determine the concentration of a given solution of an optically active substance by polarimetric measurements.
d) To determine the specific and molar rotation of an optically active substance, like cane sugar at a number of concentrations and hence find the intrinsic rotation of the substance.
e) To verify the Beer's law for the solution of the potassium permanganate and determine the concentration of the given aqueous solution of unknown concentration of this salt.
f) To determine the equilibrium constant of the given reaction, potentiometrically.
g) To determine the heat of neutralization of hydrochloric acid using a classical calorimeter.
h) To determine the stability constant of a $FeSCN^{2+}$ complex ion keeping ionic strength constant.
i) To determine the solubility of Ca $(IO_3)_2$ in deionized water and in dilute solution of potassium chloride at room temperature. Also evaluate the thermodynamic solubility product.
j) To determine the formula and the stability constant of a metal ion complex (Lead oxalate complex.)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 512 **Inorganic Chemistry-II** **3-0-0-3**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of D_q, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

[10]

Metal π-Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation,important reactions of metal carbonyls; preparation, bonding, structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphene as ligand.

[8]

Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes compounds with metal metal multiple bonds

[5]

Role of metal ions in biological processes: Brief study of various metal ions (Fe, Mo, Cu, Co, Ni, V, Cr, Mn, Zn, Se, B, Na, K and Ca) in biological processes.

[10]

Isopoly and Heteropoly Acids and Salts: Brief study

[6]

Suggested Books:

1. Mechanism of Inorganic Reactions; F. Basalo and R.G. Pearson, Wiley Eastern Ltd.
2. Inorganic Chemistry; D. F. Shriver and P. W. Atkins, ELBS.
3. Advanced Inorganic Chemistry; F. A. Cotton and G. Wilkinson, Edn. John Wiley & Sons.
4. Electronic Absorption Spectroscopy and Related Techniques; D.N. Sathyanarayana, Universities Press (India) Ltd.
5. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.
6. Inorganic Reaction Mechanisms; Martin L. Tobe and John Burgess, Longmans.

Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1 mechanism, Reactivity; effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet - Hauser, and Smiles rearrangments. [5]

Free Radical Reactions: Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction. [7]

Addition to Carbon Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation. [7]

Addition to Carbon-Hetero Multiple bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. [7]

Elimination Reactions: The E2, E1 and E1CB mechanisms and their spectrum. Orientation of the double bond. Mechanism and orientation in pyrolytic elimination. [5]

Pericyclic Reactions: Molecular orbital symmetry, Electrocyclic reactions, cycloaddition reactions and sigmatropic reactions, FMO and PMO approach. Correlation diagram, selection rules. Claisen, Cope and aza-Cope rearrangements, Ene reaction [8]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, John Wiley & Sons.
2. A Guide Book to Mechanism in Organic Chemistry; Peter Sykes, Orient Longman Ltd.
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Mechanism and Theory in Organic Chemistry; S.M. Mukherjee and S.P. Singh, Mac Millan India.

6. Organic Reactions and Their Mechanisms; P. S. Kalsi, New Age International Pub.

CH 532 Physical Chemistry II 3-0-0-3

Surface Chemistry:
A. Adsorption -Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of dropletes (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).

B. Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles. [12]

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures. [8]

Electrochemistry: Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham- Devanathan - Mottwatts, Tobin, Bockris, Devanathan models, Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance. [10]

Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions). [9]

Suggested Books:

1. Modern Electrochemistry; J.O'M. Bockris and A. K. N. Reddy, Plenum Press.
2. Physical Chemistry; P. W. Atkins Oxford University Press.
3. Physical Chemistry; I. N. Levine, Tata McGraw Hill Pub. Co. Ltd.
4. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.
5. Text Book of Polymer Science; F.W. Billmayer, Wiley-Interscience.
6. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
7. Chemical Kinetics; K. J. Laidler, Harper & Row.

CH 524 Spectroscopy-II 3-0-0-3

Ultraviolet and Visible spectroscopy: Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. [7]

Infrared Spectroscopy: Instrumentation and Sample handling.Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. [7]

Nuclear Magnetic Resonance Spectroscopy: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplifications of complex spectranuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE). [8]

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic , alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOSY, DEPT, INEPT, APT and INADEQUATE techniques. [6]

Mass Spectrometry: Introduction ion production EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Example of mass spectral fragmentation of organic compounds with [6]

respect to their structure determination.

Problems: Structure elucidation based on spectroscopic data. [5]

Suggested Books:

1. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J. Martin, Heyden.
2. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
3. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 534 Colloids and Surface Chemistry 3-0-0-3

Introduction: Introduction: Colloid & surface science - small particles, association structures, surfaces, interfaces, interphases and macromolecules, Survey of technologies reliant upon colloid and surface science. [5]

Particulate Dispersions (solids dispersed in fluids): Single particles, Scattering of electromagnetic radiation from matter, Single particles in external fields (gravity, electrical, etc.), Particle sizing (microscopy, scattering (ILS, DLS, x-ray, neutron), sedimentation, centrifugation, chromatography, acoustics, adsorption), Particles in fluids, Particle trajectories' Transport phenomena; Brownian motion, diffusion; Rheology & rheology of dispersions; Particle-particle interactions, potential energy diagrams; Colloid stability - aqueous, non-aqueous; Consequences of colloid stability (dispersal, flocculation, coagulation, phase separation); Measuring colloid stability; Particle-particle interactions: Dispersion forces (Hamaker theory); Solid-liquid interfaces (charging of surfaces, Electrical Double Layer, adsorption); Particle-particle interactions: Electrostatic forces; Analysis of surface charge and surface chemistry (electrokinetics [electrophoresis, streaming; potential, electro-osmosis, sedimentation potential], electroacoustics, surface spectroscopy, ESR); Particle-particle interactions: steric forces & polymer-mediated forces'' Particle-particle interactions: hydrophobic forces, Analysis of particle interactions (rheometry, AFM, CFM, MASIF, SFA); Flocculation & coagulation - Schulze-Hardy rule, inorganic coagulants, polymeric flocculants ; wastewater treatment

[15]

Wetting & Capillarity: Surface and interfacial tension; Phenomena of liquid surfaces - Phenomena of liquids near solid surfaces Wetting, spreading, penetration, film formation, adhesion, detergency and floation; Contact angles, their analysis and interpretation - component analysis; Surface roughness, chemical heterogeneity, contamination; Surface energy methods on planar, particulate, hollow and fiber surfaces; Relation of capillarity to phase diagrams; Adhesion & Contact mechanics.

[10]

Bubbles and Foams (gases dispersed in liquids): Foam stability; Film drainage; Film rupture; Film rheology; Emulsion and pseudo-emulsion films; Phase diagrams; Measuring thin film properties - disjoining pressure, thin film balance, Frothing agents', Foam breaking, Antifoaming agents & mechanisms, Flotation. [9]

Suggested Books:

1. Colloidal Dispersions: Suspensions, Emulsions, and Foams I.D. Morrison and S. Ross (2002, Wiley Interscience, NY; ISBN: 0-471-17625-7).
2. Basic Principle of Colloid Science, D.H. Everett (1988, Royal Society of Chemistry, London, ISBN : 0-85186-443-0)

CH 562 Inorganic Chemistry Laboratory - II 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $[Co(NH_3)_6]\ [Co(NO_2)_6]$
b) Cis-$[Co(trien)\ (NO_2)_2]\ Cl.H_2O$
c) $Hg[Co(SCN)_4]$
d) $[Co(Py)_2Cl_2]$
e) $[Ni(NH_3)_6]Cl_2$
f) $Ni(dmg)_2$
g) $[Cu(NH_3)_4]SO_4H_2O$

II. Qualitative and Quantitative Analysis; Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

III. Chromatography; Separation of cations and anions by
Paper Chromatography.
Column Chromatography : Ion exchange

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experiments, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 572 Organic Chemistry Laboratory - II 0-0-4-2

I. Organic Synthesis:

a) Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.
b) Friedel Crafts reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
c) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. The Products may be Characterized by Spectral Techniques
d) Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation

II. Quantitative Analysis:

a) Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
b) Estimation of amines/phenols using bromate bromide solution/or acetylation method.
c) Determination of lodine and Saponification values of an oil sample.
d) Determination of DO, COD and BOD of water sample.
e) To estimate the percentage of sulphur in the given organic sample by Messenger's method
f) To estimate the percentage of nitrogen in the given organic sample by Kjeldahl's method.
g) To estimate a halogen in the given sample by the alkaline reduction method (Modified Stepenow method).

Suggested Books:

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

CH 582 Physical Chemistry Laboratory - II 0-0-4-2

a) To determine the molecular weight of a macromolecule by viscometry.
b) To determine the order with respect to Ag(I) in the oxidation of Mn(II) by $S_2O_8^{2-}$ and the rate constant for the uncatalyzed reaction.
c) To determine the formation constant for the $[Ce^{IV}\text{-}H_3PO_2]$ intermediate complex and also the rate constant of its decomposition at 45° C.
d) Study the effect of hydrogen ion on the $H_2O_2 - I^-$ reaction and to determine the rate constants K_1 and K_2 of the given rate equation.
e) To determine the equivalent conductivity of an electrolyte at infinite dilutions, and to determine the dissociation constant of an acid at different dilutions.
f) To determine the standard electrode potential of the ferrous ferric system by titrating ferrous ammonium sulphates against potassium dichromate potentiometrically.
g) To determine the surface tension of an organic liquid (Ethyl acetate) at different temperatures by double capillary method and hence test the constancy of parachor.
h) To determine the critical micelle concentration of a soap (sodium laurate, sodium palmitate etc.) by surface tension measurements.
i) To determine the solubility and solubility product of sparingly soluble salts e.g. PbSO4, BaSO4) conductometrically.
j) To determine the strength of the given acid conductometrically using standard alkali solution. Select suitable pair for titration. (SA-SB, SA-WB, WA-SB, WA-WB)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 611 Photochemical Reactions 3-0-0-3

Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. [7]

Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy state; determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. [8]

Photochemistry of Alkene: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. [5]

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. [8]

Photochemistry of Aromatic Compounds: Isomerisations, additions and substitutions. [5]

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction, Singlet molecular Oxygen reaction, Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. [6]

Suggested Books:

1. Fundamentals of photochemistry, K.K. Rohtagi - Mukherjee, Wiley-Eastern.
2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.

CH 621 Bioorganic Chemistry 3-0-0-3

Introduction: Basic considerations, Proximity effects and molecular adaptation. [4]

Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and

enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver - Burk plots, reversible and irreversible inhibition.

[11]

Mechanism of Enzyme Action: Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase A. [6]

Kinds of Reactions Catalysed by Enzymes: Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisation reactions, β-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. [9]

Industrial Applications of Enzymes : Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-Brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. [9]

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

CH 631 Organic Synthesis-I 3-0-0-3

Reagents and reactions: Gilman's reagent – Lithium dimethylcuprate, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DDC), 1,3-Dithiane (Umpolungreagent), trimethylsilyliodide, Petersons synthesis, Bakers yeast, Organophosphorus compounds (Wittig reaction), Sulphur ylides, Phase transfer catalysts: Quaternary

ammonium and Phosphonium salts, Crown ethers. Heck reaction, Suzuki coupling and Mukaiyama reaction. [9]

Oxidation: Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate. [9]

Reduction: Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Epoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis. [8]

Rearrangements: General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil – Benzillic acid. Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. [8]

Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds: General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene, fluorine and undone). [5]

Suggested Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Uni. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier

CH 641 Separation Techniques and Data Analysis 3-0-0-3

Adsorption and partition chromatography:
(a) Definition of terms, techniques and chemical concepts
(b) Column adsorption chromatography
(c)Partition chromatography-column, paper and TLC [8]

High performance liquid chromatography -
Introduction, choice of the system, instrumentation and applications. [5]

Gas liquid chromatography: Introduction, choice of the system, instrumentation, qualitative and quantitative analysis of mixtures. [5]

Gel permeation/size exclusion Chromatography: Introduction, theory and applications. [5]

Ion exchangers: Theory, action of ion-exchange resins, ion exchange chromatography, exchange capacity, ion-exchange resins and liquid ion-exchange resins, applications of cation and anion ion exchangers. [5]

Solvent Extraction: - Introduction, principles, factors that influence solvent extraction, ion association complexes and applications of solvent extraction. [5]

Data analysis: Types of errors, propagation of errors, accuracy and precision, and least- square analysis, average standard deviation. [6]

Suggested Books:

1. Principles of Instrumental Analysis; D.A. Skoog, Saunders College Publishing.
2. Instrumental Methods of Chemical Analysis; G.W. Ewing, McGraw Hill Books Co.
3. Modern Methods of Chemical Analysis; R. L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, John Wiley.
4. Analytical Chemistry: Principles; J.H. Kennedy, Saunders Holt.

CH 651 Environmental and Green Chemistry 3-0-0-3

Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in the atmosphere, stratospheric chemistry: The chemistry of ozone layer, The role of chemicals in ozone destruction, The green-house effect and Global warming, El-Nino phenomenon. [8]

Hydrosphere : Complexation in natural water and waste-water, Micro-organism in aquatic chemical reactions, Eutrophication, Re-cycle of waste-water in process industry, Treatment of sewage and reuse of water in industry and agriculture, Microbiology mediated redox reactions and Nitrogen transformation by bacteria. [8]

Lithosphere : The terrestrial environment, Soil formations, soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, waste classification and disposal. [8]

Chemical Toxicology: Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monooxide, nitrogen oxides, sulphur oxides, ozone, PAN, cyanide, pesticides, insecticides and carcinogens. [7]

Green Chemistry: Green chemistry – Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. Microwave induction, ultrasound assisted, green solvents- reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen , citral, urethane, adipic acid and styrene. [8]

Suggested Books:

1. Green Chemistry, P. Anastas, RSC.
2. Environmental Chemistry, S.E. Manahan, Lewis Pub.
3. Environmental Chemistry, Sharma and Kaur, Krishna Pub.
4. Environmental Chemistry, A.K. De, Wiley Eastern
5. Environmental Chemistry, C. Baird, W.H. Freem

CH 661 Advanced Organic Chemistry Laboratory - I 0-0-4-2

I. Qualitative Analysis: Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

II. Multi –step Synthesis of Organic Compounds: The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques. (Any Five)

a) Photochemical reaction Benzophenone - Benzpinacol - Benzpinacolone
b) Beckmann rearrangement : Benzanilide from benzene Benzene - Benzophenone - Benzphenone oxime - Benzanilide
c) Benzilic acid rearrangement : Benzilic acid from benzoin Benzoin - Benzil -Benzilic acid.
d) Synthesis of heterocyclic compounds Skraup synthesis: Preparation of quinoline from aniline Fisher Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine.
e) Enzymatic synthesis; Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ehtyl-3-hydroxybutanoate and determine its optical purity.
f) Biosynthesis of ethanol from sucrose.
g) Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
h) Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethylacetoacetate with an alkyl halide.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R.Tatchell,J.Wiley

CH 671 Advanced Organic Chemistry Laboratory - II 0-0-4-2

Extraction of Organic Compounds from Natural Sources. (Any Five)

a) Isolation of caffeine from tea leaves.
b) Isolation of benzoic acid from tea leaves.
c) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
d) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf values reported).
e) Isolation of nicotine dipicrate from tobacco.
f) Isolation of cinchonine from cinchona bark.
g) Isolation of piperine from black pepper.
h) Isolation of lycopene from tomatoes.
i) Isolation of β-carotene from carrots.
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
k) Isolation of eugenol from clove.
l) Isolation of (+) limonine from citrus rind.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

CH 681 Advanced Organic Chemistry Laboratory - III 0-0-4-2

I. Separation and identification of the sugars and Amino acids present in the given mixture by paper chromatography and determination of Rf values

II. Identification of organic compound with the help of spectral datas.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley
3. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J.

Martin, Heyden.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
5. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
6. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
7. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 612 Organic Synthesis-II 3-0-0-3

Disconnection Approach: An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis. [8]

Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. [6]

One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis. [6]

Two Group C-C Disconnections: Diels-Alder Reaction, 1,3-difunctionalised compounds, α, β- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation. [6]

Ring Synthesis: Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings. aromatic heterocycles in organic synthesis. [5]

Synthesis of Some Complex Molecules: application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A. [8]

Suggested Books:

1. Designing Organic Synthesis, S.Warren. Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O. House, W.A Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

CH 622 Heterocyclic Chemistry 3-0-0-3

Aromatic Heterocycles: Nomenclature, General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. [6]

Non-aromatic Heterocycles: Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1, 3-diaxial interaction. Stereo-electronic effects, anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions. [7]

Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes. [4]

Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofuranes and benzothiophenes. [4]

Meso - ionic Heterocycles: General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. [4]

Six - Membered Heterocycles with one Heteroatom: Synthesis and reactions of pyrilium salts and pyrones and their comparison with pyridinium & thiopyrilium salts and pyridones. Synthesis and reactions of quinolinium and benzopyrylium salts, coumarins and chromones. [6]

Six Membered Heterocycles with Two Heteroatoms: Synthesis and reactions of diazines, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines. [8]

Suggested Books:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Techinal.

5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M.Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

CH 632 Chemistry of Natural Products 3-0-0-3

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Gereniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene. [9]

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-Coniine, Nicotine, Atropine, Quinine and Morphine. [9]

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of Steroids. [9]

Flavonoids and Anthocyanins: Occurrence, nomenclature, biogenesis and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidine, Hirsutidin. [9]

Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll. [3]

Suggested Books:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.
2. Organic Chemistry: Vol. 2 1L. Finar, ELBS
3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic

Publishers.

CH 642 Medicinal Chemistry 3-0-0-3

Structure and activity : Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery. [9]

Antibiotics and antibacterials: Introduction (i) Antibiotic β-Lactam type Penicillins, Cephalosporins (ii) Antitubercular Streptomycin(iii)Broad spectrumantibiotics-Tetracyclines (iv)Anticancer-Dactinomycin (Actinomycin D) (v)Antifungal –polyenes(vi) Antibacterial Ciprofloxacin,Norfloxacin(vii) Antiviral – Acyclovir [9]

Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine. [4]

Non-steroidal Anti-inflammatory Drugs : Diclofenac Sodium, Ibuprofen and Netopam [4]

Antihistaminic and antiasthmatic agents: Terfenadine,Cinnarizine, Salbutamol and Beclomethasone dipropionate [4]

Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurines. Recent development in cancer chemotherapy. Hormone and natural products. [9]

Suggested Books:

1. Medicinal Chemistry; Burger, Wiley Interscience Publications.
2. Principles of Medicinal Chemistry; W. O. Foye Lea & Febiger: Varghese Publishing House
3. The Organic Chemistry of Drug Synthesis; D. Lednicer and L. A. Mitscher Wiley Interscience.

Medicinal Chemistry

Mody University of Science & Technology

M.Sc. Physics

Session 2017-2018

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc. Physics

Academic Curriculum (2015 – 16 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 511	Mathematical Physics-I	3	1	0	4	3	25	25	50
	PH 521	Classical Mechanics	3	0	0	3	3	25	25	50
	PH 531	Classical Electrodynamics and Plasma Physics	3	1	0	4	3	25	25	50
	PH 541	Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 551	Statistical Physics and Thermodynamics	3	1	0	4	3	25	25	50
	PH 561	General Physics and Optics Laboratory	0	0	4	2	4	100		
	PH 571	Programming Language Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**4**	**8**	**23**	**-**	**-**		
		Foreign Language-I (Non-Credit)‡	3	0	0	3	3	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 512	Mathematical Physics -II	3	1	0	4	3	25	25	50
	PH 522	Atomic & Molecular Physics and Lasers	3	1	0	4	3	25	25	50
	PH 532	Condensed Matter Physics	3	0	0	3	3	25	25	50
	PH 542	Computational Physics	3	0	0	3	3	25	25	50
	PH 552	Elements of Nuclear and Particle Physics	3	0	0	3	3	25	25	50
	PH 562	Computational Physics Laboratory	0	0	4	2	4	100		
	PH 572	Advance Physics Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**2**	**8**	**21**	**-**	**-**		
		Foreign Language-II (Non-Credit)‡	3	0	0	3	3	25	25	50

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 611	Semiconductor Physics and Devices	3	1	0	4	3	25	25	50
	PH 621	Digital Electronics	3	1	0	4	3	25	25	50
	PH 631	Physics of Nano-Materials	3	0	0	3	3	25	25	50
	PH 641	Ancient Indian Science	2	0	0	2	3	25	25	50
	PH 651	Electronics Laboratory	0	0	4	2	4	100		
		Specialized Paper –I	3	1	0	4	3	25	25	50
		Specialized Paper –II	3	1	0	4	3	25	25	50
	Sub Total		**17**	**4**	**4**	**23**	**-**	**-**		

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 612	Advance Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 622	Instrumentation and Characterization Techniques	3	0	0	3	3	25	25	50
		Specialized Paper –III	3	1	0	4	3	25	25	50
		Specialized Paper –IV	3	1	0	4	3	25	25	50
	PH 682	Project	0	0	0	8	-	100		
	Sub Total		**12**	**3**	**0**	**23**	**-**	**-**		

Total Credits = 90

Specializations:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE**	ETE
A	**Nanoscience**								
PH 661	Elements of Nanoscience	3	1	0	4	3	25	25	50
PH 671	Nano-Fabrication Techniques	3	1	0	4	3	25	25	50
PH 632	CNT and Sensor Applications	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
B	**Photonics**								
PH 681	Advance Opto-Electronics	3	1	0	4	3	25	25	50
PH 691	Fiber and Non-linear Optics	3	1	0	4	3	25	25	50
PH 652	Quantum Optics	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
C	**Condensed Matter Physics**								
PH 613	Advance Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 623	Soft Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 662	Material Science	3	1	0	4	3	25	25	50
PH 672	Smart Materials	3	1	0	4	3	25	25	50

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

[#]*Student will perform* ***project work*** *for a period of 2 months and submit two copies of Dissertation report to the Ddepartment. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

Detailed Syllabus (M.Sc. Physics):

PH 511 **Mathematical Physics-I** **3 - 1 - 0 - 4**

1. **Vector Analysis:** Gradient, divergence, Curl and their representations in Orthogonal curvilinear coordinates. [11]

   Linear algebra: Linear vector spaces, linear operators, dual space, ket and bra notation, Hilbert space, Metric space, Function spaces.

   Matrices: The algebra of matrices, Special matrices, Rank of a matrix. Elementary transformations, Elementary matrices, Equivalent matrices, Solution of linear equations. Linear transformations, Change of Basis, Eigenvalues and eigenvectors of matrices, The Cayley-Hamilton theorem, Diagonalisation of matrices.

2. **Tensor Analysis:** Tensor analysis, Coordinate transformations, scalars, Covariant and Contravariant tensors, Addition, Subtraction, Outer product, Inner product and Contraction, Symmetric and antisymmetric tensors, Quotient law, Metric tensor, Conjugate tensor. [8]

3. Partial Order Differential Equations and Special Functions: Separation of variables-ordinary differential equations, singular points, Bessel, Leguerre, Legendre, Hermite equations. Recurrence relations, generating functions and Rodrigues formulae for the Bessel, Leguerre, Legendre and Hermite functions [11]

4. **Greens Functions:** Sturm-Lioville operators and eigen values and eigen functions. Dirac delta functions-properties and representations, Definitions and physical significance of Greens functions, Eigen function expansion of Greens function, Greens function for ordinary differential operators [9]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990.
3. M.D. Greenberg:Advanced Engineering Mathematics, 2nd Edition, PHI, New Jersey, 1998.
4. B.D. Gupta: Mathematical Physics, 3rdedition, Vikas Publishing House, New Delhi. , 2006.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, 8th ed., Wiley, New York, 1999.
2. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
3. Satyaprakash, Mathematical Physics, Sultan Chand & sons, 6th edition, New Delhi, 2004.

PH 521 **Classical Mechanics** **3 - 0 - 0 - 3**

1. **Fundamental Principles and Lagrangian Formulation and Applications:** Newtonian Mechanics: Mechanics of a particle and system of particles, Conservation laws, Constraints, Generalized coordinates, D' Alembert's principle and Lagrange's equation, Hamilton's Variational principle, **Lagrangian Problems:** Double Pendulum, Spherical pendulum, Cylinder rolling down an inclined plane. [8]

2. **Hamiltonian Formulation and Application:** Hamilton's equations, cyclic variables, Principle of least action, **Hamiltonian Problems:** motion of a particle in a central force field, charged particle moving in an electromagnetic field, Equations of motion and first integrals, Kepler's laws, Scattering by central potential, Transformation from center of mass to laboratory frame. [10]

3. **Rigid Body Dynamics and Canonical Transformations:** Rigid body motion – Kinematics - Euler's angles - Angular momentum and kinetic Energy – Moment of inertia tensor - Euler's equations of motion –Canonical transformation and their generators – simple examples, Poisson brackets. [8]

4. **Jacobi Theory and Theory of Small Oscillations :** Hamilton-Jacobi equations – application to Linear Harmonic Oscillator problem - Action Angle variables - Application to Kepler's problem - Oscillatory motion - Theory of small oscillation –Two coupled pendulums, Vibrations of a triatomic molecule. [8]

5. **Relativity:** Reviews of basic ideas of special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence [5]

Text Books:

1. H. Goldstein, C.Poole and J.Safko; Classical Mechanics, Pearson, New Delhi, 3rd ed 2002.
2. N.C.Rana and P.S.Joag; Classical Mechanics, Tata Mc: Graw Hill, New Delhi, 1991.

Reference Books:

1. L. D. Landau E.M. Lifshitz; Mechanics: Volume 1 (Course of Theoretical Physics), Pergamon Press Ltd, 2nd ed. 1969.

PH 531 Classical Electrodynamics and Plasma Physics 3 - 1 - 0 - 4

1. **Electrostatics:** Electric potential, Poisson and Laplace‟sequations.Boundary value problems, Uniqueness theorems, Green‟stheorem.Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion. [6]

2. **Electromagnetic Waves:** Maxwell‟s equations, Boundary conditions, Wave equation and its complex notation, Electromagnetic waves in vacuum, Electromagnetic waves in non-conducting and linear media, Electromagnetic waves in linear conducting media. Poynting theorem, Reflection, refraction and polarization of electromagnetic waves, [6]

3. **Waveguides and Cavities:** Metallic boundary conditions, Electromagnetic waves confined to hallow metallic pipe,TE, TM and TEM modes, TE and TM modes in rectangular waveguides, Bessel‟s function, TE and TM modes in cylindrical waveguides, Dielectric waveguides, TE and TM modes in rectangular and cylindrical Resonant cavities. [6]

4. **Potential, Fields and Radiations:**

   Scalar and vector potentials, Gauge transformation, Coulomb and Lorentz gauge, Retarded potential, Lienard-Wiechert potentials, Fields due to moving charge, Power radiated by an accelerated charge and angular distribution, Bremstrahlung Cerenkov and Synchrotron radiations. [6]

5. **Relativistic Electrodynamics:** Four vectors, Lorentz transformation in terms of Four vectors, Lorentz transformation matrix, Transformation of electromagnetic fields, Field Tensor, Dual field strength tensor, Maxwell's equations in terms of strength tensors, [6]

6. **Plasma Physics:** Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, Motion of charged particles in electric and magnetic fields, Adiabatic Invariants Wave in Plasma: Polarisation, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and Perpendicular to the Magnetic Field Propagation at Finite Angle. [9]

Text Books:

1. David J. Griffith; Introduction to Electrodynamics, PHI Private Limited, 1999
2. John D. Jackson; Classical Electrodynamics, Wiley Eastern Limited, 1998
3. F.F. Chen; Plasma Physics and Controlled Fusion,Springer,2006

Reference Books:

1. Edward C. Jordan and Heith G. Balmain; Electromagnetic Waves and Radiating Systems, PHI, 1991
2. W.K.H. Panofsky and M. Phillips; Classical Electricity and Magnetism, Dover Publications; 2nd Ed., 2005
3. J A Bittencourt; Fundamentals of Plasma Physics, 3rd Ed, Springer, 2004

PH 541 **Quantum Mechanics** **3 - 1 - 0 - 4**

1. Limitations of classical mechanics, development of Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states. Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest‟s theorem, momentum Eigen functions in the coordinate representation, box normalization and Dirac delta function. Coordinate and momentum representations, Schrodinger equation in momentum representation [10]

2. Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, Eigen values and Eigen vectors, Hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations. Matrix representation of operators, change of basis, unitary transformations, quantum dynamics, Schrodinger, Heisenberg and interaction picture. [10]

3. Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method. Angular momentum operator, commutation relations, expression for L2 operator in spherical polar coordinates, Role of L2 operators in central force problem, eigen value problem for L2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator. [10]

4. Generalized angular momentum, raising and lowering operators, matrices for J2, Jx, Jy, Jz operators, Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions. [9]

Text Books:

1. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
2. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

Reference Books:

1. L.I.Schiff; Quantum Mechanics, TMH, 2010.
2. Mathews and Venkatesan; A Textbook of Quantum Mechanics, TMH 1976,
3. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
4. J.J.Sakurai; Modern quantum Mechanics, Addison Wesley; 2 ed., 2010

PH 551 Statistical Physics and Thermodynamics 3 - 1 - 0 - 4

1. **Review: (Elementary Probability Theory & Thermodynamics):** Preliminary concepts, Random walk problem, Binomial distribution, mean values, standard deviation, various moments, Gaussian distribution, Poisson distribution, mean values. Extensive and intensive variables, laws of thermodynamics, thermodynamic potentials, Maxwell relations, applications of thermodynamics to (a) ideal gas, (b) magnetic material, and (c) dielectric material. Laws of thermodynamics [4]

2. **Statistical Description of System of Particles and Statistical Thermodynamics:** State of a system, microstates, ensemble, basic postulates, behavior of density of states, density of state for ideal gas in classical limit. Thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of density of states on external parameters, Statistical calculation of thermodynamic variables [10]

3. **Classical Statistical Mechanics :** Microcanonical ensembles and their Equivalence, Canonical and grand canonical ensembles, partition function, thermodynamic variables in terms of partition function and grand partition function, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem. Maxwell-Boltzmann gas velocity and speed distribution. Chemical potential, Free energy and connection with thermodynamic variables, First and Second order phase transition; phase equilibrium. [10]

4. **Quantum Statistical Mechanics :** Formulation of quantum statistics, Density Matrix, ensembles in quantum statistical mechanics, simple applications of density matrix. The theory of simple gases : Maxwell-Boltzmann, Bose-Einstein, Fermi Dirac gases. Statistics of occupation numbers, Evaluation of partition functions, Ideal gases in the classical limit. [10]

5. **Ideal Bose System :** Thermodynamic behavior of an Ideal Bose gas, Bose-Einstein condensation. Thermodynamics of Black body radiation, Stefan-Boltzmann law, Wien's displacement law. [5]

Text Books:

1. B. B. Laud; Fundamentals of Statistical Mechanics, New Age International, 2007.
2. F. Reif; Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965
3. S. Loknathan&Gambhir; Statistical and Thermal Physics: An Introduction, PHI Learning, 1991.

Reference Books:

1. K. Huang; Statistical Mechanics, 2nded, John Wiley & Sons, 1987.
2. R. K.Pathria, Paul D. Beale, Statistical Mechanics;Butterworth-Heinemann Press, 2011.
3. L. D. Landau and E. M. Lifshitz; Statistical Physics: Volume 5 (Course of Theoretical Physics), 3rded Butterworth-Heinemann Press, 1980.

PH 561 General Physics and Optics Laboratory 0-0-4-2

Experiments based on Mechanics, Optics, Basic Electronics, PH 531.

PH 571 Programming Language Laboratory 0-0-4-2

Programming based on C^{++} related to Physics.

PH 512 Mathematical Physics -II 3 - 1 - 0 - 4

1. **Complex Analysis :**Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula, Taylor's series and Laurent's series expansion, Zeros and singular points, Multivalued functions, Branch Points and Cuts, Riemann Sheets and surfaces, Residues, Cauchy's Residue theorem, Evaluation of definite integrals. [11]

2. **Group Theory:** Definition of groups e.g. matrix groups- transformation groups , Representation of groups: matrix, faithful, Unitary, reducible and irreducible representations' Lie groups and algebras: Definition of Lie groups with examples- O(3), SO(3), SU (2) groups- representation of SU(2), SO(3). [9]

3. **Fourier Series & Transforms**: Integral transforms, Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives [9]

4. **Laplace Transforms:** Convolution Theorems, Momentum representation, Laplace transform, Properties and examples of Laplace Transform, Laplace transforms of derivatives, Use for solving differential equations [10]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. M. R. Spiegel: Theory and Problems of Complex Variables, Schaum's outline series, 6thed., 2008
3. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990,
4. B.D. Gupta: Mathematical Physics, 3rd edition, Vikas Publishing House , New Delhi. , 2006,

Reference Books:

1. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
2. E. Kreyszig: Advanced Engineering Mathematics, 8thed., Wiley, New York, 1999.
3. M.D. Greenberg: Advanced Engineering Mathematics, 2nded., PHI, New Jerrsey, 1998,

PH 522 **Atomic & Molecular Physics and Lasers** **3 - 1 - 0 - 4**

1. Time independent perturbation theory, First order perturbation theory applied to nondegenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic [11]

2. **Pauli's Principle and Shell Structure:** Systems with several electrons and spin functions. [2]

3. **Complex Spectra:** LS-Coupling scheme, normal triplets, basic assumptions of the theory, identification of terms, selection rules, jj- coupling (Qualitative). [2]

4. **Infrared and Raman Spectra:** Rigid rotator, energy levels, spectrum (no derivation of selection rules), Harmonic oscillator: energy levels, eigenfunctions, spectrum, comparison with observed spectrum, Raman effect, Quantum theory of Raman effect, Rotational and Vibrational Raman spectrum. Anharmonic oscillator: energy levels, Infrared and Raman Spectrum, Vibrational frequency and force constants. Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of Dunham coefficients), Symmetry properties of rotational levels, influence of nuclear spin. [12]

5. **Electronic Spectra:** Electronic energy and potential curves, resolution of total energy,Vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronicbands: General relations, branches of a band, band-head formation, Intensity distribution in avibrational band system. [6]

6. **Lasers:** Basic concept and principle of laser, Component of lasers, Einstein's and Gain coefficient, Types of lasers and pumping, Gas laser, YAG laser and chemical laser, Erbium lasers, Fibre lasers, Erbium-doped fibre lasers. Q-Switching:Laser Spiking and relaxation oscillations, Rate equations, TW and PW laser systems, Application of lasers. [6]

Text Books:

1. Kuhn H., Atomic Spectra, Academic Press, 1962
2. Herzberg I G., Molecular Spectra and Molecular Structure Van-Nostrand Rein-hold, 1950

Reference Books:

1. White H.E., Atomic Spectra, Mc-Graw Hill, 1934.
2. C N Banwell and E M McCash, Fundamentals of Molecular Spectroscopy: Tata Mc-Graw Hill, 2008
3. Chandra S., Molecular Spectroscopy, Narosa, 2009.
4. Vishwakarma H. L., Applied Physics, Wiley India Pvt. Ltd., 1st Edition, 2013.

PH 532 **Condensed Matter Physics** **3 - 0 - 0 - 3**

1. **Elastic Constants:** Binding in solids; Stress components, stiffness constant, elastic constants, elastic waves in crystals. [5]

2. **Lattice Dynamics and Thermal Properties:** Rigorous treatment of lattice vibrations, normal modes; Density of states, thermodynamic properties of crystal, anharmonic effects, thermal expansion. [5]

3. **Energy Band Theory**: Electrons in a periodic potential: Bloch theorem, Nearly free electron model; tight binding method; Semiconductor Crystals, Band theory of pure and doped semiconductors; elementary idea of semiconductor superlattices. [8]

4. **Transport Theory:** Electronic transport from classical kinetic theory; Introduction to Boltzmann transport equation; electrical and thermal conductivity of metals; thermoelectric effects; Hall effect and magnetoresistance. [7]

5. **Dielectric Properties of Materials:** Polarization mechanisms, Dielectric function from oscillator strength, Clausius-Mosotti relation; piezo, pyro- and ferro-electricity. [6]

6. **Liquid Crystals:** Thermotropic liquid crystals, Lyotropic liquid crystals, long range order and order parameter, Various phases of liquid crystals, Effects of electric and magnetic field and applications, Physics of liquid crystal devices. [8]

Text Books:

1. Kittel C., Introduction to Solid State Physics, Wiley, New York, 2005.
2. Kittel C., Quantum Theory of Solids, Wiley, New York, 1987.
3. Ziman J., Principles of the Theory of Solids, Cambridge University Press, 1972.

Reference Books:

1. Ibach H. and Luth H., Solid State Physics, Springer Berlin, 3rd ed. 2002.
2. Walter A. Harrison Solid State Theory, Tata McGraw-Hill, New Delhi, 1970.
3. Chandrasekhar S. Liquid Crystals, Cambridge University, 2nd ed. 1992.
4. Sluckin T.J., The Liquid Crystal Phases, Physics & Technology, Contemporary Physics Taylor & Francis, 2000.

PH 542 **Computational Physics** **3 - 0 - 0 - 3**

1. **Errors analysis and curve fittings:** General formula for errors – Errors of observation and measurement, Empirical formula, Graphical method, Method of averages, Least square fitting, curve fitting, parabola, exponential. Least square curve fittings methods for linear and polynomial functions. [7]

2. **Numerical solution of algebraic and transcendental equations:**

   The bisection method, the iteration method, The method of false position, Newton – Raphson method. [7]

   Linear systems of equations: Direct methods, Gauss elimination method, Gauss–Seidel method.

3. **Interpolation:** Finite differences (Forward, backward and central difference), Newton Interpolation formula, Central difference Interpolation formula, Cubic spline interpolation formula, Newton's interpolation formula for unequal intervals. [8]

4. **Numerical Differentiation and Integration:** Newton's forward and backward difference formula for numerical derivatives, Numerical Integration: the trapezoidal rule and Simpson's rule. [7]

5. **Numerical Solutions of Ordinary and Partial Differential Equations:** Taylor's method, modified Euler's method, second and fourth order Runge-Kutta methods, Predictor-Corrector methods. Finite-difference approximation to derivatives, S.O.R. and Jacobi methods for solving Laplace equations, Parabolic equations and Hyperbolic equations. [10]

Text Books:

1. S.S. Sastry; Introductory Methods of Numerical analysis, PHI New Delhi, 3rd Ed, 2003.
2. E. Balagurusamy; Numerical methods, Tata Mc Graw Hill, New Delhi, 2008.

Reference Books:

1. Erwin Kreyszig; Advanced Engineering Mathematics, 10thed, John Wiley and Sons, 2011.
2. W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling ; Numerical Recipes in C, , Cambridge University, 1996.

PH 552 **Elements of Nuclear and Particle Physics** **3 - 0 - 0 - 3**

1. **Nuclear Properties and Models:** General properties of Nuclei: nuclear size, Rutherford scattering, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magnetic dipole moment and electric quadrupole moment. Liquid drop model, Bethe-Weizs¨acker binding energy/mass formula, Fermi model, Shell model. [6]

2. **Nuclear Two-body Problem:** Properties of deuteron, Schr¨odinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces. Experimental n-p scattering data, Partial wave analysis and phase shifts, scattering length, magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Scattering from molecular hydrogen and determination of singlet and triplet scattering lengths, effective range theory, low energy p-p scattering, Nature of nuclear forces: charge independence, charge symmetry and iso-spin invariance of nuclear forces. [10]

3. **α, β and γ Decay:** α-decay, Gamow theory, Barrier penetration, fine structure of α spectrum. alpha decay, neutrino hypothesis β emission and electron capture, Fermi's theory of allowed β decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment, Gamma decay- Multiple transitions in nuclei- Angular momentum and parity selection rules [8]

4. **Nuclear Reactions and Fission:** Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions — Breit Wigner dispersion relation; Compound nucleus formation and break-up, Statistical theory of nuclear reactions and evaporation probability, Optical model; Principle of detailed balance, Transfer reactions, Nuclear fission and fusion. [8]

5. **Elementary Particle Physics:** Elementary particles: Photons, quarks, baryons, mesons, leptons, hadrons, Elementary idea of quark model. Conservation laws in particle reactions, Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula, C, P, T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic Kinematics. [7]

Text Books:

1. B L Cohen; Concepts of Nuclear Physics, Tata-McGraw Hill, 2008
2. Kenneth S. Krane; Introductory Nuclear Physics, Wiley India Pvt., 1988.
3. I.Kaplan;Nuclear Physics; Addison-Wesley, 1955

Reference Books:

1. S S M Wong; Introductory Nuclear Physics, Wiley, 1998.
2. S.B.Patel; Introductory Nuclear Physics, New Age International, 1991.
3. D.C.Tayal; Nuclear Physics, Himalayan Publishing House, 5th Edition, 2014.
4. R. R. Roy and B. P. Nigam; Nuclear Physics: Theory and Experiments, John Wiley & Sons, 1967.

PH 562 Computational Physics Laboratory **0-0-4-2**

Practical exercises based on 542, 512 and computational methods in Physics

PH 572 Advance Physics Laboratory **0-0-4-2**

Practical exercises based on 522, 532, 552 and related experiments.

PH 611 Semiconductor Physics and Devices 3 - 1 - 0 - 4

1. **Network Theorems:** Thevenin's, Norton's theorem and analysis of equivalent Circuits of networks. [9]

   Power Supplies: Half-Wave, Full-Wave and Bridge rectifiers with Capacitive input, Inductance input and PI filters, Shunt regulated power supplies using Zener diodes, Series regulated power supply. I. C. Voltage regulators.

2. **Transistor Amplifiers:** The CE, CB and CC configurations. Class A, Class B and Class C amplifiers. Low-frequency amplifiers. The transistor hybrid model and the h-parameters for a transistor. Conversion formulae for the h-parameters of the different transistor configurations. Analysis of a transistor CE amplifier at low frequencies using h-parameters. The CE amplifier with un-bypassed emitter resistor. The emitter follower at low frequencies. The emitter-coupled differential amplifier and its characteristics. Low frequency power amplifiers. The push-pull and the complementary - symmetry power amplifiers. Transistor biasing, Self-bias and thermal stability. [10]

3. **BJT and FET:** The BJT at high frequencies – the hybrid – model. Analysis of CE amplifier at high frequencies. Single stage CE amplifier and the gain-bandwidth product. Cascaded amplifiers. The emitter follower at high frequencies. The field effect transistor and its small signal model. The CS and CD amplifiers at low frequencies. Biasing the FET. The CS and CD amplifiers at high frequencies. [7]

4. **Feedback:** The Gain of an amplifier with feedback. General characteristics of negative feedback amplifiers. Stability of feedback amplifiers, The Barkhaussen Criteria. Grain and Phase margins. Compensation. Sinusoidal oscillators: RC oscillators – The Phase shift and the Wien's bridge oscillators. LC oscillators. Frequency stability and the crystal oscillators. [7]

5. **Operational Amplifiers:** Characteristics of an ideal operational amplifier. Applications of operational amplifiers – Inverting and Non-inverting amplifiers. Summing circuits, integration and Differentiation. Waveform generators. [6]

Text Books:

1. Maillman and Halkias, Integrated Electronics, Tata McGraw-Hill 1972.
2. V K Mehta; Principal of Electronics S. Chand and Sons 2008.
3. Donald Neamen; Semiconductor Physics and Devices, McGraw-Hill; 4th ed. 2011.

Reference Books:

1. M K Achuthan and K N Bhat; Fundamental of Semiconductor Devices, TMH 2006.
2. Rolf Enderlein, Norman J. M. Horing; Fundamentals of semiconductor physics and devices, World Scientific Pub, 1997.
3. John D. Ryder & Charles M. Thomson; Electronic Circuits & Systems, PHI Publication, 1976.

PH 621 **Digital Electronics** **3 - 1 - 0 - 4**

1. **Binary Number System:** Binary number system and other codes, binary arithmetic series and parallel processing of bites, logic of the addition operation, logic fundamentals, Boolean theorems, synthesis of Boolean functions, Karnaugh diagram. [8]

2. **Basics of Digital Electronics**: Basics and derived gates: OR gate, AND gate, NOT gate, NAND gate, NOR gate, XOR gate, Boolean identities and logic circuits using gates, Boolean algebra- DeMorgans Theorems, Sum of products and product of sums expressions, Minterm, Maxterm, SOP and POS from truth tables. [10]

3. **Combinational and Sequential Circuits:** Parity checker and generator, Half adders, full adders, Binary adders, decoders, multiplexer, demultiplexer, encoders, ROM and applications, Digital comparator, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and applications, A/D and D/A converters; Microprocessor and microcontroller basics. [12]

4. **Digital Circuits with MOS:** MOSFET, MOS invertors- static inverter, dynamic inverter, two phase inverter, MOS NAND gates, NOR gates, complementary MOSFET technology, CMOS inverter, CMOS NOR gates and NAND gates, MOS shift register and RAM. [9]

Text Books:

1. Malvino & Brown:Principle Of Digital Computer Electronics, 3rd Ed., McGraw-Hill, 1992.
2. Morris Mono: Digital logic Design, 4th edition, PHI, 2006.
3. J. Millman and C.C. Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi, 1991.

Reference Books:

1. Mottershed: Electronics fundamentals and application, 8th edition, PHI, 2009.
2. A.P. Malvino and D.P. Leach, Digital Principles and. Applications, 6thed., TMH, 2003.

PH 631 **Physics of Nano-Materials** **3 - 0 - 0 - 3**

1. **Introduction**: An overview of quantum mechanical concepts related to low dimensional systems. [12]

   Concepts related to Electronic Structure: direct lattice, Reciprocal lattice, Brilloujn zones, Diffraction from 2D structures, Free —electron approximation, periodic boundary Conditions, allowed k values, Fermi energy, density of electronic states for electron gas, Energy bands, Electron statistics, carrier concentration and Fermi level, Direct- and Indirect- gap semiconductors, Lattice matching, Effective mass, Variation of energy bands with alloy compositoin and its exploitation for devices.

2. **Hetrostructures and Electron States**: Hetero junctions, Type I and Type II hetero structures, Classification of Quantum confined systems, Electrons and holes in Quantum wells. Surface to volume ratio in quantum confined systems, Electronic wave functions, energy sub bands and density of electronic states in Quantum wells, Quantum wires, and Quantum dots, Effective mass mismatch in hetero structures. Coupling between Quantum wells, Super lattices, Wave functions and Density of States for super lattices, Unit cell for quantum well, for quantum wire and for quantum dot. [12]

   EXCITONS: Excitons in bulk, in Quantum structures and in hetero structures.

3. **Nanoclusters and Nanoparticles**: Introduction, Particle shape and the surface, Collective surface area, Porosity, Spherical cluster approximation, Metal nanoclusters – Magic numbers, Geometric structures, Electronic structure, Bulk to nanotrasition, Magnetic clusters; Semiconducting nanoparticles; Rare-gas and molecular Clusters. [6]

4. **Carbon nanotubes**: Chiral vector, Chiral angle and the Unit cell for the Carbon nanotubes. [5]

5. Bulk Nanostructurs Materials: Solid disordered nanostructures, Nanostructured crystals, photonic crystals. [4]

Text Books:

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio; Quantum Heterostructures: Microelectronics and Optoelectronics, Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens; Introduction to Nanotechnology, Wiley India, 2003.
3. T. Pradeep; Nano: The essentials, Tata McGraw-Hill, New Delhi, 2007.
4. P. Harrison; Quantum Wells, Wires, and Dots: Theoretical and Computational Physics of Semiconductor Nanostructures, Wiley, 2009.

Reference Books:

1. G. Streetman and S. Banerjee; Solid State Electronic Devices, Prentice Hall of India, 6th Edition, 2005.
2. A. Y. Shik ; Quantum Wells: Physics and Electronics of two-dimensional systems, World Scientific, 1997.
3. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao; Introduction to Nanoscience, CRC Press, 2009.

PH 651 Electronics Laboratory 0-0-4-2

Practical exercises based on 611, 621 related to analog and digital electronics.

PH 641 Ancient Indian Science 2 - 0 - 0 - 2

1. **Reference of Science in Vedas** [3]

2. **SAGE Scientists and Their Achievements:** Baudhayan, Aryabhatta,Brahmgupta, Bhaskaracharya , varahamihira, Mahaviracharya, Acharya Kanad, Varahamihira, Nagarjuna, Acharya Bhardwaj, SusrutaAtreya, Acharya Charak, Patanjali. [8]

   Scientists of modern era: C. V. Raman (1888-1970), S. Ramanujan (1887-1920), J. C. Bose (1858-1937), H. J. Bhabha (1909-1966), V. A. Sarabhai (1919-1970), H. G. Khorana (1922-2011), Harish Chandra (1923 - 1983), S. N. Bose (1894 - 1974)), S. S. Bhatnagar (1894 – 1955), Visvesvaraya (1860 –1962)[, MeghnadSaha (1893–1956) etc.

3. **Discoveries in Astronomy and Physics of Ancient India:** Earth's rotation, Gravity, Speed of light, Lunar Eclipse, Planetary motion, Mechanics, Matter, Magnetism and Optics [5]

4. **Vedic Mathematics**: Algebra & Arithmetic, Geometry, Trigonometry [5]

5. **Chemical and Biological advancement of Ancient India**: Chemistry (Distillation, Caustic Alkali, Cell and Explosives), Metallurgy (Crucible, Furnaces, Air Blowers, Metal Powder, Binder), Botany, Medicine and Pharmacology. [5]

Text Books:

1. Pride of India- A Glimpse into India's Scientific Heritage. SamskritaBharati, New Delhi, 2006.
2. Science in Samskrit, SamskritaBharati, New Delhi, 2007.
3. N. K. Jain; Science and Scientists in India. Kalyani India, Delhi, 2001.
4. Awakening Indians to India, All India ChinmayaYuvaVendra, Central Chinmaya Mission Trust, Mumbai, 2003.

Reference Books:

1. N.K. Jain; History of Science and Scientific Methods. Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi, 1990.
2. S. Soni; India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd., New Delhi, 2006.

PH 612 **Advance Quantum Mechanics** **3 - 1 - 0 - 4**

1. Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission,atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein‟s A and b coefficients and their calculations.Approximation methods: W. K. B. method and its application to barrier penetration.Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential. [10]

2. System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule. [11]

3. Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential , Partial wave method, phase shifts and their importance, scattering by a square well; potential and a perfectly rigid sphere, resonance scattering. [6]

4. Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac‟s relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac‟s theory, negative energy states and their qualitative explanations. [12]

Text Books:

1. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
2. L.I.Schiff; Quantum Mechanics, TMH, 2010.

Reference Books:

1. E. Merzbacher, Quantum Mechanics, Wiley and Sons, 1998
2. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
3. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

4. Pauling, Introduction to Quantum Mechanics, Dover Publication 2008.

PH 622 **Instrumentation and Characterization Techniques** **3 - 0 - 0 - 3**

1. **Imaging Techniques:**

Optical microscopy: Use of polarized light microscopy, Phase contrast microcopy, Interference Microscopy, hot stage microscopy - surface morphology. [2]

Scanning electron microscopy: Basic design of the scanning electron microscopy , Modes of operation, Backscattered electrons, secondary electrons, X-rays – typical forms of contrast, Resolution and contrast, Specimen Preparation, application of SEM. [5]

Transmission electron microscopy: Basic principles, Modes of operation, Specimen preparation, Diffraction in imperfect crystals, Dislocations, precipitates, Structure of Grain boundaries and interface. [4]

Force microscopy: Basic concepts-Interaction force, AFM and the optical lever, force curves, measurements and manipulation, feedback control, different modes of operation, contact non-contact and tapping mode, Imaging and manipulation of samples in air or liquid environments-Imaging soft samples, Applications . [6]

Scanning tunneling microscopy: Principle, Instrumentation, importance of STM for nanostructures, surface and molecular manipulation using STM. [4]

2. **Qualitative and Quantitative analysis**

X-Rays powder diffraction: Single crystal diffraction techniques, Determination of accurate lattice parameters, structure analysis , profile analysis, particle size analysis using Scherer formula. [3]

Thermal analysis methods: Principle and Instrumentation of Thermogravimetry, Differential Thermal Analysis and Differential scanning calorimetry. Electron Energy Loss Spectroscopy; Atom probe field ion microscopy-X-Ray Photoelectron Spectroscopy, X-Ray Characterization, EDAX and WDA analysis, EPMA, ZAP corrections. [7]

Spectroscopic techniques: Introduction to Molecular Spectroscopy and Differences-With Atomic Spectroscopy-Infrared (IR) Spectroscopy and Applications- Microwave Spectroscopy-Raman Spectroscopy and CARS Applications-Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique. [8]

Text Books:

1. Cullity, B. D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
2. Loretto, M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.

Reference Books:

3. Rose, R.M., Shepard, L.A. and Wulff, J., The Structure and Properties of Materials, 2nd Ed., Wiley Eastern Ltd, 2005.

PH 661 **Elements of Nanoscience** **3 - 1 - 0 - 4**

1. **History , Scope and Classes of Nanomaterials:** Pre-nanotechnology, origins of concepts of Nano, Basics and basis of Nanotechnology, Generations and Development, Molecular aspects, Top down and Bottom up approaches, fullerenes: properties of fullerenes [8]

2. **Nanomagnetics**: Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics. [12]

   Quasicrystals: Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

3. **Optical and Vibrational Spectroscopy**: spectroscopy of semiconductor; infrared surface spectroscopy, Raman spectroscopy, Brillouin spectroscopy, luminescence (photoluminescence, thermoluminescence), [7]

4. **Biological Materials**: biological buildings blocks, nucleic acids, biological nanostructures. [6]

5. **Nanomachines and Nanodevices**: MEMS, MEMSs, molecular and super molecular switches. [6]

Text Books:

1. S. Shanmugam; Nanotechnology, MJP Publishers, Chennai, 2010.
2. Guozhong Cao; Nanostructures and Nanomaterials, Imperial College Press, London, 2004.
3. Charles P. Poole, Frank J Owens; Introduction to Nanotechnology, Wiley, 2003.
4. T. Pradeep; Nano: The Essentials, TMGH, New Delhi, 2009.

Reference Books:

1. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

PH 671 **Nano-Fabrication Techniques** **3 - 1 - 0 - 4**

1. **Physical and Chemical Methods:** Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE), Sol-Gel Process — Self-assembly – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Photochemical Synthesis - Sonochemical Routes – Reverse Micelles and Micro emulsions - Combustion Method – Template Process - Chemical Vapor Deposition (CVD) – Metal Oxide Chemical Vapor Deposition (MOCVD) [12]

2. **Optical Lithography:** Introduction - Necessity for a clean room- different types of clean rooms-construction and maintenance of a clean room- Lithography -Optical lithography- Optical projection lithography- Multistage scanners resolution- Photomask- Binary mask- Phase shift mask - Attenuated phase shift masks - alternating phase shift masks - Off axis illumination- Optical proximity correction - Sub resolution assist feature enhancement-Optical immersion lithography- Optical interferometric lithography- Holographic lithography. [9]

   Maskless optical projection lithography - Zone plate array lithography-Extreme ultraviolet lithography.

3. **Electron Beam and Ion Beam Lithography:** Scanning electron-beam lithography- maskless EBL- parallel direct-write e-beam systems-electron beam projection lithography - Scattering with angular limitation projection e-beam lithography- Projection reduction exposure with variable axis immersion lenses. [8]

   Focusing ion beam lithography - Ion projection lithography - Projection focused ion multi-beam - Masked ion beam lithography- Masked ion beam direct structuring- atom lithography.

4. **Nanoimprint Lithography and Soft Lithography**: Nanoimprint lithography (NIL)- NIL- hot embossing- UV-NIL- Soft Lithography- Moulding/Replica moulding: Printing with soft stamps- Edge lithography -Dip-Pen Lithography-set up and working principle. [5]

5. **Etching Techniques**: Reactive Ion etching- RIE reactive ion etching- Magnetically enhanced RIE- IBE Ion beam etching- Other etching techniques. [5]

Text Books:

1. Zheng Cui; Nanofabrication-Principles, Capabilities and Limits, Springer, 2008
2. Guozhong Gao; Nanostructures & Nanomaterials: Synthesis, Properties & Applications, , Imperial College Press, 2004.

Reference Books:

1. K. Suzuki and B W Smith, Microlithography: Science and Technology, 2nd Ed., CRC Press, 2007.
2. M.Ratner, D Ratner. Nanotechnology - A Gentle Introduction to the Next Big Idea, Pearson, 2003.
3. Bhushan, B., Handbook of nanotechnology, 2nd Ed., Springer, 2007.

PH 632 CNT and Sensor Applications 3-1-0-4

1. Structure of CNTs

Allotropes of carbon, Buckminsterfullerene, Fullerene-related carbon nanotubes, Single- and double-walled nanotubes, Catalytically produced carbon nanotubes, Bonding in carbon materials, Vector notation for carbon nanotubes, Unit cells of nanotubes, Symmetry classification of nanotubes, Defects in the hexagonal lattice, The layer structure of multiwalled nanotubes, Theory of nanotube capping, multiwalled nanotubes produced by arc-evaporation, multiwalled nanotubes produced by catalysis, experimental studies: single-walled nanotubes General features Electron diffraction of SWNTs, HRTEM of SWNTs, Scanning tunnelling microscope of SWNTs, Neutron diffraction.

[9]

2. Physical properties of CNTs

Electronic properties of graphite, Electronic properties of nanotubes, Band structure of single-walled tubes, Effect of curvature and of tube–tube interactions, Electron transport in nanotubes, Effect of a magnetic field, Correlation between electronic properties and structure of single-walled nanotubes, Quantum conductance, Electronic properties of nanotubes in a magnetic field, Superconductivity, Mechanical properties of carbon nanotubes, Optical properties of nanotubes, Thermal properties of nanotubes.

[8]

3. Chemistry and biology of CNTs

Covalent functionalization, Functionalization of nanotube ends and defects, Functionalization of sidewalls, Non-covalent functionalization, Characterizing chemically functionalized nanotubes, Biological functionalization, Proteins, Nucleic acids, Toxicity of carbon nanotubes.

[6]

4. Synthesis, Purification and processing of CNTs

Production of multiwalled nanotubes by arc-evaporation, Growth mechanisms of multiwalled nanotubes in the arc, Production of multiwalled nanotubes by high-temperature heat treatments, Production of single-walled nanotubes by arc-evaporation, Production of single-walled nanotubes by laser vaporization, Growth mechanisms of SWNTs in the arc and laser methods, Purification of single-walled and multiwalled tubes, Processing of single-walled and multiwalled nanotubes.

[10]

5. Probes and sensors Applications

Nanotube tips for atomic force microscopy, Preparing nanotube tips: mechanical assembly, Preparing nanotube tips: chemical vapour deposition, Imaging using nanotube AFM tips, Gas sensors, Biosensors, Physical sensors.

[6]

Text Books

1. Applied Physics of Carbon Nanotubes: Fundamentals of Theory, Optics and Transport Devices, Rotkin Slava V. , Subramoney Shekhar, Springer (2005)
2. Aligned Carbon Nanotubes: Physics, Concepts, Fabrication and Devices, Zhifeng Ren, Yucheng Lan, Yang Wang, Springer-Verlag Berlin Heidelberg (2013)

3. Carbon Nanotube and Graphene Device Physics, H.-S. Philip Wong, Deji Akinwande , Cambridge University Press (2011)

Reference Books

1. Carbon Nanotubes – Growth and Applications Edited by Mohammad Naraghi Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia (2011)
2. Carbon nanotubes : properties and applications Edited by Michael J O'Connell, CRC Press (2006)
3. Carbon Meta-Nanotubes: Synthesis, Properties and Applications, Edited by Mark Monthioux, Willey (2011)

PH 642 Nanophotonics 3 - 1 - 0 - 4

1. **Photons and electrons:** Isomorphism of Schrodinger and Helmholtz equations, free space propagation. Confinement of photons and electrons. Bloch waves, reciprocal space, and Brrilouin zones Propagation through well and barriers, Cooperative effects for photons and electrons. [8]

2. **Quantum Confinement Effect:** Quantum confinement effects in solids, nanoscale interaction dynamics, quantum wells, quantum wired, quantum dots, quantum rings. Manifestation of quantum confinement: linear and nonlinear optical properties. [10]

3. **Photonic Crystals**: Basics Concepts, Light in periodic nanostructures, Features of Photonic Crystals, photonic bandgaps, Band gap and band structures in 1-D, 2-D and 3-D photonic lattices. Photonic Crystal Sensors, Microstructure Fibers: Photonic crystal fiber, photonic band gap fibers (PBG), band gap guiding, single mode and multi mode, dispersion and nonlinear effect of Photonic crystal devices using crystal fibers. [12]

4. **Plasmonics:** Optical response of metals, plasmons, shell nanoparticles, metal-dielectric shell nanoparticles, Nonlinear optics with surface plasmons, Plasmon waveguides, Applications of Metallic Nanostructures: nanolasers, nanowire lasers, resonant cavity LED, Metamaterials. [9]

Text Books:

1. Paras N Prasad: Nanophotonics, John Wiley & Sons, 1st edition, NJ, 2004.
2. S V. Gaponenko, Introduction to Nanophotonics, 1st ed., Cambridge University Press, NY, 2010.
3. J D Joannopoulos, R.D. Meade and J.N.Winn: Photonic Crystals: Modelling Flow of Light; 2nd ed. , Princeton University Press, NJ, 2008.

Reference Books:

1. Lukas Novotny and Bert Hecht: Principles of Nano Optic,2nd ed., Cambridge Univ. Press, 2012.
2. J MLourtioz, H Benisty; V Berger, Jean-Michel Gerard: Photonic Crystals: Towards Nanoscale Photonic Devices, 2nd ed., Springer, Berlin 2008.

PH 681 **Advance Opto-Electronics** **3 - 1 - 0 - 4**

1. **Optical Properties of Semiconductors:** Basic of semi-conductors, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, External quantum efficiency, double hetero-junction, fabrication of hetero-junction, Solar cells, photo-resistors quantum wells and super lattices. [6]

2. **Optical Sources:** Current Densities and Injection Efficiency, Injection Luminescence and the Light-Emitting Diode, Spectrum of Injection Luminescence, Selection of Materials for LEDs, Internal/External Quantum Efficiency The Hetero-junction, Surface-Emitting LEDs, Edge-Emitting LEDs, Super-luminescent Diodes, LASER as an amplifier of light and necessary conditions for amplification, special properties of LASER- monochromatic, coherent and light power nature, directionality, divergence and attenuation of LASER beam. Study of three level Laser (Ruby LASER), Study of four level laser (He-Ne laser), semiconductor laser and applications of high power, low power continuous wave and pulse lasers [14]

3. **Light Detectors:** Idea of light detectors and their basic types, Optical Absorption Coefficient and Photocurrent, Quantum Efficiency, Responsivity, Long-Wavelength Cut-off, p-i-n-Photodiode, Avalanche photodiodes (APDs) [4]

4. **Opto-electronic Modulator and Display Devices:** Optical polarization, Electro-optic effect, Longitudinal and Transverse Electro-optic modulator, Acousto-optic effect, Raman-Nath Modulator, Bragg Modulator. Display devices, Photoluminescence, cathodo luminescence, EL display, LED display, drive circuitary, plasma panel display, liquid crystals, properties, LCD displays, numeric displays. [9]

5. **Organic Optoelectronic Devices:** Organic Light-Emitting Diodes (OLEDs), Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs Organic photovoltaic diodes (OPVDs), Exciton absorption, Exciton dissociation ,Charge collection Characterization of OPVDs [6]

Text Books:

1. A. YarivOptical Electronics,4thed, Saunders Collage Press, 1991.
2. A. Ghatak&K.Thyagarajan; Optical Electronics, Cambridge University Press, 1989.
3. R. P. Khare; Fiber Optics and Optoelectronics, Oxford University Press, 2004.
4. Wolfgang Brutting;Physics of Organic Semiconductors, Wiley, 2006.

Reference Books:

1. Pallabh Bhattacharya, Semiconductor Optoelectronics Devices, Prentice Hall; 2nd ed. 1996.
2. A. Roger, Essentials of Optoelectronics, Chapman Hall, 1997.
3. Jasprit Singh, Electronic & Optoelectronic properties of Semiconductor, Cambridge University Press, 2007.

PH 691 **Fiber and Non-linear Optics** **3 - 1 - 0 - 4**

1. **Basic Optics :** Basic optical laws, reflection at plane interface, Brewster angel and total internal reflection, Linear and nonlinear medium, Maxwell's equations, Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides, polarization, dielectric susceptibility, first and higher order susceptibilities. [6]

2. **Optical Fiber Waveguides and Sources:** Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays, evanescent field and Goos-Haechen shift, step index and graded index fibers, single and multi-mode fibers. [5]

3. **Transmission Characteristics of Optical Fibers:** Attenuation , material absorption losses in silica fibers, linear and nonlinear scattering losses, fiber bend loss, mid-infrared and far-infrared transmission, intra-modal and inter-modal dispersion, overall fiber dispersion in multimode and single-mode fibers, modal birefringence. [8]

4. **Fabrication Techniques and Connection of Optical Fibers:** Glass fibers, Preparation of optical fibers, Liquid-phase (melting) and Vapour-phase deposition techniques, characteristics of single-mode, multimode, plastic-clad and all-plastic fibers, Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen absorption, fiber alignment and joint loss, fiber splices, Fiber connectors, Fiber couplers, Sources to Fiber Power launching. [8]

5. **Nonlinear Optical Effects in Fiber and Solitons in Optical Fiber Communication:** Refractive index, frequency and intensity dependent refractive index, group velocity dispersion, self-phase modulation, Kerr effect, chirping, stimulated Raman scattering , stimulated Brillouin scattering, self-steepening, self-focusing, self-defocusing, concept of solitons, formation of solitons, Nonlinear Schrödinger equation for solitons, soliton switching, soliton laser, advantages of soliton based communication. [12]

Text Books:

1. AGhatak and K. Thyagarajan; Introduction to fiber optics, Cambridge University press, 6th ed., 2006.
2. K. Thyagarajan and A Ghatak; Fiber Optic Essentials, , Wiley-IEEE Press, 2007.
3. G. Keiser, Optical Fiber Communications, Mc Graw-Hill, 5th ed., 2013.
4. Govind P. Agrawal, Nonlinear Fiber Optics, Academic Press, 2001

Reference Books:

1. John M. Senior; Optical fiber communications: Principles and practice, PHI, 3rded, 2009.
2. B.B. Laud; Lasers and Non-Linear optics, John Wiley & Sons, 1985.
3. Robert W Boyd; Nonlinear fiber optics, Elsevier, 2nd ed., 2006.

PH 652 **Quantum Optics** **3 - 1 - 0 - 4**

1. **Quantized States of Radiation**: Quantization of the radiation field, quantum harmonic oscillator, the zero-point energy. the connection between the positive and negative frequency parts of the electric field operator; states of the quantized radiation field - single mode number states, thermal states, phase states, the minimal uncertainty states; the coherent and squeezed coherent states. [6]

2. **Semi-classical and Quantum Descriptions of a Radiation Field**: Various definitions of a coherent state: the minimal uncertainty states, the states with classical motion, the displacement operator eigen states etc; the Glauber-Sudarshan P-function, the Q-function and other quasi-probability distribution functions and their use in the semi-classical description of a radiation field; Nonclassical aspects like squeeezing and antibunching and examples of nonclassical states and experimental status. Important experiments in Quantum Optics: Photon counting experiments, Intentsity-intensity correlation - Hanbury-Brown and Twiss experiment. [8]

3. **Classical and Quantum Theories of Optical Coherence**: The concept of an analytic signal, elementary description of stochastic processes, correlation functions and coherence functions; Stationary and ergodic processes, Wiener-Khinchin relations etc. Young's double slit experiment to discuss the conditions on the classical coherence functions and quantum coherence functions for various orders of coherence; higher-order correlations functions etc. [8]

4. **Interaction Between Light and a Two-level Atom**: The Jaynes-Cummings model interaction and the corresponding Hamiltonian - its solution and the expression for the population inversion; the experimental developments; the classical and quantum signatures -collapses and revivals. [6]

5. **Quantum Theory of Laser**: Photon rate equations, threshold conditions, laser photon distribution, fluctuations in laser light and laser phase diffusion. [12]

   Special topics: Spontaneous emission, laser cooling, collective and cooperative effects in the light-atom(s) interaction, quantum beats, the role of quantum optics in the problem of quantum entanglement and quantum information.

Text Books:

1. L. Mandel and E. Wolf; Optical coherence and quantum optics, Cambridge, 1995.
2. M Fox; Quantum Optics, An Introduction, Oxford University Press, 2006.

Reference Books:

1. P. Meystre and M. Sargent; Elements Of Quantum Optics 3Ed, Springer (India) Pvt. Ltd., 2006.

PH 613 Advance Condensed Matter Physics 3 - 1 - 0 - 4

1. **Plasmons, Polaritons and Polarons:** Dielectric function of the electron gas, Plasma optics, Dispersion relation for electromagnetic waves, Transverse optical modes in plasma, Longitudinal plasma oscillations, Plasmons, electrostatic screening, Mott metal-insulator transition, Screening and phonons in metals; Polaritons and LST relation, Electron-electron interaction; Electron –phonon interaction (Polarons). [9]

2. **Optical Properties and Raman Effect in Crystals:** Optical reflectance, Kramers-Kronig relations, Excitons, Frenkelexcitons, weakly bound excitons, Raman Effect in crystals, Electron spectroscopy with X-rays, Energy loss of particles in a solid. [8]

3. **Superconductivity:** Superconductors, Meissner effect, heat capacity, energy gap, isotope effect, London penetration depth, coherence length, BCS theory, Flux quantization in a superconducting ring, Josephson tunnelling. [5]

4. **Magnetic Properties of Solids and Magnetic Resonance:** Langevin diamagnetism, quantum theory of paramagnetism, paramagnetic susceptibility of conduction electrons, ferromagnetic, Curie point, temperature dependence and saturation magnetization at absolute zero, Magnons, Curie temperature and susceptibility of Ferrimagnets, Antiferromagnetics and susceptibility below Neel temperature, Ferromagnetic domains, Nuclear magnetic resonance, line width, hyperfine splitting, electron paramagnetic resonance [12]

5. **Imperfections in crystals and diffusion in solids:** Point, line and surface imperfections, Dislocations; Fick's law of diffusion, Fick's second law, Kirkendall effect, Temperature dependence of diffusion coefficient, determination of diffusion coefficient and activation energy [5]

Text Books:

1. Kittel C, Introduction to Solid State Physics, Willey 7th ed. 2005
2. Hayden W., Moffatt W. G. And Wulff J., Structure and properties of materials, Willey Vol. 3rd.
3. Dekker A., Solid State Physics, Prentice-Hall, 1967

Reference Books:

1. Azaroff L. V., Introduction to Solids, Mc-Graw Hills, 2010
2. Vijaya M. S. And Rangrajan G., Material Science, Tata McGraw Hills, 2006
3. J. R. Hook, H. E. Hall., Solid State Physics, Wiley; 2 edition, 1995.
4. Narula and Gupta, Material Science, Tata McGraw Hills, 2007

PH 623 **Soft Condensed Matter Physics** **3 - 1 - 0 - 4**

1. **Introduction and Review of Statistical Mechanics:** Examples of soft materials in industry and biology, Foams as a lead-off example of macro properties derived from micro, Atomic- and molecular-scale forces and bonds, Repulsion, entropy, hydrophobicity. Probabilities; Boltzmann distribution, Helmholtz energy, Equipartition theorem, Example of pulling RNA and measuring stiffness of a network (experiments). [8]

2. **Van der Waals Forces and Fluctuation-induced forces:** Keesom, Debye, and London contributions, Mean-field models of media, Measurements; list of Hamaker constants, relationship to surface tension, Derjaguin approximation; interaction between spherical particles. Osmotic pressure, Depletion attraction, Repulsion between membranes, Tension in a polymer. [7]

3. **Polymer :** Part A: Survey of types of polymers. Ideal-chain and Freely-jointed chain models.

   Part B: Worm-like chain (Kratky-Porod) model. The spectrum of fluctuations and the stiffness of a single polymer. [4]

4. **Friction in Fluids and The Diffusion Equation:** The Langevin Equation of motion of a particle in fluid. Viscosity and a simple model for its value; terminal velocity; sedimentation. The mean-square displacement, Fluctuation-dissipation theorem. A free particle; an ink spot; diffusion to capture, etc. Particle-hopping model; Fick's law; diffusion with drift. Experimental methods: Dynamic light scattering and the correlation function. Measuring interactions: terminal velocity; g(r); Boltzmann method. [10]

5. **Fluid Interfaces**, **Fluid Dynamics and Electrostatics in Solution (3D):** Surface tension, surfactants and Pickering emulsions. Consequences of a surface tension: LaPlace pressure, Jurin's Law, the Rayleigh instability, the Young-Dupre law and wetting, the shape of a meniscus: the equation of capillarity. Forces among interfacial inclusions (the 'Cheerios Effect'). Assembly of particles at liquid interfaces. [10]

   The Navier-Stokes equation for an isotropic fluid. Reynolds Number, laminar flow, Poiseuille flow, lubrication. Poisson-Boltzmann theory and Debye length Inter-particle forces,

Text Books:

1. Richard A.L Jones., Soft Condensed Matter, Oxford University Press, 1st Edition, 2002.
2. Chaikin P. M. and Lubensky T.C. , Principles of Condensed Matter Physics, Cambridge University Press, 1st Edition 2000

Reference Books:

1. Poon W.C.K. , David Andelman, Soft Condensed Matter Physics in Molecular and Cell Biology, CRC Press, Taylor and Francis Group, 2006

PH 662 **Material Science**

3-1-0-4

1. **Introduction**

   Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern Materials.

   [2]

2. **Phase Diagrams and Phase Transition in materials**

   Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system.

   Solid solutions, Phases, Thermodynamics of solutions, Phase rule, Binary phase diagrams, Binary isomorphous systems, Binary eutectic systems, ternary phase diagrams, kinetics of solid reactions. Order disorder phenomenon in binary alloys, long range order, super lattice, short range order.

   [14]

3. **Elastic,Anelastic and viscoelastic behaviour**: Atomic model of elastic behavior- Rubber like elasticity- Anelastic behavior- Viscoelastic behavior, Spring-Dashpot model.

   [5]

4. **Plastic deformation, Creep and Fracture**

   Plastic deformation - Slip - twinning - Critical resolved shear stress - theoretical shear strength of perfect crystal - role of dislocation in plastic deformation - methods of strengthening crystalline materials - strain hardening - grain size - solid solution strengthening - precipitation strengthening - fibre reinforced materials - whiskers - creep - creep curves - mechanism of creep - creep resistant materials, Ductile, Brittle fracture, Fracture toughness, Ductile-Brittle transition, fatigue fracture, Method of protection against fracture.

   [14]

5. **Oxidation and Corrosion**

   Mechanisms of oxidation, Oxidation resistant materials, Principles of corrosion, Protection against corrosion

   [4]

Text Books:

1. Dekker A J, "Solid State Physics", Macmillan and Co., (2000).
2. Raghavan V, “Materials Science and Engineering: A First Course", 5th Edition, Prentice Hall of India Pvt. Ltd., (2004).
3. Narula G K,Narula K S and Gupta V K,”Material Science”4th Ed.Tata McGraw Hill,(1993).

Reference Books:

1. Callister W D, "Materials Science and Engineering: An Introduction", 7th Edition, John Wiley & Sons, Inc., (2007).
2. James F Shackelford, "Introduction to Materials Science for Engineers", 7th Edition,Pearson Prentice Hall, (2009).
3. Van Vlack L H, "Elements of Materials Science and Engineering", 5th Edition, Addison Wesley, New York, (1989).

PH 672 Smart Materials 3 - 1 - 0 - 4

1. **Smart Materials: An Introduction:** States of matter, atomic structure, chemical bond, oxidation and reduction, aldehydesand ketones, amines and amino acids, lipids, carbohydrates, proteins and Enzymes, Biological Cell structure, Bacteria, Viruses, DNA and heredity , chromosomes, Genes, Study of Smart Materials and their integration into novel designs. Classifies according to their Response and Stimuli ability. Describes the effect of crystalline structures in the properties of piezoelectric materials, magnetostrictive materials, shape memory alloys. [10]

2. **Sensing Elements And Transducers:** Mechanical spring devices, Cantilever, Helical spring, Torsion bars or Shaft; Pressure Sensitive Devices, Bourdon tubes, bellows; Passive and active transducers, Theory of strain gauges, measurement of temperature, Thermocouples, RTDs, Thermistors, LVDT, Capacitive transducers, Hall effect transducers. [12]

3. **Chemical, Gas and optical Sensors:** pH, pH electrode, pH measurement, Humidity, Absolute and relative humidity, measurement of humidity, P-i-n and APD photodetectors, Fiber optic sensor, sensors using CNTs [6]

4. **MEMS and NEMS:** An elementary idea of MEMS, NEMSs, molecular and super molecular switches. [7]

5. **Biosensors:** Insulin therapy, Enzyme electrode, bio receptor molusles, Transduction mechanisms in biosensors. [4]

Text Books:

1. Jasprit Singh, Smart Electronic Materials, Cambridge University Press,2005.
2. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
3. Vinod Kumar Khanna, Nano Sensors, CRC Press, 2012.
4. Helmut Budzier, Gerald Gerlach; Thermal Infrared Sensors, John Wiley & Sons, Ltd, 2011.

Reference Books:

1. Jon S. Wilson, Sensor Technology Handbook, Elsevier, 2005.

2. Pavel Ripka, AloisTipek,Modern Sensors, ISTE, 2007.

Mody University of Science & Technology

Ph.D.

(Effective from Academic Year 2017-18)

RM20.711 **Research Methodology** **3-0-2-4**

Course Objectives:

1. To equip students with knowledge, abilities and insight in research methodology and related interdisciplinary fields.
2. To plan and design research using scientific and statistical methods.

1. Introduction to Research: Meaning, nature, purpose and motivation; Types of research – exploratory, descriptive, causal, and analytical; Research process; Definition of construct and variables and types of variables; Bases for choosing a topic; Problem definition; Literature review, Identification of research gap; Formulation of objectives; Signification and relevance of research objectives. **[06]**

2. Research Design and Sampling: Research Design - Meaning, need, features, types, important concepts, developing a research plan. **[06]**
Sampling: Census and Sample Survey, implications and types of sampling, process of sample selection, criteria and characteristics of selecting a good sample.

3. Scaling and Methods of Data Collection: Definition and types of scales, construction of measurement scale, errors, test of sound measurement scale. **[06]**
Methods of data collection: Types, sources and methods (Qualitative and Quantitative).

4. Statistical Tools for Data Analysis*: Measures of central tendency – Mean, Median, Mode, Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness, Correlation – Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests – Chi-Square test. **[09]**

5. Application of Computer in Research*: MS office and its application in Research, Use of Internet in Research – Websites, Search Engines, E-journal and E-Library – INFLIBNET. **MS-Excel:** Data representation, application of inbuilt formulas, formulation of equation using BODMAS rule in MS-Excel. **[06]**

6. Foundation of Research and Report Writing*: Significance and technique of interpretation, importance of report writing, types of reports, structure and components, writing research proposal and synopsis, planning phase of report writing (cauterization), Bibliography, Appendices, referencing, Style Manuals – APA style, MLA style, ASA style, Harvard/IEEE etc), plagiarism, journals, citations and indexing, funding agencies, ethics in research, characteristics of a good research report. **[06]**

Remark: 39 Hours for Lecture and 26 Hours for Practical*.

Course Outcome:

1. Develop the ability to understand and analyse the problems and able to connect the problem with practical and present scenario.
2. Develop the ability to think independently as well as scientifically towards for continuous lifelong learning process.
3. Analyse the situation, convert into problem and find its solution.

Suggested Readings

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill.India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics.Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House(Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami, O. R., Ranganatham M. (2011). Methodology of Research in SocialSciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New AgeInternational (P) Publisher. New Delhi
8. Lambert, Joan , Frye, Curtis D. (2016). Microsoft Office 2016 Step By Step. PHI
9. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd. India
10. Sekaran Uma (2003). Research Methods for Business. Wiley India.
11. Zikmund, Babin, Carr, Griffin (2003). Business Research Methods. Cengage Learning,India.

https://www.proschoolonline.com/blog/top-10-data-analytics-tools

BT 761	Forensic Biotechnology	3-0-0-3
Forensic Serology: General Introduction, Collection, preservation and packing of Biological fluids. Forensic applications of Isozymes and Polymorphic proteins. Introduction to Human Leucocyte Antigen, classification and typing		**[6]**
DNA profiling: Nuclear DNA and Mitochondrial DNA Techniques involved: PCR, Sequencing, RFLP analysis, analysis of STR, SNP Significance of DNA profiling DNA extraction/isolation from different samples, FTA cards, Ethical issues		**[7]**
Forensic Toxicology: Brief Idea of Toxins and Drugs, Extraction, separation and Identification		**[4]**
Wild Life Forensics: Collection, Processing and Examination of forensic artefacts: Pug marks, Horn, Skin, Fur, Hair, Nail and Teeth. Extraction of species specific antigens. Introduction to forensic entomology and forensic microbiology, Wild Life Protection Act		**[9]**
Analytical techniques for forensic applications: Spectroscopy: UV-Visible, NMR and Mass Chromatography: Normal and Reverse Phase, Paper and Column (Gel filteration, Ion exchange and Affinity) Electrophoresis: Agarose, PAGE-1D and 2D, IEF Antigens- Antibody reactions. ELISA, Immuno-electrophoresis, RIA, single diffusion, double diffusion, and rocket electrophoresis Microscopy: Simple and Compound microscope, Phase contrast Microscope, Fluorescent Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM) Centrifugation: Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges		**[13]**
Suggested Readings **Text Book** 1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986). 2. Wilson K and Walker J; Principle and Techniques of Biochemistry and Molecular Biology and Practical Biochemistry, Cambridge University Press **Reference Book** 1. Clark, E.G.C. Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986 2. Brown TA; Gene cloning; Willey-Liss Publications, Singapore. 3. Old & Primrose; Principle of Gene Manipulation; Panima Publications, New Delhi 4. Goldsby et al; Kuby Immunology; Freeman and Company, New York.		

Evaluation Pattern

Course Code	Course Title	Contact Hours per Week	Credits	ETE Duration	Weightage (%)

		L	T	P		Hours	CW	MTE	ETE
BT 761	**Forensic Biotechnology**	3	-	-	3	3	100		

Annexure-VIII

Ph.D. Syllabus

BT 711	**Animal Toxicology**	**3-0-0-3**
	Introduction to the subject, History, Terminology, Disciplines. Basic Principles, Dose, Dose Response, Toxic Effects and Testing methods, Risk Assessment, Exposure Standards and Guidelines. Toxicokinetics: Absorption, Distribution, Biotransformation and elimination of toxic agents Environmental Toxicology, Classification of toxicants, Routes of Exposure, Duration and frequency, category of toxic effects, bio-magnification Cellular Toxicology, Introduction, Effects of toxicant on cell structures, DNA damage Cellular Toxicology, Biochemical disturbance, cellular response and repair Mechanism of Toxicity: Introduction, Dose-response Relationship, Receptor Concept Natural Protection Mechanism: Role of cell organelles, Glutathione Metabolism, Antioxidants Antidotal Therapy: Types and Procedures, free radicals Nanotoxicology: Introduction and Interdisciplinary aspects **Suggested Readings:** 1. Landis WG, Sofield RM, Yu MH. Introduction to Environmental Toxicology, Molecular Substructures to Ecological Landscapes, CRC Press 2. Reviews of Environmental Contamination and Toxicology Springer 3. Worth DJH, Howard G J. Fundamental Toxicology Springer	
Course instructor : Dr. R.S.Chundawat		
Evaluation pattern: End Term Examination of 100 marks		

BT 721	**Plant Microbe Interaction**	**3-0-0-3**
	Introduction: Plant and microbe interaction, Plants as a host environment, The effects of microbes on plant physiology such as effects on photosynthesis, respiration, and the translocation of water and nutrients. Plants defense including structural defenses, biochemical defenses, and the hypersensitive response, Biotechnological perspectives of plant-microbe interaction Plant-Bacteria Interaction: Introduction, Abundance and distribution of bacteria in plants, Epiphytic/Endophytic bacteria, Rhizobacteria, Plant growth-	

	promoting rhizobacteria/bacteria (PGPR/PGPB), Pseudomonads *Bacillus* and as PGPR, Bacteria and plant health, Root nodule formation on legumes by *Rhizobium*spp for nitrogen fixation; other nitrogen fixing systems such as in alder/ *Frankia* and *Azolla*/*Anabaena*, Molecular mechanism of plant growth-promotion and biocontrol by bacteria, Microbial response to plants under habitat-imposed stresses (abiotic and biotic), Pathogenic interactions of bacteria with plants Plant-fungal Interaction: Introduction to fungal biology, Abundance and distribution of fungus in plants (Epiphytic/Endophytic), Mycorrhiza: Ecto, endo and VAM, Survey of fungal diseases important in plant pathology, Diagnostics and preventive measures Plant-virus Interaction: Diversity of plant viruses, Plant diseases caused by virus, Life cycles of plant viruses, Diagnostics and preventive measures Plant-nematode Interaction: Root-knot nematode, role of *Meloidogyne*, Plant health and nematode, Diagnostics and preventive measures **Suggested Readings:** 1. Burns and Slater. Experimental Microbial Ecology, Blackwell Scientific Publications, Oxford 2. Alexander M. Microbial Ecology, John Wiley and Sons 3. Atlas RM and Bartha R. Microbial Ecology: Fundamentals and Principles, Benjamin Cummins, USA	
Course instructor : Dr. D.K.Choudhary		
Evaluation pattern: End Term Examination of 100 marks		

BT 731	**Plant Transgenic Biology**	**3-0-0-3**
	Agrobiology: *Agrobacterium*-plant interaction, T-DNA transfer mechanism, *Agrobacterium* based vectors, Binary and shuttle vectors. Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co -integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Gene silencing, Chloroplast transformation Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance, Plants as Bio-factories, Metabolic engineering of plant secondary metabolites pathways of metabolism Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection.	

	Transgenic animal production, Methods of transgene delivery, Integration of foreign genes and their validation, Gene targeting methods and strategies, Expression of mammalian genes into prokaryotic and eukaryotic cell **Suggested Readings:** 1. Henry RJ. Practical Application of Plant Molecular Biology, Chapman and Hall Publishers 2. Glick and Pasternak.Molecular Biotechnology: Principles and application of Recombinant DNA, ASM Press 3. P.K.Gupta: Elements of Biotechnology, Rastogi and Co. Publishers 4. Freshney I. Culture of Animal Cells, Wiley-Liss. 5. Hafez B, Hafez ESE. Reproduction in Farm Animals, Wiley-Blackwell. 6. Houdebine LM. Transgenic Animals: Generation and Use, CRC Press. 7. Decker J and Reischl U. Molecular Diagnosis of infectious diseases, 2nd Edition, Humana Press	
Course instructor: R.K. Gaur		
Evaluation pattern : End Term Examination of 100 marks		
BT 741	**Biocatalysis and Biotransformation**	**3-0-0-3**
	Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc. Stresses related defense enzymes in plants and animals Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc. **Suggested Readings:** 1. Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press 2. Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press 3. Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford	

	4. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.	
Course instructor: Dr. K.P.Sharma		
Evaluation pattern: End Term Examination of 100 marks		

BT 751	**Environmental Biotechnology**	**3-0-0-3**
	Sources, generation, classification & composition of pollutants;effect on living organism;Persistence and biomagnification of xenobiotic molecules. Biological and Chemical methods for detection ofWastes; Need for management of resources. Biodegradation. Acclimation, detoxification activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Methods in determining biodegradability; Contaminant availability for biodegradation. Microbial degradation of aliphatic and aromatic compounds; Microbial degradation of halogenated and sulfonated compounds; Biodegradation of pesticides. Bioremediation, Constraints, advantages and applications; Types of bioremediation, Bioaugmentation and biostimulation; factors affecting	

	bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol. Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, bioreactors; Phytoremediation. Sources of heavy metal pollution; Microbial interactions with inorganic pollutants - Microbial metal resistance; Microbial transformation; Accumulation and concentration of metals; Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills. **Suggested Readings:** 1. Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition,McGraw-Hill, 2000. 2. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999. 3. K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999. 4. Martin Alexander, Biodegradation and Bioremediation, 2nd edition, Academic Press, 1999. 5. M.N.V. Prasad, Kazimierz Strzalka, Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, Kluwer Academic Publishers, Dordrecht Hardbound, 2002. 6. Baker, K.H and Herson, D.S.BioremediationMcGraw Hill, Inc. New York, 1994. 7. M.V.Levin&Gealt, M.A., Biotreatment of Industrial & Hazardous Waste McGraw Hill. Inc. 1993. 8. Martin Alexander, Biodegradation and Bioremediation (2nd editon). Elsevier Science & Technology. 1999. 9. Raina M. Maier, Ian L. Pepper, Environmental Microbiology. Academic Press. 2001.	
Course instructor: Dr. Pankaj Kumar Jain		
Evaluation pattern: End Term Examination of 100 marks		

MS 711 Advanced Computational Methods and MATLAB 3-1-0-4

Algebraic and Transcendental Equations: General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graeffe's root squaring method, Muller's method, Bairstow iterative method. **[7]**

System of Linear Equations and Boundary Value Problems: Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. Finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method **[8]**

Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations. **[8]**

Elements of MATLAB-I: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. **[8]**

Elements of MATLAB-II: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[8]**

Text Books:

1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd.
2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
3. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.
4. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW	MTE	ETE

MS 711	Advanced Computational Methods and MATLAB	3	1	-	4	3	---	---	100

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
1.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
2.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
3.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
4.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**
5.	**Elements of MATLAB:** Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 3. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 4. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.		
Reference Books: 1. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 2. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.		

3. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education.
4. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
6.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
7.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
8.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
9.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**

10. Elements of MATLAB: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 5. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 6. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 7. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 8. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.	
Reference Books: 5. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 6. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited. 7. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education. 8. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.	

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

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Session 2018-2019

Mody University of Science & Technology

B.Sc. (Hons) Psychology
Session 2018-2019

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H)-Psychology
Three years programme
(Batch 18-19 onwards)
FIRST YEAR

	Course	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab. -I	-	-	2	1	4	25	25	50
	PL 111	Basic Psychological Processes-I	3	-	-	3	3	25	25	50
	PL 121	Experimental Methodology & Elementary Statistics-I	3	-	-	3	3	25	25	50
	PL 131	Psychology - I	-	-	2	1	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course	Course Title	Contact Hours per			Credits	ETE Duration	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	ZO 132	Animal Diversity - II	3	-	-	3	3	25	25	50
	BT 152	Genetics	3	1	-	4	3	25	25	50
	BT 182	Basic of Forensic Sciences	2	-	-	2	3	25	25	50
	ZO 142	Animal Diversity Lab. -II	-	-	2	1	4	25	25	50
	PL 112	Basic Psychological Processes-II	3	-	-	3	3	25	25	50
	PL 122	Experimental Methodology & Elementary Statistics-II	3	-	-	3	3	25	25	50
	PL 132	Psychology - II	-	-	2	1	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	**20**	**2**	**4**	**24**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (Hons.) Psychology
Three-Year Programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Lab	-	-	2	1	3	25	25	50
	BC 221	Bio-Instrumentation Laboratory	-	-	2	1	4	25	25	50
	PL 213	Positive Psychology	3	-	-	3	3	25	25	50
	PL 221	Psychology of Human Development - I	3	-	-	3	3	25	25	50
	PL 231	Applied Psychology - I	3	-	-	3	3	25	25	50
	PL 241	Psychology Lab - III	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	BT 262	Sensitive Sciences	2	1	-	3	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Lab.	-	-	2	1	4	25	25	50
	PL 212	Psychology of Human Development - II	3	-	-	3	3	25	25	50
	PL 222	Applied Psychology - II	3	-	-	3	3	25	25	50
	PL 232	Psychology Lab - IV	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

B.Sc. (Hons.) Psychology
Three-Year Programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW	MTE	ETE
Autumn Semester	PL 311	Social Psychology-I	3	-	-	3	3	25	25	25
	PL 321	Biological Basis of Behaviour	3	-	-	3	3	25	25	50
	PL 331	Systems of Psychology	3	-	-	3	3	25	25	50
	PL 341	Psychopathology-I	3	-	-	3	3	25	25	50
	PL 351	Industrial and Organizational Psychology-I	3	-	-	3	3	25	25	50
	PL 361	Psychological Testing-I	3	-	-	3	3	25	25	50
	PL 371	Psychology Lab.-V	-	-	4	2	3	25	25	50
		Sub Total	**18**		**4**	**20**				
	GE 301	Proficiency (Non-Credit) #								

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW	MTE	ETE
Spring Semester	PL 312	Social Psychology-II	3	-	-	3	3	25	25	50
	PL 322	Guidance and Counseling	3	-	-	3	3	25	25	50
	PL 332	Experimental Psychology	3	-	-	3	3	25	25	50
	PL 342	Psychopathology-II	3	-	-	3	3	25	25	50
	PL 352	Industrial and Organizational Psychology-II	3	-	-	3	3	25	25	50
	PL 362	Psychological Testing-II	3	-	-	3	3	25	25	50
	PL 372	Psychology Lab.-VI			4	2	3	25	25	50
		Sub Total	**18**	-	**4**	**20**				
	GE 302	Proficiency (Non-Credit) #				1				

Total credits 130

PL 213 Positive Psychology 3-0-0-3

Introduction to Positive Psychology: An Introduction, Perspectives on Positive Psychology: Western and Eastern, Classification and Measures of Strengths and Positive Outcomes, Identifying your Personal Strengths [10]

Positive Emotional States and Processes: Understanding Positive Affect, Positive Emotions, Happiness and Wellbeing: Definitions and distinguishing between the Positive and Negative: Emotional Intelligence: Definition, Working with Emotions to Bring About a Positive Change. [11]

Positive Cognitive States and Processes: Self-efficacy, Learned Optimism, Hope, Wisdom, Flow, Mindfulness: Definition, Historical Basis, Neurobiology and Scales [10]

Towards building Positive Environment: Positive Schooling, Gainful Employment, Building better Communities, Successful Aging. [8]

Text Books:

1. Snyder, C.R., & Lopez, S.J.(2007). *Positive Psychology: The scientific and practi explorations of human strengths.* Thousand Oaks, CA: Sage.

2. Baumgardner, S.R. Crothers M.K. (2010). *Positive Psychology*. Upper Saddle River, N.J.: Prentice Hall.

3. Carr, A. (2004). *Positive Psychology: The science of happiness and human strength*.UK: Routledge.

References:

1. Peterson, C. (2006). *A Primer in Positive Psychology*. New York: Oxford University Press.

2. Seligman, M.E.P. (2002). *Authentic Happiness: Using the New Positive Psychology to Realize Your Potential for Lasting Fulfillment*. New York: Free Press/Simon and Schuster.

3. Snyder, C. R., & Lopez, S. (Eds.). (2002). *Handbook of positive psychology*. New York: Oxford University Press.

BT 262 Sensitive Sciences 3-0-0-3

History and Introduction: Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation [6]

Class and Individual Characteristics: Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints. [10]

Classification of Fingerprints: Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC [10]

Fingerprint Developmental techniques: Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra- oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court. [7]

AFIS & Biometrics : AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications [6]

Text Books:

1. Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.

References:

1. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahabad, 2000.
2. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
3. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
4. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
5. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

PL 111 Basic Psychological Processes-I 3-0-0-3

UNIT-I
Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

UNIT-II
Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

UNIT-III [6]
Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance.

UNIT-IV [9]
Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.

UNIT-V [8]
Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

UNIT-I
Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

[5]

UNIT-II
Problems and Hypothesis: Nature, Type and Sources.

[7]

UNIT-III
Variables: Nature and Types; Control of Variables.

UNIT-IV [5]
Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement.

UNIT-V
Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

UNIT-VI
Measures of Central Tendency: Mean, Median and Mode. [8]

UNIT-VII
Reliability of Statistics: Significance of Difference Between Two Means [3]

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., &Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 131 Psychology Lab.-I 0-0-2-1

Assignments are based on the course PL 111 Basic Psychological Processes-I containing exercises on learning and personality.

PL 112 Basic Psychological Processes-II 3-0-0-3

UNIT-I
Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

UNIT-II
Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

[6]

UNIT-III
Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.

[9]

UNIT-IV
Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation.

[9]

UNIT-V
Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference:

2. Atkinson, R. L., Atkinson, R. C., &Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 122 Experimental Methodology & Elementary Statistics-II 3-0-0-3

UNIT-I [4]
The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales.

UNIT-II [7]
Sampling Methods: Probability and Non-Probability Sampling Methods.

UNIT-III [8]
Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs.

UNIT-IV [5]
Measures of Variability: Range, Quartile Deviation and Standard Deviation.

UNIT-V [4]
Normal Probability Curve: Properties and Applications. Skewness and Kurtosis.

UNIT-VI [6]
Reliability of Statistics: Chi-Square.

UNIT-VII [5]
Correlations: Product-Moment and Rank Order.

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., & Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 132 Psychology Lab.-II 0-0-2-1

Assignments are based on the course PL 112 Basic Psychological Processes-II containing exercises on memory and intelligence.

PL 221 Psychology of Human Development-I 3-0-0-3

UNIT-I [8]
Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.

UNIT-II [6]
Determinants of Development: Biological and Socio- Cultural.

UNIT-III [9]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.

UNIT-IV [8]
Prenatal Development: Stages and Factors Affecting Prenatal Development.

UNIT-V [8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.

Text Books:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 231 Applied Psychology-I 3-0-0-3

UNIT-I [8]
Introduction: Nature and Fields of Applied Psychology.

UNIT-II [7]
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services.

UNIT-III [6]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up,

Modern Trends in Counseling, Ethical Issues in Counseling.

UNIT-IV [9]

Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.

UNIT-V [9]

Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. Rao, S. N. Counselling and Guidance. Tata McGraw-Hill, New Delhi.
4. Charles, J. G., & Bruce, R. F. Counseling Psychology: Practices, Issues and Intervention. CENGAGE Learning, New Delhi.
5. Sue, R., Sue, D., & Sue, S. Understanding Abnormal Behaviour. Houghton Mifflin.

PL 241 Psychology Lab.-III 0-0-2-1

Assignments are based on the courses PL 221 Psychology of Human Development-I and PL 231 Applied Psychology-I containing exercises on the study of the characteristics of the neonate and guidance and counseling.

PL 212 Psychology of Human Development-II 3-0-0-3

UNIT-I

Development during Infancy: PhysicalGrowth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

UNIT-II

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

UNIT-III [9]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity.

UNIT-IV [8]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family.

UNIT-V [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues.

Text Book:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 222 Applied Psychology-II 3-0-0-3

UNIT-I

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

UNIT-II

Psychology and Health: Mental Health and General Health, Dimensions of Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

UNIT-III

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

UNIT-IV

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

UNIT-V

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. Industrial Psychology. Prentice Hall, Englewood Cliffs.
4. Misra, G. Psychological Perspective on Stress and Health. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. Social Psychology. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. Psychology in Sports: A Contemporary Perspective. Friends, New Delhi.

PL 232 Psychology Lab.-IV 0-0-2-1

Assignments are based on the courses PL 212 Psychology of Human Development-II and PL 222 Applied Psychology-II containing exercises on the study of developmental pattern of various stages of human life and stress management.

PL 311 Social Psychology - I 3-0-0-3

UNIT-I [3]
Social Psychology: Nature and Subject Matter; Relationship with other social sciences.

UNIT-II [5]
Methods: Experimental, Observation, and Sociometry.

UNIT-III
Socialization: Nature, Process and Agents of Socialization. [4]

UNIT-IV [8]
Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.

UNIT-V [5]
Social Norms: Meaning, Characteristics and Formation

UNIT-VI [6]
Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants

UNIT-VII [8]
Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional

Text Book:

1. Baron, R.A., Byrne, D. Social Psychology (10th Edn)-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E.The Handbook of Social Psychology (2nd Edn.), Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S. Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M.Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. Social Psychology (8th Edn.)-Tata McGraw Hill International Editions.
7. Penrod, S. Social Psychology (2nd Edn.) New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K.Samaj Manovigyan Ki Rooprekha (6th Edn), NewDelhi: MotiLal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O.Social Psychology (12th Edn) - Pearson Education

PL 321 Biological Basis of Behaviour 3-0-0-3

UNIT-I
Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical. [6]

UNIT-II
Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters. [7]

UNIT-III
Nervous System: Central nervous system and Peripheral nervous system – Structure and Functions. Endocrine system and its behavioral implications. [9]

UNIT-IV
Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention. [6]

UNIT-V
Motivation: Neural mechanism of Hunger, Thirst and Sex [5]

UNIT-VI
Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory. [6]

Text Book:

1. Carlson, N.Biology of Behavior. Boston : Allyn and Bacon.
2. Graham, R.B.Physiological Psychology. California :Wadsworth.

Reference Book

3. Grossman, S.P. A Text book of Physiological Psychology. New York :Siley.
4. Hoyenga, K.B. and Hoyenga, K.T.Psychobiology : The neuron and Behavior. California :Broks/Cole.
5. Kalat, J.N.Biological Psychology. California :Wadsworth.
6. Levinthal, C.R.Introduction of Physiological Psychology. New Jersey : Prentice Hall.
7. Pinel, Johan, P.J.Biopsychology.Boston : Allyn and Bacon.
8. Rosenzweig, M.R. and Liemen, A.L.Physiological Psychology. New York : Random House.

PL 331 Systems of Psychology 3-0-0-3

UNIT-I
Nature and scope of Psychology: Psychology as science; Historical Origins: Pre-experimental period- Science Among Greeks, British Empiricism, German Nativism. [4]

UNIT-II
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status [5]

UNIT-III [7]
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner.

UNIT-IV [6]
Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.

UNIT-V [6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).

UNIT-VI [5]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.

UNIT-VII [6]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.

Text Book

1. Chaplin, T. Kraweic, T.S. Systems and Theories of psychology. Holt Rinehart and Winston.
2. Schiffman, H.R. Sensation and Perception. New York: John Wiley and Sons.

Reference Book

3. Hilgard, E.H., and Bower, G.H. Theories of Learning. Englewood Cliffs : Prentice Hall.
4. Matlin, M.W. Cognition. Bangalore : Prism.
5. Mazur, J.E.Learning and Behaviour. Englewood Cliff's : Prentice Hall.
6. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology. London : Methuen and Co.
7. Marks, M.H. and William, A. Cronan – Hillix, Systems and Theories in psychology. McGraw Hill International Editions, Psychology Series.
8. Vygotsky, L.S. Thought and Language, Cambridge, mass. MIT Press.
9. Hall C.S. :Lindzey, G. Theories of Personlaity. New York : Wiley Eastern Limited.

PL 341 Psychopathology-I **3-0-0-3**

UNIT-I [3]
Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.

UNIT-II [7]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.

UNIT-III [3]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.

UNIT-IV [5]
Diagnostic Assessment: Case History, Interview, Projective Techniques

UNIT-V [12]
Anxiety Based Disorders: Nature, Symptoms and Etiology- Generalized Anxiety Disorders, Phobia, O.C.D, Conversion Hysteria and Dissociative Disorders

UNIT-VI [5]
Psycho physiological Disorders: Nature, Symptoms and Etiology – Asthma, Peptic Ulcer, CHD, Hypertension

UNIT-VII [4]
Mental Retardation: Nature, Types, Causes and its Management

Text Book:

1. Carson, R.C.; Butcher, J.N., et al. Abnormal Psychology ; New Delhi: Pearson Education.

Reference Book

2. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior ;New Delhi: PearsonEducation Inc.
3. Davison, G.C. & Neale, J.M. Abnormal Psychology ;New York: Willy.

PL 351 Industrial and Organizational Psychology-I 3-0-0-3

UNIT-I
Industrial/Organizational Psychology: Nature, historical development and scope. [5]

UNIT-II
Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing. [9]

UNIT-III [9]
Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme

UNIT-IV [10]
Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal

UNIT-V [6]
Work environment: Noise, atmospheric conditions. Illumination and performance

Text Book

1. Blumm M.L. abdNylor, J.C.Industrial Psychology. N.Y : Harper & Row.
2. Davis. K.Human Behaviour at Work. New Delhi : Tata McGraw Hill.
3. Dunnet, M.D.Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.

Reference Book

4. Ganguli, H.C.The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.

6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour,New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A.Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
9. Mohanty G.Industrial and Organizational Psychology New Delhi: Oxford and IBH.

PL 361 Psychological Testing-I 3-0-0-3

UNIT-I [9]
Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.

UNIT-II [9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.

UNIT-III [9]
Validity: meaning, validation procedures, and special problems.

UNIT-IV [12]
Construction and Standardization of Psychological Tests
General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S.Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L. Psychological Testing : Design, Analysis and UseBoston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods. New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B.Clinical methods in psychology. New York : Wiley inter science publication.

PL 371 Psychology Lab.-V 0-0-4-2
Assignments to be based on the course PL 311 (Social Psychology), PL 341 (Psychopathology) AND PL 351 (Industrial and Organizational Psychology).

PL 312 Social Psychology-II 3-0-0-3

UNIT-I [6]
Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.

UNIT-II [6]

Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects.

UNIT-III [6]

Attribution process Nature and theories: Kelly and Weiner.

UNIT-IV [5]

Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies

UNIT-V [5]

Propaganda: Nature, Tools and Techniques

UNIT-VI [5]

Aggression and Violence: Nature, Determinants and Management.

UNIT-V [6]

Social Change: Nature, Factors and Theories.

Text Book

1. Baron, R.A., Byrne, D. Social Psychology-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E..The Handbook of Social Psychology, Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S .Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. .Social Psychology-Tata McGraw Hill International Editions.
7. Penrod, S.Social Psychology ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Taylor, S.E. Peplau, L.A. Sears, D.O. Social Psychology -Pearson Education.

PL 322 Guidance and Counseling **3-0-0-3**

UNIT-I

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational. [5]

UNIT-II [5]

Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.

[9]

UNIT-III

Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.

[9]

UNIT-IV

Counseling process: External conditions and preparation;

Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.

UNIT-V [7]
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling.

UNIT-VI [4]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.

Text Book

1. Bernard, H.W. and Fullmer, D.W.Principles of Guidance. New York : Crowell.
2. Burnard, Philips; Counseling skills for Health Professional. Madras: Chapman and Hall.

Reference Book

3. Crow, L.D. and Crow, A.; Introduction to Guidance. New Delhi: Imersia Pub.
4. Gelso, G. J. and Fretz B.R. ; Counseling psychology, Banglore : Prism.
5. Jones, J.F. ;Principles of Guidance. NY : McGraw Hill.
6. Lynn, S.J. and Garske, J.P. Contemporary Psychotherapies, and methods. Ohio, Bell and Howell.
7. Rao, S.N. Counselling and Guidance, New Delhi : Tata MC Grw Hill.

PL 332 Experimental Psychology 3-0-0-3

UNIT-I
Experimental Psychology: Nature and History, Experimental Method

[4]

UNIT-II
Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. Perception: Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.

[9]

UNIT-III
Psychophysics: Problems and Methods of Classical Psychophysics.

[8]

UNIT-IV
Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.

[6]

UNIT-V
Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning

[5]

UNIT-VI
Verbal Learning: Methods, Materials, Organizational Processes.

[3]

UNIT-VII [4]
Discrimination Learning: Phenomena, Procedures and paradigms

Text Book

1. Bourne, L.E. Jr., Dominowski, R.L., & Loftus, E.F.Cognitive Processes. New Jersey. Prentice Hall.
2. D' Amato, M.R. Experimental Psychology. New Delhi: Tata McGraw Hill.

Reference Book

3. Flaherty, C.F. et. Al. Learning and Memory. Chicago: Rn McNally Pub.Co.
4. Gordon, W.C. Learning and Memory. California: Brooks / Cole.
5. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology.London: Methuen & Co.
6. Mazur. Learning and Behavour, New Delhi: Prentice Hall of India.
7. Snodgrass, J.G., Berger, G.L., & Haydon, M. Human Experimental Psychology, New York: Oxford.
8. Solso, R.L.Cognitive Psychology Allyn& Bacon.

PL 342 Psychopathology-II 3-0-0-3

UNIT-I
Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation. [6]

UNIT-II [10]
Mood Disorders: Unipolar and Bipolar Symptoms and Etiology

UNIT-III [11]
Schizophrenia: Nature , Symptoms , Types and Etiology

UNIT-IV
Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT [12]

Text Book

1. Carson, R.C.; Butcher, J.N., et al.. Abnormal Psychology NewDelhi: Pearson Education.

Reference Book

2. Davison, G.C. & Neale, J.M. Abnormal Psychology New York: Willy
3. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior New Delhi: Pearson Education Inc.

PL 352 Industrial and Organizational Psychology-II 3-0-0-3

UNIT-I
Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory. [7]

UNIT-II
Job Satisfaction: Concept, determinants and measurement. [5]

[6]

UNIT-III
Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.

UNIT-IV
Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents. [6]

UNIT-V [6]
Human engineering: Man-machine system. Designs, displays, controls and action.

UNIT-VI
Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions. [9]

Text Book

1. Blumm M.L. and Nylor, J.C. Industrial Psychology. N.Y. : Harper & Row.
2. Davis. K. Human Behaviour at Work. New Delhi : Tata McGraw Hill.

Reference Book

3. Dunnet, M.D. (Ed.).Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.
4. Ganguli, H.C. The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.
6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour, New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A. Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
9. Mohanty G. Industrial and Organizational psychology New Delhi: Oxford and IBH.

PL 362 Psychological Testing-II **3-0-0-3**

UNIT-I [9]
Personality Tests: Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors.

UNIT-II [9]
Projective- Rorschach and TAT.

UNIT-III [8]
Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.

UNIT-IV [6]
Measurement of aptitude and Interest

UNIT-V [7]
Measurement of Creativity- Torrance Test
Anxiety and Depression,

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S. Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L.Psychological Testing : Design, Analysis and use Boston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods ,New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B. Clinical methods in psychology. New York : Wiley inter science publication.

PL 372 Psychology Lab.-VI **0-0-4-2**

Assignments to be based on the course PL332 (Experimental Psychology), PL342(Psychopathology) and PL362 (Psychological Testing-II).

BT 271 Food Technology **2-0-0-2**

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**
2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**
3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**
4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**
5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 Plant and Animal Biotechnology 2-0-0-2

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 Tissue Culture Laboratory 0-0-2-1

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry **3-0-0-3**

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and **[10]**

Beer.

5. **Microbes and Environment**: Microbes in mineral recovery- Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, **[5]**

Biosynthesis of unsaturated fatty acids.

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,
2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.
4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
   (a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**
   (b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**
   Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food **[7]**

preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics.

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission **[6]**

and spread of infection.

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance **[2]**
2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem **[2]**
3. Natural Resources: Renewable and Nonrenewable resources. **[2]**
4. Human Population and Environment: Population Growth, World and Indian scenario. **[2]**
5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. **[2]**
6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. **[3]**
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION
B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome) [6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]
Porifera: Canal system; Endoskeleton, Reproduction. [3]
Coelenterata: Nematocysts, polymorphism. [3]
Ctenophora: Affinities. [1]
Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]
Annelida: Excretion in annelids. Type study – Earthworm. [6]
Mollusca: Respiration. [1]
Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]
Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]
Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing

exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals.

Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated

dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster [6]

management – Floods, Earthquakes, Cyclones and Landslides.

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: *Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.* [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson

and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 **Mathematics and Statistics for Biology** **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

Mody University of Science & Technology

B.Sc. (Hons) Biotechnology

Session 2018-2019

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

BACHELOR OF SCIENCE (HONOURS)-BIOTECHNOLOGY (B.Sc.)

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)
No. of Seats: 30

Input Qualification:
Candidate should have passed 10+2 in Science stream from a recognized Board with proficiency in English.

Evaluation Procedure:
All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of Mody University shall be followed. Further, the Faculty proposes to adopt the following:

1. **Grading System:** Absolute Grading System irrespective of the number of students.
2. **Minimum Credits* required for continuation of Registration:**

S. No.	Year	B.Sc. (Hons.)-Biotech.
1.	First	20
2.	Second	40
3.	Third	60
4.	Fourth	80
5.	Fifth	Must Complete

* Excluding Proficiency credits.

B.Sc. (H)-Biotechnology
Three years programme
(Batch 18-19 onwards)
FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE (Compulsory)**									
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	CH 113	Chemistry I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Laboratory I	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 171	Biotechnology and Human Welfare	2	-	-	2	3	25	25	50
	BT 181	Bioethics and IPR	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	80
		Sub Total	**15**	**1**	**6**	**19**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	**CORE (Compulsory)**									
	BT 152	Genetics	3	1	-	4	3	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
	CH 114	Chemistry II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Laboratory II	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 172	Basics of Drug Designing	2	-	-	2	3	25	25	50
	BT 182	Basics of Forensic Sciences	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	**16**	**1**		**20**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H)-Biotechnology
Three years programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Compulsory (CC)**									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Bio-Instrumentation Lab	-	-	2	1	4	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Laboratory	-	-	2	1	4	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BO 231	Plant Physiology and Metabolism	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 291	Introductory Biomedical Science	2	-	-	2	3	25	25	80
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-I‡	3	-	-	3	2	25	25	50
		Sub Total				**21**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Compulsory (CC)**									
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	BO 232	Plant Anatomy and Embryology	3	-	-	3	3	25	25	50
	BO 222	Plant Developmental Biology Laboratory	-	-	2	1	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 381	Modern Biology	3	-	-	3	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total				**19**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology
Three years programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Compulsory (CC)**									
	BT 311	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 341	Genetic Engineering Lab	-	-	2	1	4	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocess Engineering Laboratory	-	-	2	1	4	25	25	50
	ZO 321	Immunology	3	1	-	4	3	25	25	50
	ZO 331	Immunology Laboratory	-	-	2	1	4	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 333	Introduction to Research Methodology	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
		Sub Total				**22/25**				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology
Three years programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Compulsory (CC)**									
	BT 352	Bioinformatics	3	-	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	ZO 332	Animal Biotechnology	3	-	-	3	3	25	25	50
	BO 312	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 323	Tissue Culture Laboratory	-	-	2	1	4	25	25	50
	BT 342	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 392	Environmental Biotechnology Laboratory	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 334	Enzyme Technology	3	-	-	3	3	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	BO 142	Gymnosperms and Taxonomy of Angiosperms	3	-	-	3	3	25	25	50
		Sub Total				**23/26**				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

***The student has to take maximum two courses in each semester of Third year from the DCS. The minimum strength of student should be five (5) in the particular DCS course.**

Total Credit: 125/131

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Course Description

B.Sc. (H) Biotechnology
Three years Programme
First YEAR

BT 171 Biotechnology and Human Welfare **2-0-0-2**

UNIT I [8]
Industry Application: protein engineering; enzyme and polysaccharide synthesis, Metabolites: Alcohol and antibiotic production.

UNIT II [8]
Agriculture Application: N_2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III [10]
Human Health: Diagnostics and Treatment: development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, Human genome project.

Text Book

1. Concepts in Biotechnology by Balasubrahmanian et. al.,University press, 2010

Reference Book

2. Recombinant DNA technology by Watson et. al., Scientific American Books, 2012.
3. Principles of Gene Manipulation by Old and Primrose. Blackwell, 2010
4. Biotechnology: Applications In Human Healthcare Hardcover, Sampat Nehra, Pointer Publishers (2009)

BT 181 Bioethics and IPR **2-0-0-2**

UNIT I [11]
Bioethics – Meaning and Necessity of Bioethics, different paradigms of Bioethics – National & International, Ethical issues against the molecular technologies

UNIT II [8]
IPR- Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions.

UNIT III [7]
Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

Text Book:

1. Patterns of Entrepreneurship 2005: Jack M. Kaplan. Wiley,
2. Sateesh MK. 2010 Bioethics and Biosafety, I. K. International Pvt Ltd.

References:

3. Entrepreneurship: New Venture Creation: David H. Holt Tata McGraw – Hill 2002

4. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BT 172 Basics of Drug Designing 2-0-0-2

UNIT I [5]
Drug designing-Meaning and Introduction, Disease and drug target identification

UNIT II [5]
Identification of Lead compound, SAR, optimising target interactions

UNIT III [8]
Toxicology and safety issues, Development and Production, Clinical trials, Patenting issues

UNIT IV [8]
Newer drugs, Drug discovery in cancer research/new target based drugs in clinical trials. Microbial genomics for new antibiotics, immunotoxin drug

Text Book

1. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
2. J.M. Haile , Molecular Dynamics Simulation Elementary methods, , John Wiley and Sons ,1997

References:

3. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
4. Remington's Pharmaceutical Science, Mark Publishing and Co.
5. The Organic Chemistry of Drug Design and Drug Action, by R. B. Silverman
6. An Introduction to Medicinal Chemistry by G. L. Patrick

BT 182 Basics of Forensic Science 2-0-0-2

UNIT I [8]
Introduction and principles of forensic science, tools and techniques in forensic science, Classification of injuries and their medico-legal aspects, method of assessing various types of deaths

UNIT II [6]
Fire arms and explosives, Handwriting analysis, Significance of toxicological findings

UNIT III [6]
Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification

UNIT IV [6]

Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Introduction to Cyber security.

Text Book:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

References:

3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

BT 291 Introductory Biomedical Science 2-0-0-2

UNIT I [8]

Introduction to human biology, Clinical biochemistry of human diseases, microbiology, epidemiology, and biomedical engineering

UNIT II [6]

Screening for disease, Application of biochemical techniques to inborn errors of metabolism, tumor markers, liver function, iron and porphyrins

UNIT III [7]

Enzymes and their use in laboratory medicine, clinical applications of protein biochemistry, nutrition in health and disease, lipids and atherosclerosis

UNIT IV [5]

Electronic devices used as sensors

Text Book

1. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

Reference

2. Campbell, N.A. and Reece, J.B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

BO 212 Plant Developmental Biology 2-0-0-2

UNIT I

Development and morphology of gametophyte – formation of vegetative and generative cells, microsporogenesis, organization of mature pollen grain, types of ovules, integument, nucellus, megasporogenesis, types of embryo sacs. [6]

UNIT II [4]
Pollination and fertilization – Pollen transfer, artificial pollination, pollen germination, double fertilization, self-incompatibility.

UNIT III [5]
Endosperm – development, cytology and functions of endosperm
Endosperm types - nuclear, cellular - helobial - Ruminate endosperms, function of endosperms.

UNIT IV [5]
Embryo – Development of embryo in Dicot (Capsella) and Monocot (Najas). A brief account on Polyembryony, parthenocarpy.

UNIT V [6]
Seed – Development, classification, dispersal and dormancy

Text Book

1. Plant Physiology by Taiz and Zeiger, Sinauer Associate Inc. Publishers

Reference

2. The Arabidopsis Book, ASPB publication (available freely at www.aspb.org)
3. Biochemistry and Molecular Biology of plants Ed. Buchanan, Grussem and Jones, ASPB publication.
4. Bhojwani. S.S. and Bhatnagar. S.P. 1978. The embryology of Angiosperms. Vikes Publishing Pvt. Ltd., Delhi.
5. Maheswari P.1971. An introduction to embryology of Angiosperms Tata Mc Graw Hill, Delhi.
6. Swamy B.G.L. and Krishnamurthy K.V. 1950. From flower to fruit. Tata Mc Graw Hill, Hew Delhi.

BO 222 Plant Developmental Biology Laboratory 0-0-2-1

Assignments are based on the course BO 212 Plant Developmental Biology containing exercises on plant developmental studies using permanent slides and embryo development related experiments.

BT 333 Introduction to Research Methodology 2-0-0-2

UNIT I [5]
Introduction to Research Methodology: Objectives and motivation in research

UNIT II
Defining the Research Problem, Selecting and defining a research problem, Reviewing and conducting literature search, developing a research plan [7]

UNIT III

Designing of Experiment, Number of Different experimental designs – single and multifactorial design [6]

UNIT IV

Making measurements and sources of error in measurements, Methods of data collection and record keeping. Report writing, Writing a research paper - abstract, introduction, methodology, results and discussion. [8]

Text Book

1. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi)

Reference

2. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
3. Montgomary, Douglas C. &Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
4. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT II [8]

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital

UNIT III [8]

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 Plant and Animal Biotechnology **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 **Tissue Culture Laboratory** **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 **Medical Biotechnology** **2-0-0-2**

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each **[5]**

pathway.

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,

2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.

4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
(a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical **[7]**

biochemistry; internal and external quality assurance producers

(b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; **[5]**

Indices of food sanitary quality and sanitizers.

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]

3. Natural Resources: Renewable and Nonrenewable resources. [**2**]

4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. [**3**]
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION

B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101	**Foundation Course in English**	**2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and

Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.

2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I 2-0-0-2

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation.

Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed.

2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and [6]

Landslides.

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects

and applications. [8]

Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 Animal Physiology 3-0-0-3

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation.

Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S.

Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005,

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature,

Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint

2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M.

Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk [12]

and hazard associated with their use; Potential uses and applications of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc.

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory.

[7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture.

[8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement.

[8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement.

[8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods.

[8]

MB 331 General Microbiology **3-0-0-3**

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of

[12]

microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters.

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al.*; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New Delhi.
4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation.	[4]
Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium).	[5]
Biofuels: Bioethanol, Biodiesel, Methanogenesis.	[4]
Biopesticides: Bacterial, Fungal and Viral pesticides.	[4]
Biofertilizers: Nitrogen fixing microbes and their application in crop productions.	[5]
Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and pesticide biodegradation, Biobleaching of industrial effluents.	[6]
Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling.	[6]
Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process.	[5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells.	[8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.
6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 **Environmental Biotechnology Laboratory** **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 **Tissue Culture Laboratory**

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 **Internship** **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 **Genetic Engineering** **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase. [6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors. [6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for selection of recombinant DNA molecules.

[6]

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing.

[7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen.

[6]

BT 352 Bioinformatics **3-0-0-3**

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP)

[5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized databanks). [7]

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X- [5]

ray crystallography), Algorithm for modeling protein folding.

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 Bioprocess Engineering 3-0-0-3

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation. [10]

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics. [10]

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.,), Bioprocess Engineering, Prentice Hall PTR, New Jersey. 1.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.* 2.
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York. 3.

***latest edition**

BT 334 Enzyme Technology 3-0-0-3

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes. [12]

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular emphasis on change in pH and hydrophobicty [8]

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of

Biochemistry , MacMillian Worth Publishers, US.

2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.

3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.

4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.

5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.

6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory 0-0-2-1

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory 0-0-2-1

Assignments are based on the course BT 334 Enzyme Technology

containing exercises on enzymes kinetics.

Mody University of Science and Technology

School of Liberal Arts and Sciences

BSc CBZ

2018-19

Department of Science

B.Sc. Chemistry, Zoology and Botany
Three years Programme
(Batch 2018-19 Onwards)
FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE COMPULSORY (CC)**									
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BO 121	Botany Laboratory-I	-	-	2	1	3	100		
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	100		
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Lab	-	-	2	1	3	100		
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	3	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab-I	-	-	2	1	3	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	BT 181	Bioethics and IPR	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	80
		Sub Total				**26.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	**CORE COMPULSORY (CC)**									
	BO 142	Gymnosperms and Taxonomy of Angiosperms	3	-	-	3	3	25	25	50
	BO 122	Botany-Lab II	-	-	2	1	3	25	25	50
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 142	Animal diversity lab-II	-	-	2	1	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	3	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 152	Genetics	3	1	-	4	3	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total				**24.5**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. Chemistry, Zoology and Botany
Three years Programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE COMPULSORY (CC)**									
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	3	25	25	50
	BO 231	Plant Physiology and Metabolism	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-I‡	3	-	-	3	2	25	25	50
		Sub Total				**22.5**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**CORE COMPULSORY (CC)**									
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	3	25	25	50
	BO 232	Plant Anatomy and Embryology	3	-	-	3	3	25	25	50
	BO 242	Plant Morphology and Breeding	3	-	-	3	3	25	25	50
	BO 252	Botany Laboratory -IV	-	-	4	2	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total				**26.5**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. Chemistry, Zoology and Botany
Three years Programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE COMPULSORY (CC)**									
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	3	25	25	50
	BO 311	Plant Ecology and Economic Biology	3	-	-	3	3	25	25	50
	ZO 321	Immunology	3	1	-	4	3	25	25	50
	ZO 331	Immunology Laboratory	-	-	2	1	3	25	25	50
	BO 321	Ecology Laboratory	-	-	2	1	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)									
	CH 325	Reagents and Reactions	2	-	-	2	3	25	25	50
		Sub Total				**18.5**				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**CORE COMPULSORY (CC)**									
	CH 392	Physical Chemistry-IV	2		-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2		-	2	3	25	25	50
	CH 324	Organic Chemistry–IV	2		-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-		3	1.5	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 332	Animal Biotechnology	3	-	-	3	3	25	25	50
	BO 312	Plant Biotechnology	3	-	-	3	3	25	25	50
		Sub Total				**18.5**				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

BO 111 Botany-I 3-0-0-3

Algae: General characteristics, Thallus organization and classification, economic importance. [2]

Type Study of Algal Classes: General characteristics, morphology and reproduction in Chlorophyta (Volvox), Charophyta (Chara), Xanthophyta (Vaucheria), Phaeophyta (Ectocarpus), Rhodophyta (Polysiphonia), Cyanophyta (Nostoc). [6]

Fungi: Characteristics and broad classification of fungi (Alexopolus and Mims, 1972), Economic importance of fungi. Structure and life history of Diplomastigomycotina (Sclerospora), Ascomycotina (Saccharomyces and Aspergillus), Basidiomycetes (Puccinia and Ustilago), Deuteromycotina (Cercospora, Alterneria, Colletotrichum). [8]

Parasexual Cycle in Fungi: Introduction and its importance in genetic improvement. [3]

A brief account of mycorhizza and lichens. [3]

Plant Pathology: Elementary knowledge, Plant pathogens, Common plant diseases and their symptoms, control measures. [5]

Bryophyta: General characters, classification and evolutionary trends in organization of thallus and sporogonium. A brief introduction to morphology and life cycle of Riccia, Anthoceros and Funaria. [5]

Pteridophyta: General characters, classification, stellar system, a brief study of morphology and life history of Selaginella, Equisetum, Marselia and Rhynia. [6]

Heterospory and Seed habit: Origin and evolution of heterospory and seed habit in Selaginella. [1]

Suggested Reading

Text Book

1. Vasistha P.C; Pteredophyta; S.Chand Publications, New Delhi.
2. Vasistha B.R.; Bryophyta; S.Chand Publications, New Delhi

Reference Book:

3. Morrish; Algae; Hutchinson and Company, USA
4. Sharma O.P.; Fungi; Tata McGraw Hill, New Delhi
5. Sharma O.P.; Algae; Tata McGraw Hill, New Delhi
6. Mehrotra & Aneja; An Introduction to Mycology; New Age International Publisher
7. Dubey & Maheshwari; Fungi; S.Chand Publication, New Delhi

BO 121 Botany Laboratory-I 0-0-2-1

Assignments are based on the course BO 111 Botany-I containing exercises on type studies of algae and fungi and study of plant morphology.

BO 142 Gymnosperms and Taxonomy of Angiosperms 3-0-0-3

Seed Habit in Plants: Origin and evolution of seed habit and seed plants, primitive seed plants. [5]

Gymnosperm: General characteristics and classification. Morphology, reproduction and life cycle of Cycas, Pinus and Ephedra. [8]

Angiosperm: Taxonomy, α and ω taxonomy, Taxonomic literature and plant nomenclature. [6]

Angiosperm Classification: Salient features of the system proposed by Bentham-Hooker and Engler-Prantile. [3]

Brief study of some of the Important Flowering Families:, Rannunculaceae, Brasicasseae, Malvaceae, Solanaceae, Leguminaceae, Gramineae, Rutaceae, Apiaceae, , Apocynaceae, Asclepediaceae, Euphobiaceae and Lilliaceae. [9]

Paleobotany: Fossilization, Types of fossils and their importance, Fossil Gymnosperm – William sonia and Glossopteris. [4]

Characters: Variations, OTUs characters weighting and coding: cluster analysis, phenograms, cladograms (definitions and differences) [4]

Suggested Reading

Text Book

1. Bhojwani and Bhatnagar; A Text book of Plant Embryology; Vikas Publication

Reference Book

2. Maheswari P; Plant Embryology; Tata Mc Graw Hill
3. Chamberlain C.J; Gymnosperm; CBS, New Delhi
4. Chowdhary H.K.; Elementary Principles of Plant Breeding. Oxford and IBH Publishing.

BO 122 Botany Laboratory-II 0-0-2-1

Assignments are based on the course BO 142 containing exercises on plant breeding and study of angiosperms.

BO 231 Plant Physiology and Metabolism 3-0-0-3

Water potential: Water potential and its components, Ascent of sap, Transpiration and its significance,
Root pressure and Guttation, Mechanism of opening and closing of stomata, anti-transpirants. (8)

Essential elements: Absorption of minerals role of macro and microelements, active and passive transport, carriers, channels and pumps.Translocation of organic and solutes-source sink relationship, phloem loading and unloading. (8)

Photosynthesis: Photosynthetic pigments, light reaction, CO_2 fixation by C_3 and C_4 cycle and CAM pathway. ,Photorespiration. (8)

Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.Enzyme structure and properties, Mechanism of catalysis and enzyme inhibition (6)

Plant growth and plant growth regulators: Auxin, Cytokinin, Gibberrellin, ABA, Ethylene. An introduction to secondary metabolites. (5)

Biological Rhythm: Photoperiodism (SDP, LDP, Day neutral plants), Phytochrome, Vernalisation and Senescence, Plant movement, Stress physiology: antioxidant, water stress, salt stress (4)

Suggested Reading

Text Book

1. Pandey and Sinha; Plant Physiology; Vikas Publishing House. New Delhi.
2. Malik C.P; Plant Physiology; Kalyani Publications.

Reference Book

3. Taiz, L. Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A.5thed.
4. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition
5. Srivastava H.S; Plant Physiology; Rastogi publication

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BO 221 **Botany Laboratory-III** **0-0-2-1**

Assignments are based on the course BO 231 Plant Physiology and Metabolism.

BO 232 **Plant Anatomy and Embryology** **3-0-0-3**

Plant Tissue &Tissue system: Root and shoot apical meristems. Simple and complex tissues. Structure of dicot and monocot root stem and leaf. [10]

Secondary Growth: Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).Epidermis, stomata, General account of adaptations in xerophytes and hydrophytes. [10]

Embryology: Structure of anther and pollen. Tapetum- types & functions. Microspore types. Structure and types of ovules.Types of embryo sacs, organization and structure of mature embryo sac. [7]

Pollination: Type, mechanisms and adaptations. Double fertilization & its significances. [5]

Endosperm: Types, structure and functions of endosperm. Dicot and monocot embryo. Apomixis and polyembryony, definition, types and practical applications. [7]

Suggested Readings

Text Book

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. P.C.Trivedi, Aparna Pareek, (2018-19). Plant Morphology & Anatomy, R.B.D. Publication House Jaipur, New Delhi.

Reference Book

3. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/ Cummings Publisher, USA.

4. Eames Mcdaniels: An Introduction to Plant Anatomy. Tata McGraw Hill Publication
5. Maheswari P. Plant Embryology; Tata McGraw H

BO 252 Botany Laboratory-IV **0-0-4-2**

Assignments are based on the course BO 232 Plant Anatomy and Embryology & BO 242 Plant Morphology and Breeding containing exercises on morphology, reproductive cycle and embryonic development.

BO 321 Plant Ecology Laboratory **0-0-2-1**

Assignments are based on the course BO 311 Plant Ecology and Economic Biology containing exercises on different environmental factors, eco-toxicology affecting the biological systems.

BO 311 Plant Ecology & Economic Biology **3-0-0-3**

Introduction to Ecology: Ecological factors. Soil-origin, formation, composition, profile. Water- precipitation types. Light and Temperature. Shelford, law of tolerance. Adaptation of hydrophytes and xerophytes. (6)

Plant communities: Characteristics feature, Ecotone, Succession. Ecosystem -structure; energy flow, trophic organisation, food chains and food webs, ecological pyramid. Biogeochemical cycling- carbon, nitrogen and phosphorous cycle. An introduction to phytogeography. Endemism.

An introduction to biodiversity & its conservation. [9]

An introduction to the "origin of cultivated Plants": Vavilov's work. Origin, morphology, uses of some economically important crop plants

(1) Cereals-Wheat &Rice
(2) Legumes with special reference to Gram and Soybean
(3) Spices-botanical name, family, part used, morphology and uses
(4) Beverages -Tea (morphology, processing, uses)
(5) Oils and Fats-Mustard & Groundnut
(6) Fibre yielding plants with special reference to Cotton (botanical name, family, part used, morphology and uses)
(7) Scope and importance of medicinal plants with special reference to Rajasthan (botanical name, family, part used, morphology and uses). [10]

Ethnobotany : As an interdisciplinary science. Major and minor ethnic groups or tribals of India. Plants used by the tribals: a) food plants b) intoxicants and beverages c)resins and oils and miscellaneous uses. [6]

Role of ethnobotany in modern medicine: Significance, habitat and morphology of the following plants in ethnobotany a) neem (b) tulsi (c) Gloriosa superba (g) Cassia auriculata h) Indigofera tinctoria [6]

Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. Ethnobotany and legal aspects. [2]

Suggested Readings

1. Odum. E P & Barrett. G W. Fundamentals of Ecology
2. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
3. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi.
4. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –
5.Manjula K Saksena & Anuja Tyagi. Plant Ecology & Economic Botany.
College Book House, Jaipur.
6. Singh, Pande & Jain. 2018.A text book of Botany-ANGIOSPERMS. Rastogi Publication,
Meerut.

CH 325 **Reagents & Reactions** **2-0-0-2**

Reagents: Introduction, Fenton's Reagent, Gilman's reagent, Wilkinson's catalyst, Lindlar catalyst, Adams' catalyst**,** Lithium aluminium hydride, Sodium borohydride, Anhydrous aluminium chloride, Dicyclohexyl carbodiimide, N-Bromosuccinimide, Lead tetra acetate, Osmium tetroxide, Perbenzoic acid, Raney nickel, selenium dioxide, 1,3-Dithiane (Umpolung reagent), Liquid ammonia. [10]

Reactions: Introduction, A detailed study of the following reactions: Reimer-Tiemann, Arndt-Eistert, Witting, Friedal craft, Aldol condensation, Cannizzaro, Diel's Alder, Mannich, Reformatsky, Favorskii, Hofmann, Curtius, Schmidt, Michael, Knoevenagel, Perkin , Shapiro reaction, Simmons-Smith reaction, Darzens reaction, McMurry reaction, Baeyer-Villeger, Heck reaction. [12]

Rearrangement: Introduction, nature of migration, migratory aptitude. A detailed study of the following rearrangements: Benzil – Benzillic, Beckmann, Claisen, Fries, Wagner-Meerwein, Pinacol-pinacolone, Demjanov. [04]

Suggested Books:

Text Books:

1. Reactions, rearrangements and reagents, S.N Sanyal, Bharti Bhawa
2. Name reactions and Reagents in organic synthesis, 2nd Edition, B.F WILEY, 2005.

Reference Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Camt
3. Advanced Organic Chemistry, Reactions Mechanisms and Structur
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, E
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg

BO 312 **Plant Biotechnology** **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory. [7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture. [8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement. [8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. [8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods. [8]

ZO 332 Animal Biotechnology 3-0-0-3

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.
6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

BT 324 Entrepreneurship Development 2-0-0-2

UNIT I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing

entrepreneurship, Features of a successful Entrepreneurship

UNIT II [8]

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital

UNIT III [8]

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship

MD003	Environmental Studies	3-0-0-4

Environmental Science: Definition, scope and importance, Multidisciplinary nature.	**[2]**
Ecology and Life Sustaining Process: Origin, evolution and diversification of life; natural selection; levels of selection. Ecosystem structure, functions; nutrient cycles; biomes; habitat ecology; primary and secondary productivity; Population ecology; metapopulation dynamics; growth rates; density growth; niche concept; Species interactions:. Biodiversity and bio conservation; genetic drift; biogeography and evolutionary ecology (indian context only); gene-environment interaction; Endangered and endemic species of India.	**[7]**
Present civilization and its engine:. Empowerment through Science and Technology: Its power and its consequences. The strongest contemporary ideas of science and their consequences on society. Industrial Civilization and its engine. Economics and its limitations: meta economics Psychology: The Anatomy of Greed, Envy and vanity (Freud's Psychoanalytic perspective, Hans Selye Stress Model; Self-regulation techniques) Unsustainable development. Traditional methods of protecting nature Suggested Case studies: i) Cultural Basics of our Environmental Crisis: ii) Ecofeminism	**[7]**
Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources Suggested Case Studies: i) What has posterity ever done for me? ii) Energy policy and further future: The identity problem	**[6]**
The story of Commons: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. Suggested Case Studies i) The tragedy of commons: ii) We all live in Bhopal iii) The Silent Spring;	**[7]**
Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. **Human Population and the Environment:** Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. Role of Information Technology in environment	**[7]**

and human health. Suggested Case Studies: i) Earth the Crowded Planet ii) Famine Affluence and morality iii) The world food supply	
Sustainable Development (Objective and Application): **Dysfunctional civilization, Vision of sustainable world, Satyagraha for Conservation, Buddhist Attitude towards nature , Buddhists Economics** **Suggested case studies** a. **Management Sciences**: Carbon credits and trading , green marketing and cause related marketing b. **Science and Engineering Issues: Organic farming, Renewable** energy. **c. Built Environments: Sustainable site planning, management of waste and its reduction, Low energy building materials and its implications, embodied energy, different case studies** d. **Sustainable fashion:** Online study of eco-fashion brands (how India can lead), NGO's working with local crafts; Community involvement Sampling and designing garments from recycled waste. Sampling /designing garments, comparative studies, handmade constructed from natural fiber/fabric and dyes Class room project to ; create public awareness (saying NO to garments made from non-environmentally friendly fabrics (exhibition & publicity); sustainable lifestyle challenge of starting with 'self & environment' **e. Judicial intervention**: Principle of absolute liability, inter-generational equality, environmental protection, use and conservation of natural resources, the precautionary principle, polluter pay principle, public trust doctrine and poverty eradication.	[**12]**
Field Trip & Report writing: (Any one of the following) **i)** Visit to renewable energy site **ii)** Visit to biodiversity park **iii)** Workshop on sustainable fashion **iv)** Shekhawati and its environment **v)** Morarka Foundation (organic farms) Nawalgarh/ Piplantri village rajsamand district	**[4]**
Suggested Books: **Text Book** i) Environmental Science: A Global Concern, Cunningham William P. Saigo B Woodworth, McGraw-Hill Higher Education; Sixth Edition (2001) ii) Odum E. P..Barret G.W Fundamental of Ecology, 5th Edition Cengage Learning, (2004) iii) Morgan, C.T., King, R.A., Weisz, J. R., & Schopler, J. Introduction to Psychology, International Student edition, Tata McGraw Hill, New Delhi (1986) **Reference Book** i) Environmental Law, S.C Shastri,5th Ed EBC Explorer, India, (2015) ii) Small is Beautiful: Economics as if People Mattered E.F.Schumacher, Blond and Briggs, London (1973) iii) Heywood V.H. & Watson R.T. 1995. Global biodiversity assessment, Camb ridge Univ. Press iv) Our Common Future, Report on World Commission on Environment and Development United Nations Document(1987) v) Al Gore, Dysfunctional Civilization: The Earth in Balance, Houghton, Mifflin, (1992) vi) Lester Brown, Christofer Favin, Sandra Postel, Vision of a Sustainable	

World, The Worldwatch Reader, Ed Lester R. Brown New York (1991)

vii)

Mongraphs for suggested Case Studies :

i) Cultural Basics of our Environmental Crisis: **Lweis W. Moncrief, Science Vol 170,508-12 (1970)**

ii) Ecofeminism: **Karen J Warren** Environmental Ethics, Vol 12 (1990)

iii) Satyagraha for Conservation : Awakening the spirit of Hinduism: **O. P. Dwivedi** Ethics of Environment and Development, Edited by Engel and Engel, Bellhaven Press, UK (1990)

iv) Buddhist Attitude towards nature: **Lily De Silva,** The Buddhist Attitude towards Nature, Ed: K.Sandell, Buddhist Publication Society, Sri Lanka (1987)

v) What has posterity ever done for me?: **Robert Heilbroner, Times Magazine, New York (1975)**

vi) Energy policy and further future: The identity problem: Derek Parfit, Energy and the future , Eds MacLean and Brown, (1983)

vii) The tragedy of commons: **Grrettn Hardin,** Science, 162 (1968)

viii) We all live in Bhopal: **George Bradford ,** Questing Technology, Freedom Press, US (1988)

ix) The Silent Spring: **Rachel Carson,** Houghton Mifflin Co, US (1962)

x) Earth the Crowded Planet: **Tristram Coffin, The Washington Spectator, Vol 17.15 (1991)**

xi) Famine Affluence and Morality: **Peter Singer,** World Hunger and Moral Obligation Ed William Aiken, Hugh, Lafollette, (1977)

xii) The world food supply: **Tristram Coffin, Washington Spectator, Vol 19.2, 1993**

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 ***Plant and Animal Biotechnology*** **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. *Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization* **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 Tissue Culture Laboratory 0-0-2-1

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage **[4]**

pathways; catabolism.

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,

2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.

4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
   (a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

   (b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**
   Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical

correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial **[5]**

photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation.

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New

Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press

Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]

3. Natural Resources: Renewable and Nonrenewable resources. [**2**]

4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect.
   Visit to a local area to document environmental assets [**3**]

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION

B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101	**Foundation Course in English**	**2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from

ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.

5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton [11]

and Digestive system and Brain.

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter,

Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211	**Bio-Instrumentation**	**3-1-0-4**
	Principle of pH meter.	[1]
	Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow.	[6]
	Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications.	[8]
	Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.	[8]
	Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE.	[8]
	Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography.	[8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.

2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson
and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith
G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 Animal Physiology 3-0-0-3

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology 2-1-0-3

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I 2-0-0-2

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.

2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III 2-0-0-2

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base

catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III 3-0-0-1.5

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory 0-0-2-1

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory 0-0-2-1

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology 3-1-0-4

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic [5]

fertilization, significance of fertilization.

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, [5]

Antigenic determinants of antibody molecules.

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis

on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand

& Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk and hazard associated with their use; Potential uses and applications of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc. [12]

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory.

[7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture.

[8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in

crop improvement. [8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. [8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods. [8]

MB 331 General Microbiology **3-0-0-3**

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters. [12]

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al*.; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New Delhi.
4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation. [4]

Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium). [5]

Biofuels: Bioethanol, Biodiesel, Methanogenesis. [4]

Biopesticides: Bacterial, Fungal and Viral pesticides. [4]

Biofertilizers: Nitrogen fixing microbes and their application in crop productions. [5]

Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and

pesticide biodegradation, Biobleaching of industrial effluents.

[6]

Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling.

[6]

Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process.

[5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..

2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.

3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.

4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.

5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.

6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 Environmental Biotechnology Laboratory **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 Tissue Culture Laboratory

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 Internship **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 Genetic Engineering **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase.

[6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors.

[6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for selection of recombinant DNA molecules.

[6]

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing.

[7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen.

[6]

BT 352 Bioinformatics **3-0-0-3**

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP)

[5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized databanks).

[7]

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X-ray crystallography), Algorithm for modeling protein folding. [5]

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 Bioprocess Engineering 3-0-0-3

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation. [10]

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration [10]

and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics.

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.,), Bioprocess Engineering, Prentice Hall PTR, New Jersey.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.*
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York.

***latest edition**

BT 334 Enzyme Technology 3-0-0-3

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes. [12]

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular [8]

emphasis on change in pH and hydrophobicty

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of Biochemistry , MacMillian Worth Publishers, US.
2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.
3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.
4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.
5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.
6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory 0-0-2-1

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory 0-0-2-1

Assignments are based on the course BT 334 Enzyme Technology containing exercises on enzymes kinetics.

Mody University of Science & Technology

B.Sc. (Hons) Maths
Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc (Honours) in Mathematics
(Mathematics, Physics and Computer Science*/Chemistry)**
Three-Year Programme
Academic Curriculum
First Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
						5				
	Mathematics									
	MS 111	Calculus	3	-	-	3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 111	Mechanics, Properties of Matter and Relativity	3	-	-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 121	Programming concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 181	Physical and Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 23*/23.5**									
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 23
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

First Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
						6				
	Mathematics									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2	-	-	2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 122	Data Structure Through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
						8				
	Chemistry*									
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 27*/24.5**									
	GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 27

**Mathematics, Physics and Chemistry 24.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language I ‡	3	-	-	**3**	3	25	25	50
	Mathematics									
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
						7				
	Physics									
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
						8				
	Computer Science*									
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
						8				
	Chemistry**									
	CH 291	Physical Chemistry- I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry -III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry -III	-	-	3	**1.5**	4	25	25	50
						7.5				
	Total Credits: 26*/25.5**									
	GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Autumn Semester

*Mathematics, Physics and Computer Science 26

**Mathematics, Physics and Chemistry 25.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language II ‡	3	-	-	3	3	25	25	50
	Mathematics									
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3	3	25	25	50
						7				
	Physics									
Spring Semester	PH 212	Mathematical Physics and Special theory of Relativity	3	1	-	4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
						6				
	Computer Science*									
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 272	Physical Chemistry- II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry- II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry -IV	-	-	3	1.5	4	25	25	50
						7.5				
	Total Credits: 21*/23.5**									
	GE 202	Proficiency (Non-Credit) #	-	-	-	1	-	-		

‡ *Refer to the Foreign Languages Section*

*Mathematics, Physics and Computer Science 21
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Third Year -Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	Mathematics									
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
	MS 331	Combinatorics	3	-	-	3	3	25	25	50
	MS 341	Vector Calculus	3	-	-	3	3	25	25	50
	MS 351	Probability and Statistics	3	1	-	4	3	25	25	50
	MS 361	Analytical Solid Geometry	3	1	-	4	3	25	25	50
	Total Credits:21									
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Third Year - Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	Mathematics									
	MS 312	Special Functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
	MS 332	Advanced Calculus	3	-	-	3	3	25	25	50
	MS 342	Graph Theory	3	-	-	3	3	25	25	50
	MS 352	Basic Differential Geometry	3	-	-	3	3	25	25	50
	MS 362	Dissertation	-	-	-	5	-	100		
	Total Credits:21									
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Total Credits (all Semester)- 139/139

$ CW (Course work): It would include attendance, assignments, class /quiz test.

MS 331 **Combinatorics** **3-0-0-3**

1. Relation: Definition, different forms, properties and operations on sets, principle of inclusion and exclusion, partition of a set, definition of relation, types of relation, composition, properties and graphical representation of relation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice and different forms. **[10]**

2. Function: Properties, definition of function and different forms, composition and properties of functions, recursively defined functions, applications of functions. **[10]**

3. Induction: Mathematical induction, strong induction and well-ordering, definition of recursive, structural induction. **[10]**

4. Counting: Basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.

Reference Books:

1. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd edt., Mc Graw Hill Education, New Delhi.
2. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International

MS 341 **Vector Calculus** **3-0-0-3**

1. Vector Differentiation I: Vector algebra, operations with vectors, scalar and vector product of three vectors, product of four vectors, reciprocal vectors, scalar-valued functions over the plane and the space, vector function of a scalar variable, curves and paths, vector differentiation. **[10]**

2. Vector Differentiation II: Directional derivative, gradient of a scalar function, conservative field, divergence, curl, related properties of gradient, divergence and curl of sums, second order differential operator, cylindrical and spherical coordinates. **[10]**

3. Vector Integration I: Integration of a vector function of a scalar argument, line integral, work done , potential, conservative field and area, surface integrals, surface area and flux, volume integrals. **[10]**

4. Vector Integration II: Green's theorem in plane, transformation between line integral and double integral, area in Cartesian and polar coordinate, Stoke's theorem, Gauss divergence theorem. **[09]**

Text Books:

1. Shanti Narayna, A Text Book of Vector Calculus by, S. Chand & Co., New Delhi.
2. R.Murrary, Theory and Problems of Advanced Calculus by Spiegal, Schaum's Publishing Company, New York.

Reference Books:

1. N. Saran and S.N. Nigam, Introduction to Vector Analysis by Pothishala Pvt. Ltd., Allahabad.
2. Thomas, Calculus by Thomas, 11 Editions, Pearson.
3. G. Paria, A Text Book on Vector Calculus by Scholar's Publishing House, Indore.
4. B.V. Ramana(2006), Higher Engineering Mathematics by TMH.

MS 351 **Probability and Statistics Theory** **3-1-0-4**

1. Basic Statistics: Mean, mode, median for grouped and ungrouped data, variance, standard deviation, dispersion and measures of dispersion, skewness and measures of skewness, moments. **[10]**

2. Probability Theory: Recapitulation of basic probability theory, law of addition and law of multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[10]**

3. Random Variables and Distribution: Discrete and continuous random variables, types of distribution, probability mass and density functions, mean variance and standard deviation of distribution, discrete distributions (binomial and Poisson), continuous distributions (normal and uniform). **[10]**

4. Hypothesis and Correlation-Regression: Simple and composite hypothesis, type I and type II errors, tests of significance, simple correlations, linear regression. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics, 3rd ed., SCS Publisher.

MS 361 **Analytical Solid Geometry** **3-1-0-4**

1. Plane and Straight Line: Different form of plane, angle between two planes, perpendicular distance of a point from a plane, plane through intersection of two planes, bisectors of two intersecting planes, locus of a plane, different form of straight line, angle between two lines, distance of a point from a straight line, coplanarity of straight lines, shortest distance between two lines, intersection of three planes. **[10]**

2. Sphere: Different form of sphere, plane section of a sphere, intersection of two spheres, sphere through a given circle, intersection of a straight line and sphere, tangent planes and normal, touching spheres and condition of orthogonality. **[10]**

3. Conicoids I: Different form of cone, equation of the cone with given vertex and a given conic for its base, angle between the lines in which a plane cuts a con, tangent lines and tangent plane, reciprocal con, right circular con, different form of cylinder, equation of tangent plane, enveloping cylinder, right circular cylinder. **[10]**

4. Conicoids II: Ellipsoid, hyperboloid of one and two sheets, elliptic paraboloid , hyperbolic paraboloid, tangent plane , equation of normal, director sphere, polar plane and pole of the plane. **[09]**

Text Books:

1. R.J.T. Bell (1994), Elementary Treatise on Co-Ordinate Geometry of Three Dimensions by, Macmillan India Ltd.
2. Shanti Narayan, Analytical Solid Geometry by S. Chand & Company, New Delhi.

Reference Books:

1. Deepak Chatterjee, Analytic Solid Geometry by PHI Learning Private Ltd., New Delhi.
2. H.M. Vasavada (1992), Analytical Geometry of Two and Three Dimensions.

MS 332 **Advanced Calculus** **3-0-0-3**

1. Preliminary: Functions, continuity, the derivative, composite functions Rolle's theorem, theorem of the mean, Taylors's series with remainder indeterminate forms, fundamental theorems on infinitesimals. **[10]**

2. Power Series: Definition, tests for convergence, region of convergence, uniform convergence, integral and derivative of power series, operations with two power series, exponential, trigonometric, hyperbolic and dominant functions, conditionally convergent series. **[10]**

3. Partial Differentiation: Functions of two variables, partial derivatives of composite function, Euler's theorem on homogeneous functions, directional derivative, higher differential, implicit functions, one equation of two or more variables, two equations of four variables, four equations of six variables, Jacobians. **[10]**

4. Definite Integral: Definition and properties, existence proof, Simpson's rule, change of variables, differentiation of a definite integral, differentiation under the integral sign, differentiation and integration of integral with infinite limit, infinite integrand, multiple integrals, beta and gamma functions, Dirichlet's integral. **[09]**

Text Books:

1. Frederick S Woods (1934), Advanced Calculus by Ginn and Company.
2. George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Thomas Calculus by Pearson.

Reference Books:

1. R.C Buck , Advanced Calculus by Waveland Press, Inc.
2. Walter Rudin, Principles of Mathematical Analysis by McGraw-Hill.
3. Gerald B. Folland, Advanced Calculus by Pearson.

MA 342 **Graph Theory** **3-0-0-3**

1. Graphs: Introduction, definition and applications of graphs, finite and infinite graphs, null graph, sub graphs, incidence and degree, isolated vertex, pendant vertex, walk, path and circuits, connected graphs, disconnected graphs and components, isomorphism, Euler graphs, operations on graphs, Hamiltonian paths and circuits, the travelling sales man problem, matrix representation of graphs, properties and some standard theorems on graphs. **[10]**

2. Directed Graphs: Definition, in-degree, out-degree, isomorphic digraphs, types of digraphs, digraph and binary relations, relation matrices, directed paths and connectedness, Euler digraphs, fundamental circuits in digraphs, properties and some standard theorems on digraphs. **[10]**

3. Trees: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's algorithm and Prim's algorithm. **[10]**

4. Cut-Sets and Cut-Vertices: Cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism, some standard theorems. **[09]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science, PHI.
2. Chartland G., Zhang P. (2006) Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.

MS 352 **Basic Differential Geometry** **3-0-0-3**

1. Preliminaries: Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces orientation, the gauss map. **[10]**

2. Tensors: Definition of tensors and basic properties, Christoffel symbols, uses of tensors in differential geometry. **[10]**

3. Geodesics I: Parallel transport, Weingarten map, curvature of plane curves, arc length and the line integrals, curvature of surfaces. **[10]**

4. Geodesics II: Envelops and evolutes, first fundamental form, metric potentials, direction coefficient and angle between two curves on a surface. **[09]**

Text Books:

1. Chuan-Chih Hsiung (1997), A First Course in Differential Geometry by International Press, Cambridge.
2. T.J. Willmore(1964), An Introduction to Differential Geometry by Oxford University Press.

Reference Books:

1. M. Abate and F. Tovena, Curves and Surfaces by Springer.
2. A. K. Peters (2010), Differential Geometry of Curves and Surfaces by Ltd., Natick.
3. D.J. Struik(1988) , Lectures on Classical Differential Geometry by 2nd Edition, Addison-Wesley.

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 *Physics Laboratory-I* 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. [7]

Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission [10]

grating and its resolving power.

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.

3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10] [8]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and [8]

grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments.

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of [6]

cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon-nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and [6]

Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]
Applications of Matrices: Applications of matrices to a system of linear	[9]

(both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.

2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd.,

Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 *C Language Laboratory* 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi
4. Achyut S Godbole, "Operating Systems", TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and [8]

Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes.

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, "Let Us C++", BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, "Mastering C++" , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, "C++ The Complete Refernce", TMH, New Delhi.
2. Lafore R, "Object Oriented Programming Using C++", GalgotiaPulications, New Delhi
3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 *Computational Numerical Analysis Laboratory* **0-0-4-2**

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular

velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's **[5]**

equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey,

reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child [5]

Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and

pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand

& Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing [8]

mechanism

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology 3-0-0-3

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons, Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal

system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.

4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

B.Sc. (Hons) Chemistry

Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (Hons.) Chemistry
Three Years Programme: Curriculum Structure
2018-2019 and onwards

FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Programme Core**									
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	3	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 111	Calculus	3	-	-	3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3	-	-	3	3	25	25	50
	PH 111	Mechanics, Properties of Matter and Relativity	3	-	-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BO 121	Botany Laboratory-I	-	-	2	1	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Lab	-	-	2	1	3	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab-I	-	-	2	1	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
		Total Credits Main	**20.5 with Math Group**				**24.5** with Bio Group			
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Programme Core**									
	CH 182	Physical and Inorganic Chemistry-II	2			2	3	25	25	50
	CH 192	Organic Chemistry-II	2			2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II			3	1.5	4	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	BO 142	Gymnosperms and Taxonomy of Angiosperms	3	-	-	3	3	25	25	50
	BO 122	Botany-Lab II	-	-	2	1	3	25	25	50
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 142	Animal diversity lab-II	-	-	2	1	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Total Credits Main	**22.5** with Math Group				**17.5** with Bio Group			
	GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

SECOND YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Programme Core**									
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2			2	3	25	25	50
	CH 223	Organic Chemistry-III	2			2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-		3	1.5	4	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 211	Linear Algebra	3	-	-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	3	25	25	50
	BO 231	Plant Physiology and Metabolism	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	3	25	25	50
	CH 283	Basic Mathematics	2	-	-	2	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
		Foreign Language-I	3	-	-	3	3	25	25	50
		Total Credits Main	**25.5** with Math Group				**20.5** with Bio Group			
	GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

SECOND YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Programme Core**									
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS222	Real Analysis	3	-	-	3	3	25	25	50
	PH 212	Mathematical Physics and Special theory of Relativity	3	1	-	4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	ZO 232	Animal Developmental Biology	3	-	-	3		25	25	50
	ZO 242	Animal Developmental Biology Laboratory	-	-	2	1		25	25	50
	BT 212	Molecular Biology	3	1	-	4		25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
		Foreign Language-II	3	-	-	3	3	25	25	50
		Total Credits Main	**23.5** with Math Group				**18.5** with Bio Group			
	GE 202	Proficiency (Non-Credit) #	-	-	-	1	-	-		

THIRD YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Programme Core**									
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 313	Instrumental Methods of Analysis	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	3	25	25	50
	CH 333	Laboratory Course for Instrumental Methods of Analysis	-	-	3	1.5	3	25	25	50
	CH 343	Project[$]	-	-	-	5	-	-	-	100
	PROGRAMME ELECTIVES(Select any one)									
	CH 323	Chemistry of Polymers and Petrochemicals	2	-	-	2	3	25	25	50
	CH 325	Reagents & Reactions	2	-	-	2	3	25	25	50
		Total Credits Main	**18.0** with Math Group & Bio Group							
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-		

THIRD YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Programme Core**									
	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry-VI	2	-	-	2	3	25	25	50
	CH 334	Green and Environmental Chemistry	2	-	-	2	3	25	25	50
	CH 344	Organic Reaction Dynamics, Reactive Intermediates and Photochemistry	2	-	-	2	3	25	25	50
	CH 354	Pharmaceutical Chemistry	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	3	25	25	50
	CH 364	Photochemistry and Green Chemistry Laboratory	-	-	3	1.5	3	25	25	50
	CH 374	Pharmaceutical Chemistry Laboratory	-	-	3	1.5	3	25	25	50
	PROGRAMME ELECTIVES(Select any one)									
	CH 316	Advanced Materials	2	-	-	2	3	25	25	50
	CH 318	Organometallic Chemistry	2	-	-	2	3	25	25	50
		Total Credits Main	**18.5** with Math Group & Bio Group							
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Total Course Credits: 117..5/128.5

Sr No	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Chemistry with **Botany and Zoology**	24.5	17.5	20.5	18.5	18	18.5	**117.5**
Chemistry with Physics and Maths	22.5	22.5	25.5	23.5			**128.5**

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.

Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

COURSE DESCRIPTION
B. Sc. Honors Chemistry

COURSE DESCRIPTION
B. Sc. Honors Chemistry

Compulsory Courses

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 J$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [7] [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int E.dr$. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their [10]

applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem.

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]
Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]
Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory

4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics,

Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998

3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998

4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.

2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992

3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of [10]

molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [6]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [8]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments.

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]
2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]
3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]
4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma [10]

transitions (no derivation).

PH 362 Statistical Mechanics 4-0-0-4

5. **Accelerators and Detectors:** Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, [5]

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation [5]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009

2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996

3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991

2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers,

Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix [13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

Group: Algebraic structure, Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

MS 1[illegible] Abstract Algebra **3-0-0-3**

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution [9]

of second order linear differential equations with variable coefficients(Complementary Functions only)

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970

2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, “Operating Systems”, New Delhi
2. Ritchie, “Operating System”, BPB Publication , New Delhi
3. Dhamdhere D. M. “System Programming and Operating System”, TMH New Delhi
4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.
5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, “Information Systems for Modern Management”, PHI, New Delhi

2. Jawadkar, “Management Information System”, TMH, New Delhi

Reference Books:

1. Sadagopan, “Management Information System”PHI, New Delhi

2. Parker, Case, Thomas, “Management Information System: Strategies and Action”, TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, ”System Analysis and Design”, TMH, New Delhi
2. Hawayszkiewyez Igor, “Introduction To System Analysis and Design” PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 **0-0-4-2**

Computational Numerical Analysis Laboratory

Assignments are based on the Course Numerical Analysis.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 Physical and Inorganic Chemistry-I 2-0-0-2

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction.

Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid **[4]**

and liquid. Classification, structure of nematic and cholestric phases.

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.

4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi

4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.

3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use [6]

and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication,

Meerut

2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.

2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base

catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic [5]

fertilization, significance of fertilization.

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, [5]

Antigenic determinants of antibody molecules.

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV 2-0-0-2

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis

on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand

& Co. Ltd.

CH 262 **Laboratory Course in Chemistry-IV** **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I 2-0-0-2

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
4. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

7. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
8. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
11. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
12. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in

hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

2. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
5. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
6. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton [11]

and Digestive system and Brain.

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter,

Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
4. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

7. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
8. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
11. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
12. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II 2-0-0-2

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
4. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
5. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
6. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II 3-0-0-1.5

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy. [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.

3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, [4]

Kidney and Bone.

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials.

Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

3. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
4. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

5. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L.

Gaus. 5rd Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
7. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with **[4]**

epoxides.

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

3. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
4. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in [5]

chromosome.

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 **Physical Chemistry-II** **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and

specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
4. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

5. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
8. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
7. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction,

Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

3. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
4. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

Mody University of Science & Technology

B.Sc. (Hons) Food and Nutrition

Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	BC111	General Biochemistry	3	-	-	3	3	25	25	50
	FN 111	Principle of Nutrition	3	-	-	3	3	25	25	50
	FN 121	Nutrition through Life	3	-	-	3	3	25	25	50
	CH 113	Chemistry-I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Lab-I	-	-	2	1	3	25	25	50
		Sub Total	17	1	6	21				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MB 331	General Microbiology	3	1	-	4	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	3	25	25	50
	FN 112	Food Science	3	-	-	3	3	25	25	50
	FN 122	Food Science laboratory	-	-	2	1	3	25	25	50
	CH 114	Chemistry-II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Lab-II	-	-	2	1	3	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Sub Total	15	2	10	22				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	FN 211	Food Safety	3	-	-	3	3	25	25	50
	FN 221	Family Nutrition	3	-	-	3	3	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Lab	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	17	1	6	21				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN 212	Public Health Nutrition	3	-	-	3	3	25	25	50
	FN 222	Food Chemistry	3	-	-	3	4	25	25	50
	FN 232	Therapeutic Nutrition	3	-	-	3	2	25	25	50
	FN 242	Nutritional Laboratory-I	-	-	4	2	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total	15	-	6	18				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester										
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
	FN 311	Maternal and Child Nutrition	3	1		4	3	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocessing Engineering Lab	-	-	2	1	4	25	25	50
	FN 321	Nutrigenomics & Personalised Nutrition	3	1	-	4	3	25	25	50
	FN 331	Nutritional Laboratory-II	-	-	4	2	4	25	25	50
		Sub Total	13	4	6	20				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-			

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester										
	MB312	Microbial Ecology	2	-	-	2	3	25	25	50
	MB322	Microbial Ecology Lab	-	-	2	1	4	25	25	50
	FN 312	Dietetics	3	1	-	4	3	25	25	50
	FN 322	Food Services Management	3	-	-	3	3	25	25	50
	FN 332	Nutraceuticals and Health Foods	3	1	-	4	4	25	25	50
	FN 342	Food quality and sensory evaluation	3	1	-	4	3	25	25	50
	FN 352	Nutritional Lab-III	-	-	4	2	4	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	80
		Sub Total	16	3	6	22				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-			

FN 111 Principle of Nutrition 3-0-0-3

UNIT-I [7]
Indian foods - Food and culture, Traditional Indian Dietary patterns and Indian ethnic cuisines, Nutritional/medicinal quality of traditional foods - Traditional food beliefs, foods in Ayurveda. Food processing technologies

UNIT-II [6]
Nutrition and Food Science – Definition, history, RDA (Recent), factors affecting RDA – Methods used for deriving RDA, Basic four/five food groups and the functions of food, Food pyramid

UNIT-III [6]
Carbohydrates – classification, functions, digestion and absorption, Sources, deficiency diseases. Role fo fibre in human Nutrition

UNIT-IV [4]
Protein – classification – functions, sources digestion and absorption, sources and deficiency disorders.

UNIT-V [4]
Lipids – Classification, functions, digestion and absorption, sources, excess and deficiency disorder

UNIT-VI [6]
Vitamins – Fat soluble vitamins A, D, E & K, functions, sources, requirements deficiency diseases. Water soluble vitamins – B like thiamine, Riboflavin, Niacin, Phridoscin, Folic acid, B2 and Vitamin C and their functions sources requirements and deficiency diseases.

UNIT-VII [6]
Minerals – Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Flourine and their functions, sources requirements and deficiency diseases.

Text Book

1. Srilakshmi. B. (2010) Nutrition Science, V Edition, New Age International Publishers, New Delhi

References:

2. Chintapalli Vidya (2004) A Text book of Nutrition, New Delhi: Discovery Publishing House
3. Gopalan. C. Ramasastry, B.V. and Balasubramanian, S.C. (1976), Nutrition value of Indian Foods, Hyderabad: National Institute of Nutrition
4. 4. Swaminathan M. (1972), Essentials of Food and Nutrition, Philadelphia: Ganesh and Company

FN 121 Nutrition through life 3-0-0-3

UNIT-I [6]
Principles of meal planning: Balanced diet, Food groups, Food exchange list, Factors effecting meal planning and food related behavior, Dietary guidelines for Indians and food pyramid

UNIT-II [3]
Nutrient requirements: Dietary Concept, Overview of methods for assessment of

nutrient needs

UNIT-III [10]

Nutrition for adulthood and old age : Adult: Nutrient requirements for adult man and woman, RDA, nutritional guidelines, nutritional concerns, diet and lifestyle related diseases and their prevention, Elderly – Physiological changes in elderly, RDA, nutritional guidelines, nutritional and health concerns in old age and their management, factors contributing to longevity

UNIT-IV [10]

Nutrition during pregnancy and lactation: Pregnancy – Physiological changes in pregnancy, RDA, nutritional guidelines, nutritional needs, effect of nutritional status on pregnancy outcome, optimal weight gain and its components, nutrition related problems in pregnancy and ways to control them, Lactation – Physiology of lactation, RDA and nutritional needs of a nursing mother, nutritional guidelines

UNIT-V [10]

Nutrition during childhood: Growth and development, growth reference/ standards, RDA, nutritional guidelines, nutritional concerns and healthy food choices - Infants - Preschool children - School children – Adolescents

Text Book

1. Barrer. K. (2007) Basic Nutrition Counseling Skill Development Wadaworth Pub. Co.

References

2. Bendich. A. (1997) Preventive Nutrition Humana Press
3. Blackwell Scientific Publication. (1994). Manual Of Dietetic Practice.2nd ed.
4. British Nutrition Foundation. (1999). Obesity. Blackwell Science Pub.
5. Brown. J. (2002). Nutrition Through The Lifecycle. Wadsworth Pub Co.
6. Gable. J. (1997) Counselling skills for Dietitians, Blackwell Publishing House
7. Garrow .J.S (1993). Human Nutrition and Dietetics, 9th ed., Churchill Livingstone Pub.
8. Gibney, J. M. (2005). Clinical Nutrition. Blackwell Publishing House.
9. Gopalan .C.(2000). Nutritive Value of Indian Foods. NIN ICMR Pub.
10. ICMR Pub. (2000). Nutrient Requirement and Recommended Dietary Allowances for Indians

FN 112 Food Science 3-0-0-3

UNIT-I [10]

Cereals and Cereal Products: Structure Nutritive value of rice, wheat, maize and locally available millets, Enrichment and fortification. Batters and Doughs; Milling and parboiling; Malting of cereals. b. Pulses and Nuts : Composition and Nutritive value, factors affecting cooking quality of pulses, germination of whole grams.

UNIT-II [5]

Vegetables and Fruits – classification, Nutritive value, changes during cooking of vegetables, changes during ripening of fruits. Storage

UNIT-III [12]

Milk & Milk Products: Composition and Nutritive value, Different types of milk products; pasteurization of milk. b. Egg: Structure, Composition and Nutritive

value. Measure of quality, factors affecting foam formation, uses of egg in cookery. Home preservation and storage. c. Fleshy Foods: Composition and Nutritive value of meat, fish and poultry selection and storage – Effect of cooking on colour, texture and flavour. Factors affect tenderness.

UNIT-IV [12]

Fats & Oils : Composition and Nutritive value of common fats and oils, and reuse of oils, smoking temperature, rensidity of fat, absorption. b. Beverages : Classification, Nutritive value – Coffee, Tea, Cocoa, milk based fruit juices, aerated and alcoholic beverages. c. Spices and Condiments : Types, uses in Indian cookery

Text Book

1. Swaminathan, M. (6th Edition) Hand Book of Food Science and Experimental Food Text.

References:

2. Hughes and Benion, (1970), Introductory Foods.. McMillan Publishing Company.
3. Peckham, C.G. (1969) Foundation of Food Preparation, McMillan Publishing Company
4. Swaminathan, M. (1976) Essentials of Food and Nutritive Vol.I Bangalore Printing
5. 5. Potler, N. 5th Edition, Food Science. New York : Chapman & Hall

FN 122 Food Science laboratory 0-0-2-1

Experiments based on the contents of FN 112

CH 113 Chemistry - I 3-0-0-3

UNIT-I [6]

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

UNIT-II [8]

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. *Critical Phenomena:* PV isotherms of real gases; continuity of states, the isotherms of Van der Waals equation, relationship between cirtical constants and Vander-Waals constants, reduced equation of state.

UNIT-III [10]

Mechanism of Organic Reactions: homolytic and heterolytic bond cleavage. Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Mechanisms of nucleophilic substitution SN1 and SN2. Reactive intermediates - carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Methods of determination of reaction mechanism.

UNIT-IV [5]

Periodic Properties : Atomic and ionic radii, ionization energy, electron affinity

and electronegativity - definition, methods of determination of evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT-V [10]

Stereochemistry of Organic Compounds : Optical Isomerism- Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, chiral and achiral molecules with two stereogenic centres, diastereomers, resolution of enantiomers, inversion, retention. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature, geometric isomerism in oximes and alicylic compound. Conformational isomerism: Conformational analysis of ethane, propane and n-butane by the Newman projection.

Text Book:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI.

References

2. Malik, W.U., Tuli G.D. and Madan R.D. (2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
3. Puri, Sharma and Pathani (2013) Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
4. Stanley H Pine, Organic Chemistry, 5th Edition, Tata McGraw-Hill.
5. Mukherjee, S.M. and Singh, S.P. 3rd Edition; Reaction Mechanism in Organic Chemistry, Macmillan India Limited.

CH 123 Chemistry Laboratory-I 0-0-2-1

The laboratory experiment will be based on the theory paper CH 113

CH 114 Chemistry - II 3-0-0-3

UNIT-I [9]

Chemical Bonding: Covalent Bond: Valence bond Theory, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, concept of multicentric bonding, percentage ionic character. Ionic Solids: Ionic structures, radius ratio effect and coordination number, lattice energy and Born haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

UNIT-II **[9]**

S and p Block Elements: S-Block elements- Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies. P-Block Elements -Comparative study of groups 13-18 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron- diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride. Structure of Xenon compounds.

UNIT-III **[7]**

Chemical Kinetics and Catalysis: Chemical kinetics and its scope, rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half-life and Radioactive decay as a first order phenomenon. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, collision theory, transition state theory. Catalysis & types of catalysis,

Mechanism of catalysis, Enzyme catalysis

UNIT-IV **[6]**

Alkanes and Cycloalkanes: Classification of carbon atoms in alkanes, isomerism, sources, methods of formation (with special reference of Wurtz reaction, Kolbe reaction, Corey house reaction and decarboxylation of carboxylic acids). Physical properties and chemical reaction of alkanes.

[8]

UNIT-V

Alkenes and Alkynes: Nomenclature, preparation and reactions of alkenes, Saytzeff and Hofmann elimination, Mechanisms of hydrogentation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization. Chemical reaction of alkynes, mechanism of electrophilic and nucleophilic addition reaction, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.

Text Book

1. Bahl, A. and Bahl, B. S.: A Textbook of Organic Chemistry, S. Chand and Co. Ltd. New Delhi.

References

2. Puri, Sharma and Pathania (2013): Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
3. Malik, W.U., Tuli G.D. and Madan R.D.(2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
4. Morrison, R. T. and Boyd R. N. 6th Edition. Organic Chemistry, Prentice Hall, Englewood Cliffs, New Jersey.
5. R.K. Bansal; Organic Reaction Mechanisms, 3rd Ed., Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

CH 124 Chemistry Laboratory-II **0-0-2-1**

The laboratory experiment will be based on the theory paper CH 114

FN 221 Family Nutrition **3-0-0-3**

UNIT-I [7]

Principles of Nutrition - Nutrients and their functions. Food groups, meal planning, RDA, Over nutrition, under nutrition, malnutrition.

UNIT-II

Nutrition during Pregnancy and Lactation. Importance of Nutrition during pregnancy. Complications in pregnancy, food and nutritional requirements for lactating women. [8]

UNIT-III

Nutrition for Infants and Preschoolers Importance of breast milk, food and nutritional requirements for infants, weaning and supplementary foods for infants, food habits of preschoolers, nutritional requirements for preschool children. [8]

UNIT-IV

Nutrition for School Age and Adolescents. Nutritional requirements for school going children and adolescents, factors influencing food intake, nutritional disorders. [8]

UNIT-V

Nutrition during Adulthood and Old age. Food and nutritional requirements for adults. Importance of nutrition during old age, factors influencing food intake, nutritional requirements, nutritional problems and management of old age [8]

Text Book:

1. Gopalan, C. and Balasubramanian, B.C.Diet Atlas of India, NIN, Hyderabad, 1971.
2. Gopalan, C.Ramasastry, B.V. and Balasubramanian, S.C. Nutritive value of Indian foods, NIN, Hyderabad, 1976. 24

Reference:

3. Margaret Mc.Williams, "Food Fundamentals" John Wiley and Sons, London, 1974.
4. Swaminathan, M.Essentials of Food and Nutrition Vol.I& II BAPPCO., The Bangalore Printing and Publishing co., ltd., No.88, Mysore Road, Bangalore.

FN 211 Food Safety 3-0-0-3

UNIT-I [4]

Introduction to Food Safety

Definition, Types of hazards, biological, chemical, physical hazards Factors affecting Food Safety ,Importance of Safe Foods

UNIT-II [5]

Food Hazards of Physical and Chemical Origin

Introduction ,Physical Hazards with common examples ,Chemical Hazards(naturally occurring ,environmental and intentionally added , Packaging material as a threat ,Impact on health ,Control measures

UNIT-III [5]

Food Hazards of Biological Origin

Introduction ,Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes ,Seafood and Shell fish poisoning , Mycotoxins

UNIT-IV [4]

Management of hazards

Need ,Control of parameters ,Temperature control, Food storage

UNIT-V [5]

Hygiene and Sanitation in Food Service Establishments

Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal ,Pest and Rodent, Control Personnel Hygiene

UNIT-VI [4]

Food Safety Management Tools

Basic concept Prerequisites- GHPs, GMPs, HACCP ISO series TQM - concept and need for quality, components of TQM, Kaizen. Risk Analysis Accreditation and Auditing

UNIT-VII [5]

Microbiological criteria

Microbiological standards and limits (for processed food, water) Sampling Basic steps in detection of food borne pathogens Water Analysis

UNIT-VIII [3]

Food laws and Standards

Indian Food Regulatory Regime Global Scenario Other laws and standards related to food

UNIT-IX [4]

Recent concerns

New and Emerging Pathogens Genetically modified foods \ Transgenics Organic foods Newer approaches to food safety

Text Book

1. Lawley, R., Curtis L. and Davis,J. The Food Safety Hazard Guidebook , RSC publishing, 2004
2. De Vries. Food Safety and Toxicity, CRC, New York, 1997

Reference:

3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000
5. Forsythe,S.J.The Microbiology of Safe Food , second edition, Willey-Blackwell,U.K.,2010

FN 212 Public Health Nutrition 3-0-0-3

UNIT-I [8]

Concept of public health nutrition- relationship between health and nutrition, role of public health nutritionists in the health care delivery. Public health and nutrition policies- plan of action and programs.

UNIT-II [6]

Food and nutrition security- food production, distribution, access, availability and consumption. Socio cultural aspects and dietary patterns: their implication for nutrition and health.

UNIT-III [4]

Health care facility- primary health care of the community, health care delivery system.

UNIT-IV [10]

Determinants of nutrition and health status- socio cultural, biologic, environmental and economic factor, indicators of health and malnutrition. Economics of malnutrition- impact on productivity and national development. Socio demographic, health and nutrition transitions

UNIT-V [11]

Approaches and strategies for improving nutritional status and health: national and international contributions, role of government and non-government organizations. Case studies of selected strategies and programs: their rationale and context- health based, intervention, food based interventions including fortification, genetic improvement of foods, supplementary feeding, and nutrition education for behavior change

Text Book

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers

Reference:

2. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill..
3. Sethi P and lakra P Aahaarvigyaan ,Poshanevam Suruksha, Elite Publishing house, 2015
4. Khanna K et al. Textbook of Nutrition and Dietetics;2013; Phoenix Publisher.

FN 222 Food Chemistry 3-0-0-3

UNIT-I [9]

Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam.

UNIT-II [8]

Carbohydrates:Monosaccharides,Oligosaccharides,Polysaccharides,Starch,Cellulose,Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber

UNIT-III [7]

Lipids: Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids.

UNIT-V [7]

Amino Acids, Peptides and Proteins: Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein.

UNIT-VI [8]

Food colorants: pigments in animal and plant tissues. Flavors: Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances.

Text Book

1. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.

Reference:

2. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
3. Fennema, O.R, 2006, Food Chemistry, Academic Press.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. Food Chemistry. Marcel Dekker.

FN 232 Therapeutic Nutrition 3-0-0-3

UNIT-I

Diet in Cardiovascular diseases : Aetiology, Symptoms, Risk factors, pathophysiology, dietary management and prevention of Atherosclerosis, Coronary Artery Disease, Myocardial Infarction, Ischemic Heart Disease, Rheumatic Heart Disease(RHD), Congestive Cardiac Failure (CCF), Hypercholesterolemia, Hypertension – classification, sodium restricted diet, dangers of severe sodium restriction [16]

UNIT-II

Diet in Diseases of Liver and Gall Bladder: Aetiology, Symptoms, Dietary treatment in Jaundice, Hepatitis, Pancreatitis, Cirrhosis, Hepatic Coma. Role of food and alcohol in developing liver diseases. Biliary Tract Diseases- Cholecystitis Cholelithiasis and Choled ocholithiasis [8]

UNIT-III

Diet in Renal disease: Causes, Symptoms and dietary management in Nephritis, Nephrosis, Acute and chronic renal failure, Renal calculi, Acid and alkali producing foods, End Stage Renal Diseases (ESRD), Dialysis. [7]

UNIT-IV

Diet in Cancer: Tumor markers and their applications, Types of cancer, Risk factors, Symptoms, Metabolic alterations and Nutritional problems of cancer and cancer therapy, Medical Nutrition Therapy, Role of food in prevention of cancer. [8]

Text Book

1. Kumar .P. Clark M (2005) , Clinical Medicine, 6th Edition, Elsevier Saunders Publishing Co.

Reference:

2. Gibney M J., Elia.M, Lingqvist. O (2005),Clinical Nutrition, Blackwell Science publishing Co.
3. Guthrie, H.A and Picciano, M.F, (1995), Human Nutrition, Mosby Publishing Co, New York.
4. Kris Etherton.P and Burus J.H.(1998), Cardiovascular Nutrition, American Dietetic Association ,Chicago, Illinosis.

FN 242 Nutritional Laboratory-I 0-0-4-2

Experiments based on the contents of FN 212, FN 222 and FN 232

FN 311 Maternal And Child Nutrition 3-1-0-4

UNIT-I [13]

Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth outcome. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT-II [10]

Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and counselling

UNIT-III [10]

Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality, IMR and U5MR; link between mortality and malnutrition;

UNIT-IV [6]

Overview of maternal and child nutrition policies and programmes.

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s Banarasidas Bhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 321 Nutrigenomics & Personalised Nutrition 3-1-0-4

UNIT-I [6]

Introduction. Concept of functional genomics, systems biology, nutrigenomics, nutrigenetics, personalised nutrition

UNIT-II [13]

Molecular biology and genomics: Nutritional requirements and metabolic responses at cellular level, Impact of a changing nutrient environment, Introduction to molecular diagnostics: nutrients influences on genomes

UNIT-III [9]

Diet and gene expression: nutrients as regulators of activity and transcription factors. Nutrients as epigenetic exchange agents.

UNIT-IV [11]

Diet in early life and metabolic programming. V Diet as a possible risk or preventive factor in illnesses. Gene polymorphisms and responses to diet. Examples related to cardiovascular disease, cancer, osteoporosis. Risk/benefit biomarkers

Text Book

1. Principles and Applications by FransKok, Laura Bouwman, Frank Desiere, CRC press

R**eference**:

2. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition by Lynnette R. Ferguson, CRC press

FN 331 Nutritional Laboratory-II 0-0-4-2

Exercises based on Courses BC 311, FN 311 and FN 321

FN 312 Dietetics 3-1-0-3

UNIT-I [3]
Concept of Diet therapy: growth and source of dietetics, purpose and principles of therapeutic diets, modification of normal diet, classification of therapeutic diets.

UNIT-II [3]
Role of Dietician: Definition of nutritional care, interpersonal relationship with patient, planning and implementary dietary care, Team approach to nutritional care.

UNIT-III [6]
Diet in surgical conditions, burns and cancer.
Obesity and leanness- causes, complication and health effects, dietary treatment and other recommendation

UNIT-IV [3]
Diet in fever and infections- Types- metabolism in fever, general dietary consideration diet in influenza, typhoid fever, recurrent malaria and Tuberculosis.

UNIT-V [3]
Diet in gastritits, peptic ulcer- symptoms, clinical findings, treatment, dietary modification, adequate nutrition, amount of food, and intervals of feeding, Chemically and mechanically irrigating foods, four stage diet (Liquid, soft, convalescent, liberalized diet).

UNIT-VI [3]
Diet in disturbances of small intestine and color. Diarrhoea- (child and adult)- classification, modification of diet , fibre, residue. Fluids & nutritional adequacy. Constipation- flatulence - dietary considerations. Ulcerative colitis (adults) - symptoms, dietary treatment. Spruce, coeliac disease- disaccharide intolerance, dietary treatment.

UNIT-VII [6]
Diet in diseases of the liver, gall bladder and pancreas, a) Etiology, symptoms and dietary treatment in - Jaundice, hepatitis, cirrhosis and hepatic coma. b) Role of alcohol in liver diseases. c) Dietary treatment in cholecystitis, cholelithiasis and pancreatitis. Gout- Nature and occurrence of uric acid, causes, symptoms and diet.

UNIT-VIII [3]
Diet in allergy and skin disturbances: Definition, classification, manifestations, common food allergies and test and dieteric treatment.

UNIT-IX [3]
Diet in Diabetes mellitus: a) Incidence and predisposing factors. b) Symptoms-types and tests for detection. c) Metabolism in diabetes d) Dietary treatment & meal management e) Hypoglycemic agent, insulin and its types. f) Complication of diabetes.

UNIT-X [3]
Diet in Renal diseases: Basic renal function, symptoms and dietary treatment in acute and chronic glomerulonephritis, Nephrosis, renal failure, dialysis. Urinary calculi-causes & treatment, acid and alkali producing and neutral foods and dietary treatment.

UNIT-XI [3]
Diet in Cardiovascular diseases: Role of nutrition in cardiac efficiency, incidence of Atherosclerosis, dietary principles, Hyperlipidenmia, Hypertension- causes and dietary treatment, Sodium restricted diet, level of sodium restriction, sources of sodium, danger of severe sodium restriction.

Text Book

1. Antia P. Clinical Dietetics and Nutrition, 2nd edition, Oxford University press.

Reference:

2. Garrrow J.S, James W. P.T, Ralph A, (2000), Human Nutrition and Dietetics, 10th edition, Churchill Livingston, London.
3. Guthrie H. A, Picciano M. F (1995), Human Nutrition, Mosby, St. Louis Missorie.

FN 322 Food Service Management 3-0-0-3

UNIT-I [6]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel

UNIT-II [6]

Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules. Theories about approaches to food service management

UNIT-III [10]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-IV [9]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance. Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of Kitchen records.

UNIT-V [8]

Financial management – Budgeting, costing and cost control, accounting. 8. Hygiene and sanitation in preparation and serving area – Personal hygiene, types and sources of contamination, prevention and safety measures. Methods of controlling infestation. Methods of dish washing.

Text Book:

1. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.

Reference:

2. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.
3. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.

FN 332 Neutraceuticals and Health Foods 3-1-0-3

UNIT-I

Nutraceuticals: (a) Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases (b) Definition, Classification, food and non-food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [13]

UNIT-II

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [8]

UNIT-III

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [9]

UNIT-IV

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India [9]

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s BanarasidasBhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 342 Food Quality And Sensory Evaluation 3-1-0-3

UNIT-I [4]

Introduction to quality attributes of food, Appearance, flavour, textural factors and additional quality factors

UNIT-II [10]

Gustation: introduction and importance of gustation, Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands. Mechanism of taste perception Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami, Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold, Taste measurement- Electronic Tongue, Taste abnormalities

UNIT-III [10]

Olfaction: Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Theories of odour classification, chemical specificity of odour. Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc. Olfactory abnormalities

UNIT-IV [5]

Colour: Introduction and importance of colour, Dimensions of colour and attributes of colour; gloss etc. Perception of colour. Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, etc. Colour abnormalities

UNIT-V [10]

Texture: Introduction, definition and importance of texture, Phases of oral processing, Texture perception, receptors involved in texture perception, Rheology of foods Texture classification, Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation. Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products

Text Book

1. Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.

Reference:

2. Rao E. S. (2013). Food Quality Evaluation. Variety Books.
3. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.

FN 352 Nutritional Lab-III **0-0-4-2**

Exercises based on Courses FN 312,FN 322, FN 332 and FN 342

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT-I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT-II

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital [8]

UNIT-III

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports [8]

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference:

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

Mody University of Science & Technology

B.Sc. (Hons) Forensic Science
Session 2018-2019

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 151	Cell Biology	3	1	-	4	2	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	25	25	50
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	2	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	2	25	25	50
	FS 101	Introduction to Forensic Science and Criminology	2	1	-	3	3	25	25	50
	EL 101	Foundation Course in English	2	-		2	3	25	25	50
	FS 131	Criminal Law-IPC/CrPC/IEA	2	1	-	3	3	25	25	50
	FS 141	Trace Evidence Analysis	3	-	-	3	3	25	25	50
	FS 151	Trace Evidence Analysis in Lab	-	-	2	1	3	25	25	50
			16	**3**	**7**	**22.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 152	Genetics	3	1	-	4	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	3	25	25	50
	FS 102	Concepts of Physics in FS	2	-	-	2	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
	FS 132	Crime Scene Investigation	2	1	-	3	3	25	25	50
	FS 142	Crime Scene Investigation Practical	-	-	4	2	3	25	25	50
		Sub Total	**15**	**2**	**7**	**20.5**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	3	25	25	50
		Foreign Language-I	3		-	3	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	3	25	25	50
	FS 231	DNA Profiling	2	1	-	3	3	25	25	50
	FS 241	DNA Profiling Lab	-	-	2	1	3	25	25	50
	FS 251	Forensic Anthropology and Personal Identification	2	1	-	3	3	25	25	50
	FS 261	Forensic Anthropology Practical	-	-	2	1	3	25	25	50
		Sub Total	**16**	**3**	**9**	**23.5**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 232	Forensic Toxicology	3	1	-	4	3	25	25	25
	FS 242	Forensic Toxicology Practical	-	-	2	1	3	25	25	25
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	3	25	25	50
		Foreign Language-II	3	-	-	3	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	25
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	3	25	25	50
	FS 252	Fingerprint Science	2	1	-	3	3	25	25	50
	FS 262	Fingerprint Science Practical	-	-	2	1	3	25	25	50
		Sub Total	**16**	**2**	**9**	**22.5**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 371	Forensic Serology and Blood Splatter Analysis	2	1	-	3	3	25	25	50
	FS 381	Serology Practical	-	-	2	1	3	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	3	25	25	50
	FS 391	Digital Forensics	2	1	-	3	3	25	25	50
	FS 313	Digital Forensics Practical	-	-	2	1	3	25	25	50
	FS 323	Programing in C++	2	1	-	3	3	25	25	50
	FS 333	Programing Lab in C++	-	-	4	2	3	25	25	50
	FS 343	Forensic Photography, Digital Imaging and Portrait Parley	3	1	-	4	3	25	25	50
	FS 353	Digital Imaging Lab	-	-	2	1	3	25	25	50
			12	**5**	**12**	**23**	-			
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 372	Instrumentation in Forensic Science	2	1	-	3	3	25	25	50
	FS 382	Instrumentation Practical	-	-	2	1	4	25	25	50
	FS 392	Wildlife Forensics	2	1	-	3	3	25	25	50
	FS 314	Multimedia Forensics	2	1	-	3	3	25	25	50
	FS 324	Questioned Document Examination	2	1	-	3	3	25	25	50
	FS 334	Questioned Document Examination Practical	-	-	2	1	3	25	25	50
	BT 352	Bioinformatics	2	1	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	FS 344	Forensic Ballistics and Toolmarks	2	1	-	3	3	25	25	50
	FS 370	SUMMER INTERNSHIP*				4		100		
		Sub Total	**12**	**6**	**6**	**25**	-			
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

Total = 137

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.#* Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

*Each student will be required to submit a report based on a week long attachment they would be provided after 2 years of their course at any Central/State Forensic Science Laboratory. Weightage would be 100 marks.

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)

FIRST SEMESTER

CELL BIOLOGY

BT 151 **3-1-0-4**

CELL BIOLOGY LAB

BT 161 **0-0-1-1**

PHYSICAL AND INORGANIC CHEMISTRY-1

CH 181 **2-0-0-2**

ORGANIC CHEMISTRY-I

CH 191 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-I

CH 171 **0-0-3-1.5**

INTRODUCTION TO FORENSIC SCIENCE AND CRIMINOLOGY

FS 101 **2-1-0-3**

Course Contents:

Unit I: Types of Crime and Criminal Behavior [9]

Definition: Crime, Criminal and Criminology; Criminology as Science, The field and scope of Criminology; Methods and Techniques in Criminology; Concept of a criminal and classification of criminals. Organized crime; White – collar crimes/ Occupational crimes; Murders; Sexual offences; Terrorism; Serial Crimes; Crime against women and children.

Unit II: Juvenile Delinquency and Punishment [10]

Definition, Types of Juvenile Delinquents ; Classification of Juvenile Delinquents; Factors in Juvenile Delinquency, Custody of juvenile delinquents; Juvenile courts procedure; behavior modification techniques; Preventive Programmes. Concept of punishment, kinds of punishments, Humanitarian approach to concept of punishment, capital punishment in India, Introduction to criminal Laws: IEA, IPC and CRPC

Unit III: Police Administration [10]

Role of police in regard to criminals; Police role in the society; Custodial crimes: Complaints against police personnel; Interrogation of suspects and offenders; interviewing the criminals; improving the Police force. Evidence Applicability in Court**;** Definition, Various types of evidences, the law of evidence, Expert's testimony and admissibility of scientific evidence in court of Law.

Unit IV: Introduction to FS and History [10]

Definition, description, principles, concept, needs and scope. History of Forensic Science and Forensic Science Labs; Progressive development and transformation of Forensic Science Labs. Forensic Science Laboratories: Main Authority, Organizational structure of Forensic Science Laboratory – roles and responsibilities, Sections/ Divisions, Services

Provided. Mobile forensic science laboratory – their distribution in India, functions, need and utility.

Text:

1. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

1. Ellis, L. and Walsh, Anthony, Criminology – A Global Perspectiven, Allyn and Bacon, Boston, 2000.
2. Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.
3. Abaadinsky, H., Organised Crime (2nd Edn.), Nelson – Hall, Chicago, 1998.
4. Adler, F., Mueller, G. O. W. and Laufer, W. S., Crminology, McGraw – Hill, Boston, 1991.
5. Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rd Edn.), Oxford University Press, Oxford, 2002.
6. Ahuja, R., Criminology, Rawat Publication, ND, 2000.
7. Bajpai, G. S., Development without Disorders. Vishwavidyala, Prakashan, Sagar (M. P.), 2002.
8. Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rd Edn.), Oxford University Press, Oxford, 2002.
9. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
10. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; an Introduction to Criminalitics, McGraw Hill, New York, 1983.
11. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
12. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
13. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida, 1999.

FOUNDATION COURSE IN ENGLISH

EL101 **2-0-0-2**

CRIMINAL LAW-IPC/CrPC/IEA

FS 131 **2-1-0-3**

Unit I: Indian Penal Code [13]
Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b) Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), Sections pertaining to poisons; General exceptions, Offences against person, Offences against property, Attempt to suicide, Sexual offences.

Unit II: Criminal Procedure Code [13]
Code of Criminal Procedure- Introduction, organization and powers of Criminal Law Courts in India, Police powers of arrest, search and seizure; Introduction and general idea of sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176.

Unit III: Indian Evidence Act [13]
Indian Evidence Act-Admissions, Confessions, Dying Declarations. Of Experts, Oral and Documentary Evidence; Introduction and general idea of sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159.

Text:

1. Criminology by Ram Ahuja

References:

1. Criminology and Penology by Prof Panjape N.V.
2. Introduction to forensic Science by Dr. B.S.Naber.
3. Synopsis of Forensic Medicine by Dr.K.S.Narayan Reddy.
4. Police and Polity in India by P.D.Sharma.
5. Karnataka Police Manual.
6. Criminal Major Acts Eastern Law Publications, Allahabad.

TRACE EVIDENCE ANALYSIS

FS 141 **2-1-0-3**

Course Contents:
Unit I: Introduction of Physical Evidences [9] Definition, Collecting, packaging, preservation and forwarding of evidences: biological fluids, chemicals, poisons, firearms, fingerprints and tool marks; Linking a Crime Scene with the suspect through field notes, witnesses and interrogation, Reconstruction of crime scene and associative/ corroborative evidences.
Unit II: Crime and Suspect [10] Search and seizure, privilege against self – incrimination, subpoenas deposition, Miranda rights, condemned of court, FIR, types of cognizable and non-cognizable offences; Expert's Testimony: the role of the expert as witness; Acceptance of evidence in the Court of Law; Mcnaughton Rule; child witness in the court, admissibility of scientific evidence; Expert Testimony: The role of the expert as witness; Acceptance of evidence in the Court of Law; Mcnaughton Rule; child witness in the court, admissibility of scientific evidence; Examination in the Court: Direct examination, cross – examination and re-examination of Prosecution lawyer and Defense lawyer and Court presentation, Law of evidence: testimonial and real evidence.
Unit III: Glass and Soil Examination [10] Glass: Composition, Comparing glass fragments, glass fractures. Examination of soil, Color, density, size distribution of soil particles, mineral analysis and chemical analysis of soil, collection of preservations of soil. Analysis Techniques-Physical, Chemical, instrumental
Unit IV: Forensic Paint Examination [5] Introduction, paint chemistry, forensic examination of household paints and automobile paints. Analysis Techniques-Physical, Chemical, instrumental
Unit V: Forensic Examination of Hair and Fiber [5] Examination of Hair; Importance, nature, location, collection, evaluation; Classification of fibers, preliminary examination, properties of fiber, microscopic and chemical examination of fibers. Analysis Techniques-Physical, Chemical, Instrumental

Text:

1. Saferstein, Richard, Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2. Sharma, B.R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd., New Delhi, 2001.

References:

1. Bodziak, W., Footwear Impression Evidence (2nd Ed.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
4. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
5. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida. 1999.
6. Heard, B. J., Handbook of Firearm and Ballistics, Wiley & Sons, Chichester, England, 1997.

7. James, S. H., and Nordby, J. J., (Edt), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

TRACE EVIDENCE ANALYSIS IN LAB

FS 151 **0-0-2-1**

1. Physical Analysis of Glass-Density
2. Physical Analysis of Glass-RI
3. Physical Analysis of Soil-Density
4. Analysis of Microscopic Glass Chip
5. Microscopic Examination of Hair
6. Microscopic Examination of Fiber
7. Fabric Count
8. Instrumental analysis of Paint Chip
9. Instrumental analysis of Paint Smear
10. Microscopic Examination of Paint Chip

SECOND SEMESTER

GENETICS

BT 152 **3-1-0-4**

PHYSICAL AND INORGANIC CHEMISTRY-II

CH182 **2-0-0-2**

ORGANIC CHEMISTRY

CH 192 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-II

CH 172 **0-0-3-1.5**

CONCEPTS OF PHYSICS IN FS

FS 102 **2-0-0-2**

Course Contents
Unit I: Motion & Force Definition of motion, position and displacement, average velocity, average speed, acceleration, acceleration of freely falling body, projectile motion, uniform circular motion, relative motion in one dimension and two dimension. Newtonian mechanics, Newton's Ist law, force, mass, Newton's II law, Newton's III law, friction, properties of friction, drag force and terminal speed.
Unit II: Kinetic Energy and Work Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, work done on system by external force, conservation of energy.
Unit III: Rotation The rotational variable, rotation with constant angular acceleration, relating linear and angular variables, kinetic energy of rotation.
Unit IV: Gravitation and Waves Newton's law of gravitation, gravitation near earth's surface, gravitation inside the earth. Types of waves, transverse and longitudinal waves, wavelength and frequency, speed of traveling wave, the wave equation, sound waves, speed of sound, intensity and sound level, the Doppler effect, shock waves.

Text:

1. Herbert Goldstein: Classical Mechanics, 2nd ed, 1980

References:

1. Amato, Joseph (December 1996). "The introductory calculus-based physics textbook". Physics Today 49 (12): 46–51.
2. Thomas Brody (1993.) "The Philosophy Behind Physics"pp 18–24 (Chapter 2)
3. Glimm, James; Jaffe, Arthur (1987), 'Quantum physics: a functionalintegral point of view'(2nd ed.), New York, [NY.]: Springer.

ENVIRONMENTAL STUDIES

MDC 003 **3-1-0-4**

CRIME SCENE INVESTIGATION

FS 132 **2-1-0-3**

Course Contents:
Unit I: Crime Scene [9] Defining a crime scene, Importance, problem, location and processing of Crime Scene and Crime scene Management.
Unit II: Types of Crime Scenes [8] Mobile, Indoor and outdoor crime scenes; various searching techniques used for locating physical evidences at scene of crime.
Unit III: Recording the Scene of Crime [5] Barricading of crime scene; Crime Scene Photography; Sketching; Notes making; Handling clues and evidences.
Unit IV: Crime scene reconstruction [5] Procedure and requirement for Crime Scene Reconstruction; Guidance from field notes; Modus operandii, role of Investigating Officer.
Unit V: Physical Evidences [12] Definition, types of physical evidences, Collection, packaging, preservation and forwarding of physical evidences, Chain of custody.

Text:

1. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

References:

1. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press,

CRIME SCENE INVESTIGATION PRACTICAL

FS 142 **0-0-4-2**

1. Crime Scene Processing
2. Crime Scene Searching
3. Indoor Crime Scene-Baseline Method
4. Outdoor Crime Scene-Baseline Method
5. Indoor Crime Scene-Triangulation Method
6. Outdoor Crime Scene-Triangulation Method
7. Outdoor Crime Scene- Polar Coordinate Method
8. Packing and Packaging of Evidence

THIRD SEMESTER

BIO-INSTRUMENTATION

BC 211 **3-1-0-4**

INSTRUMENTATION LABORATORY

BC 221 **0-0-2-1**

FOREIGN LANGUAGE-I

ORGANIC CHEMISTRY-III

CH 223 **2-0-0-2**

PHYSICAL CHEMISTRY-I

CH 291 **2-0-0-2**

INORGANIC CHEMISTRY-I

CH 213 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-III

CH 281 **0-0-3-1.5**

DNA PROFILING

FS 231 **2-1-0-3**

Course Contents:
Unit I: Introduction to DNA Fingerprinting [6] Definition, Importance of DNA Fingerprinting in Forensic Science., Structure of DNA, RNA, Chromosome, Nuclear DNA and Mitochondria DNA
Unit II: DNA Isolation Techniques [5] Collection and types of evidences for DNA fingerprinting, Different types of DNA Isolation techniques (Organic, Inorganic and Mechanical), FTA cards for isolation of DNA. DNA isolation from different evidences.
Unit III: Techniques for DNA Fingerprinting [10] Electrophoresis and Southern blotting, Polymerase Chain Reaction (Denaturation, annealing and extension, Detection of PCR products).
Unit IV: Types of DNA Fingerprinting Techniques [10] Mini satellites and Micro-satellites., VNTR and RFLP, STRs and Genotyping.
Unit V: Practical application of DNA Fingerprinting [8] Paternity testing and Personal identification. DNA databank, Limitations of DNA Fingerprinting; Legality of DNA Fingerprinting in India.

Text:

1. Sharma, B. R. (3rd Edition) Forensic Science in Criminal Investigation and Trials, Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

2. Norah Rudin and Keith Inman (2nd Edition) An Introduction to Forensic DNA Analysis, CRC Press, New York, 2002.

3. John M. Butler (1st Edition) Fundamentals of Forensic DNA Typing, Academic Press, 2005.

DNA PROFILING LAB

FS 241 **0-0-1-2**

1. Isolation of Plasmid and Genomic DNA
2. Restriction Digestion
3. DNA Fragment Size Détermination
4. PCR Demonstration and Principal
5. DNA Estimation through Spectroscopy
6. Isolation of Microbes through Soil, Air and Water Samples
7. Study of Bacterial Slides

FORENSIC ANTHROPOLOGY and PERSONAL IDENTIFICATION

FS 251 **2-1-0-3**

Unit I: Anthropology and Personal Identification [9] Definition, scope and application of Forensic Anthropology; and related sciences. Human and animal remains; Reconstruction Process: Superimposition, Facial reconstruction and its importance; Importance and need for personal identification, cases that will require personal identification. Documents proof, scars, professional marks, personal articles, Finger printings, dentures, sketches and photographs
Unit II: Victim Identification [10] Assessing and determining the time and cause of Death, Study of burned bones and bone fragments; Attribution of Sex, Estimation of Age and reconstruction of stature from long bones and their medico legal implication. Establishment of Partial and Complete identity of skeletal material and dead bodies; Craniometry: Identification of human skull, determining the age ,race and sex of the skull and its measurement;
Unit III: Odontology and Bite Marks [10] Odontology: Introduction to human dentition, structure of teeth, types and functions of different teeth, age and sex determination, identification in mass disasters; Bite Marks: Types of bite marks; collection and preservation of DNA samples, forensic importance of bite marks; identification - Case studies
Unit IV: Autopsy [10] Ante and Post – mortem examinations; external examination; internal examination; collection, preservation and packaging of viscera.

Text

1. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001
2. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References

1. Modi, A Text Book of Medical Jurisprudence & Toxicology.
2. Parikh, A Text Book of Medical Jurisprudence & Toxicology.
3. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
4. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
5. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

FORENSIC ANTHROPOLOGY PRACTICALS

FS 261 **0-0-2-1**

1. Estimation of height, weight using long bones
2. Determination of age, sex, using skull, pelvic bones, long bones, etc.

FOURTH SEMESTER

FORENSIC TOXICOLOGY

FS 232 **3-1-0-4**

Unit I: Toxicology and Drugs of Abuse [9] Definition, dosage, administration of poisons, Classification of poisons on analytical basis and medical basis; Sedatives, Narcotics, Stimulants and Hallucinogens, Drug Addiction and its signs and symptoms, Drugs and Crime; The role of drug recognition expert, Interpreting drug findings
Unit II: Toxicology of Alcohol [9] The fate of ethyl alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, analysis of blood for alcohol
Unit III: Metallic Poisons, Barbiturates and Corrosive Poisons [5] Arsenic, Mercury. Nature, administration, symptoms, postmortem findings, Detection and medicolegal aspects; Barbiturates: Classification, administration, symptoms, postmortem findings, detection and medico-legal aspects; Corrosives: HCl, H_2SO_4, HNO_3 Corrosive poisons-2: Alkalis; NaOH, KOH
Unit IV: Insecticides, Volatile Poisons [8] Organophosphorous compounds, Organochloro Compounds and Carbamates- Nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal findings; Volatile Poisons: Methyl alcohol, Chloroform. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings
Unit V: Miscellaneous Poisons [8] Animal poisons: Snake, Vegetable Poisons: Opium, Cannabis Dhatura, Oleander, Abrus precatrious, etc. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings.

Text:

1. Saferstein, Richard, Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

References:

1. Benjamin, D. M., Forensic Pharmacology. In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentic-Hall, Englewood Cliffs, New Jersey, 1993.
2. Caplan, Y. H., The Determination of Alcohol in Blood and Breath, In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, New Jersey, 1982.
3. James, S. H. and Nordby, J. J. (Eds)., Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. Karch, S. B., The Pathology of Drug Abuse. (2nd Edn.) CRC Press, Boca Raton, Florida, 1996.
5. Reject Paul. M.P, Forensic Toxicology, SSBT,New Delhi,2009

FORENSIC TOXICOLOGY PRACTICAL

FS 242 **0-0-2-1**

1. Analysis of metallic poison
2. Analysis of volatile and non-volatile poisons.
3. TLC of insecticides, Barbiturates and other drugs
4. Analysis of vegetable poisons
5. TLC of different kinds of inks
6. Lab Tests for Hallucinogens

PLANT AND ANIMAL BIOTECHNOLOGY

BT 242 **2-0-0-2**

TISSUE CULTURE LABORATORY

BT 252 **0-0-2-1**

FOREIGN LANGUAGE-II

ORGANIC CHEMISTRY-IV

CH 292 **2-0-0-2**

INORGANIC CHEMISTRY-II

CH 282 **2-0-0-2**

PHYSICAL CHEMISTRY-II

CH 272 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-IV

CH 262 **0-0-3-1.5**

FINGERPRINT SCIENCE

FS 252 **2-1-0-3**

Course Contents:
Unit I: History and Introduction [5] Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation.
Unit II: Class and Individual Characteristics [10] Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints.
Unit III: Classification of Fingerprints [10] Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC
Unit IV: Fingerprint Developmental techniques [7] Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.
Unit V: AFIS & Biometrics [7] AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications

Text:

1. Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.

References:

1. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
2. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
3. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
4. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
5. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

FINGERPRINT SCIENCE PRACTICALS

FS 262 **0-0-2-1**

1. Contact Prints
2. Rolled Prints
3. Analysis of Class and Individual Characteristics
4. Ridge Counting
5. Ridge Tracing
6. Identification based on Chance Prints
7. Fingerprint Lifting
8. Fingerprint Development: Iodine, Ninhydrin

FIFTH SEMESTER

FORENSIC SEROLOGY and BLOOD SPLATTER ANALYSIS

FS 371 **2-1-0-3**

Course Contents
Unit 1:Blood and its Properties [8] The nature of blood, collection, preservation and packing of blood evidence, procedures and precautions; Tests used in Blood Analysis: Identification of bloodstains by microscopic methods, Catalytic tests, crystal tests, Spectrophotometric method, chromatographic and immunological methods. Electrophoresis methods; Introduction to Body Fluids: Introduction to various body fluids, their nature and characteristics; Forensic analysis of Body Fluids: Forensic analysis of Semen, Saliva, Urine, Sweat etc.
Unit 2: Species of Origin& Grouping of Bloodstains [8] Determination of species of origin, Ring test, Immunoelectrophoresis, single diffusion, double diffusion, Crossed-Over electrophoresis, ABO system, Rh system and MN system; Techniques for the determination of blood groups.
Unit IV: Introduction to Bloodstain Pattern Analysis [10] Basic tenets of bloodstain pattern analysis, The purpose and function, history, application of basic scientific method, biohazards associated with bloodstain patterns, Characteristics of liquid blood and blood droplets under force, the effects of surface tension on individual droplets and pools of blood, the effects of terminal velocity on free falling droplets, characteristics of blood droplets on impact, effect of the volume, effect of target surface characteristics, limitations of determining distance fallen for individual droplets, relationship of angle of impact to stain shape.
Unit V: Recognition and Creation of Basic Stain Patterns [13] Passive Stains: a. Drip Patterns, Flow Patterns: Pools, saturation stains; Projected and Impact Spatter stains: Impact Patterns, splashes, cast-off patterns, arterial spurt and gush patterns, expired bloodstain patterns, transfer stains, wipe patterns, swipe patterns, transfer/contact patterns, void patterns, fly spot patterns, bubble rings, perimeter/skeletonized bloodstains. Point (Area) of Origin Determinations. Determine the impact angle, Determine directionality, determine point (area) of convergence, "stringing" and/or mathematical methods for point (area) of origin determinations, limitations

Text

1. Saferstein, R. (1998).Criminalistics, An Introduction to Forensic Science, 6th Ed. 6th Ed. Prentice –Hall

References

1. Eckert, W.G., & James S.H., Interpretation of bloodstain evidence at crime scene, CRC Press, Florida, 1989.
2. James, S.H. and Nordby, J.J. (Eds.), Forensic Science - An introduction to Scientific and investigative Techniques, CRC Press, London, 2003.
3. Kirk, P.L., Introduction in crime investigation (2nd), John Willey and, New York, 1974

SEROLOGY PRACTICALS

FS 381 **0-0-2-1**

1. Presumptive and Confirmatory tests for blood
2. Examination and Identification body fluids
3. Blood Splatter Analysis: Drop Direction, Force applied, Angle of Attack
4. Gel Immuno Diffusion tests for species origin
5. Blood Grouping

IMMUNOLOGY

MB 232 **3-1-0-4**

IMMUNOLOGY LABORATORY

MB 321 **0-0-2-1**

DIGITAL FORENSICS

FS 391 **2-1-0-3**

Course Content:

Unit 1: Cyber Crimes [8]

Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.

Unit 2: Basics of Computers [8]

Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations

Unit 3: Computer Forensics [10]

Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.

Unit 4: Forensic Tools and Processing of Electronic Evidence [13]

Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images

Text:

1. Fred Cohen, Digital Forensic Evidence Examination, Copyright (c) Fred Cohen 2009-2013 5th Edition

References:

1. C. Altheide& H. Carvey Digital Forensics with Open Source Tools, Syngress, 2011. ISBN: 9781597495868.
2. Cert-In Guidelines
3. Online Course management System: https://esu.desire2learn.com/

DIGITAL FORENSIC PRACTICAL

FS 313 **0-0-2-1**

1. Open Source Forensic Tools-Linux and Windows
2. Disk Forensics and Data Recovery
3. Anti-forensic techniques: TrueCrypt, Shredder
4. Steganography
5. Key loggers
6. Network monitors
7. Flowchart management
8. Algorithm designs
9. Registry Forensics

PROGRAMMING IN C++

FS 323 **2-1-0-3**

Course Contents:

Unit I: Introduction [10]

Introduction, Advantage, C and C++, Exception Handling, Object Oriented Programming, Standard Template Library, Types and declarations, Types, Booleans, Integer Types, Floating-Point Types, Sizes, Void, Enumerations, Declarations

Unit II: Pointers, Arrays and Structures [10]

Pointers, Arrays, Pointers into Arrays, Constants, References, Pointers to void, Structures, Expressions and Statements, A Deck Calculator, Operator Summary, Statement Summary, Comments and Indentation

Unit III: Functions [10]

Function Declarations, Argument Passing, Value Return, Overloaded Function Names, Default Arguments, Pointer to Function, Macros, Namespaces and Exceptions, Namespaces, Exceptions Source Files and Programs, Separate Compilation, Linkage, Using Header Files, Programs

Unit IV: Classes [9]

Classes, Access Control, Constructors, Member functions, Static members, Destructors, Memory allocation, Member initialization, Operator overloading, Introduction, Operator Functions, A Complete Number Type, Conversion Operators, Friends, Large Objects, Essential Operators, Subscripting, Functions Calls, Dereferencing, Increment and Decrement, A String Class, Derived class, Introduction, Derived Classes, Abstract Classes, Design of Class, Hierarchies, Class Hierarchies and Abstract Classes

Text:

1. Sumita Arora, “Introduction to C++”

References:

1. “C++ programming language” 3 rd edition by Bjarne Stroustrup.

PROGRAMING LAB IN C++

FS 333 **0-0-4-2**

1. Types and Declaration
2. Pointers
3. Arrays
4. Structures
5. Expression
6. Statement
7. Function
8. Classes
9. Derived Classes

FORENSIC PHOTOGRAPHY, DIGITAL IMAGING AND PORTRAIT PARLEY

FS 343 **3-1-0-4**

Course Contents:

Unit 1: Photography [10]

Basic principles and techniques of photography, cameras and lenses, exposing, developments and printing, Different kinds of developers and fixtures, modern developments in photography, linkage of cameras and film negatives, digital photography, digital water marking and digital imaging, photogrammetry, videography/ high speed videogaphy, crime scene and laboratory photography

Unit II: Digital Image Processing [20]

Digital image fundamentals - Digital Image through scanner, digital camera. Concept of gray levels. Gray level to binary image conversion. Sampling and quantization. Relationship between pixels. Imaging Geometry; Image

Transform; Image enhancement Point processing. Histogram processing. Spatial filtering; Image Segmentation; Image Processing

Unit III: Portrait Parley [15]

Composite Imagery: Graphic images composed of individually described characteristics of the human face; Image Modification/Identification: Methods of manipulation, enhancement and comparison; Demonstrative Evidence: Visual information used for court purposes; Reconstructive/Postmortem Drawings: Methods of identifying human remains in various conditions of decomposition

Text

1. Gonzales & Woods "Digital Image Processing" (3rd Addition) 2011

References:

1. Henry Horeustein, Colour Photography A Working Manual; Little Brow Company, Boston; (1995)
2. B.H.E. Jacobson, Sidney Ray GG Attridge, The Manual of Photograph Focal Press, London; (1998)
3. Jahne B; Digital Image Processing; Heidelberg Springer (1996)
4. Workinson, J; Art of Digital Video; Oxford Focal Press (1994)

DIGITAL IMAGING LAB

FS 353 **0-0-2-1**

1. Digitizing Image
2. Scaling Image
3. Filtering an Image
4. Image Normalization
5. Image Enhancement
6. Portrait Parley: Free Tools

SIXTH SEMESTER

INSTRUMENTATION IN FORENSIC SCIENCE

FS 372 **2-1-0-3**

Unit I: Spectroscopy [9]
Principal; Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection; Fluorescence and phosphorescence spectrophotometry: Atomic absorption spectrometry; Atomic emission spectrometry; X-ray spectroscopy, X-ray diffraction; Infrared spectrophotometry: Dispersive and Fourier Transform spectrophotometry, sample handling, quantitative analysis and interpretation of IR spectra;

Unit II: Centrifugation Techniques [10]
Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges

Unit III: Microscopy [10]
Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infrared Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

Unit IV: Mass Spectrometry [10]
Sample flow, Ionization methods, Mass Analyzer, Vaccum Systems, Correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS),

Text:

1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).

References:

2. Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993)
3. Skoog, Holler, Crouch, principles of instrumental analysis, 6th edition, 2007.
4. Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.
5. N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.

INSTRUMENTATION PRACTICAL

FS 382 **0-0-2-1**

1. Experiments in Stoichiometry
2. Molarity of Solution
3. Molality of Solution
4. Beer-Lambert Law
5. Qualitative Analysis using UV-Visible Spectrometer
6. Quantitative Analysis using UV-Visible Spectrometer
7. Sample Preparation for IR Spectrometer
8. IR Spectrometer Demonstration

WILDLIFE FORENSICS

FS 392 **2-1-0-3**

Course Contents:

Unit I: Wildlife Forensics [10]
Definition, introduction, gravity of the crime, endangered wild flora and fauna, various types of the evidences encountered their location, collection and packing; Introduction to forensic medicine and microbiology.

Unit II: Forensic Entomology [9]
Forensic importance of various insects, importance of various insect growth stages, Entomological evidences, their location, collection and packing, Determination of time since death from entomological evidences.

Unit III: Forensic Botany [9]
Introduction to Forensic Botany, Plants as Evidence, Evidence Collection and analysis, Moss as evidence, forensic microscopy, Palynology, phytoforensics, algae in forensics investigations, DNA methods in plant identification, Plant physiology and growth in forensic botany (gravesite analysis, time of deposition, geomorphology, Forensic Wood Science, Forensic mycology - spores, fruiting bodies, botanical decomposition, site conditions, commercial concerns.

Unit IV Forensic Biology [11]
Introduction, importance of various biological evidences (hair, fiber, pollens, wood), collection and evaluation in general, bite marks, human skeletal remains, importance and examination.

Text:

1. Wildlife Law News Quarterly (2007-2014), Center for Wildlife Law, University of New Mexico School of Law Wolfe, M. L. 1995. An overview of legal systems for managing wildlife, in J. A. Bissonette and P. A. Krausman (eds.) Integrating people and wildlife for a sustainable future.

References:

2. Anderson, G. S. 1999. Wildlife forensic entomology: determining time of death in two illegally killed black bear cubs. Journal of Forensic Sciences, 44:856-860.
3. Bowen, G. J., L I. Wassenaar and K. A. Hobson. 2005. Global application of stable hydrogen and oxygen isotopes to wildlife forensics. Oecologia 143:337-348.
4. Buck, S. J.. 2006. Ch 6: Managing Wildlife and Public Lands in Understanding Environmental Administration and Law, 3rd edition. Island Press.
5. Freyfogle, E. T. and D. D. Goble. 2010. Wildlife Law: A Primer. Island Press.
6. Manel, S., P. Berthier and G. Luikart. 2002. Detecting Wildlife Poaching: Identifying the Origin of Individuals with Bayesian Assignment Tests and Multilocus Genotypes.Conservation Biology 16:650-659.
7. Rawley, Edwin V. and LeeAnn Rawley. 1967. A brief history of the Utah Fish and Game: http://wildlife.utah.gov/about/history.php Utah Division of Wildlife Resources various Guide Books and publications. 2016/2017: http://wildlife.utah.gov/hunting-in-utah/hunting-information.html

MULTIMEDIA FORENSICS

FS 314 **2-1-0-3**

Unit I: Multimedia [13]
Various modalities of device fingerprints, Extraction and representation of device fingerprints, Enhancement of device fingerprints, Source device identification based on device fingerprints, Content/device linking based on device fingerprints, Content integrity verification based on device fingerprints, Source-oriented image/video clustering based on device fingerprints, Digital content hashing, Data hiding, Digital watermarking for copyright protection, Digital watermarking for content authentication, Steganography, Steganalysis

Unit II –Speech Recognition [13]

Introduction-Regular Expressions and automata-Words and transducers-N-grams Part of speech tagging-Hidden Markov and Entropy models, Speech-Phonetics-Speech synthesis-Automatic speech recognition-Speech Recognition advanced topics-Computational Phonology

Unit III – Speech Parsing and Semantics of Speech Recognition [13]

Formal grammar of English-Syntactic parsing-Statistical parsing-Features and Unification-Language and complexity, Semantics and Pragmatics-The representation of meaning-Computational Semantics-Lexical semantics- Computational lexical semantics-Computational discourse

Text:

1. Daniel Jurafsky and James Martin "Speech and Language Processing", 2nd edition, Prentice- Hall, 2008.

References:

1. Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, "Spoken Language Processing", Prentice- Hall, May 2001.
2. Paul Taylor,"Text-to-Speech Synthesis", Cambridge University Press, February 2009.
3. Samir Nanavati, Michael Thieme, Raj Nanavati "Biometrics – Identity Verification in a Networked World", WILEY- Dream Tech Edition 2009.(UNIT 1,2,3,4,)
4. Paul Reid "Biometrics for Network Security", Pearson Education.2009. (UNIT – V)
5. John D. Woodward, Jr. Wiley Dreamtech Biometrics- The Ul
6. Perry J. Gait analysis. Normal and Pathological Fuction. SLACK Incorporeted, 1992

QUESTIONED DOCUMENT EXAMINATION

FS 324 **2-1-0-3**

Course Contents:
Unit I: Introduction to Questioned Documents [8] Document and Questioned documents, Various types, Characteristic features of genuine handwriting/ signatures, Forgery and its types, characteristic components of forged documents and its examination, Disguise writings, features of disguised writings and its examination. Procedure adopted for collection of standards for comparison of documents, admitted signature/writing, specimen signature/writings.
Unit II: Principle of Handwriting Identification [8] Introduction of Handwriting, Principle of handwriting identification, Handwriting characteristics: Class and individual characteristics, Natural variations in handwriting, causes of variations, Tampered Documents: addition, alteration, obliteration, secret writing. Examination of the documents for the ink, paper, photocopies/ xerox, printouts and scanned documents.
Unit III: Various Questioned Documents Cases [10] Disputed documents - wills, deeds, cheques, suicide letters, anonymous letters, threatening letters, stamps fraud, fake currencies, fake paintings and printing, fake rubber stamps and seals, Tampered documents, charred documents, Computer generated/ electronic documents/ typed and photocopied documents.
Unit IV: Signature Verification [7] Handwriting characteristics, natural variations, principles of identifications, features encountered in forged handwriting/ signatures, characteristic features of disguised handwriting/ features, external and internal factors affecting handwriting.
Unit V: Instrumentation in Questioned Documents [6] Camera, Compound microscope, Stereo microscope, magnifying glasses, illuminated torch, Video Spectral Comparator, Docu-centre, color filters, Osborn's scale, geometrical requirements, Projectina, ESDA, Transmitted light apparatus, Oblique light, UV and IR radiations, TLC and Paper Chromatography.

Text:

1. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.

References:

1. Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998.
2. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
3. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.
4. Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
5. Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.
6. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
7. Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
8. Kurtz, Sheila, Grapholypes a new plant on handwriting analysis, Crown Publishers Inc., USA, 1983.
9. Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
10. Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.

QUESTIONED DOCUMENT EXAMINATION IN LAB

FS 334 **0-0-2-1**

1. Studying Individual Characteristics
2. Hiatus Calculation
3. Handwriting Comparison
4. Author Identification
5. Signature Verification
6. Free Hand Forgery
7. Transmitted Light Forgery
8. Auto-Forgery
9. Ink Identification

BIOINFOMATICS

BT 352 **2-1-0-3**

BIOINFOMATICS LAB

BT 314 **0-0-2-1**

FORENSIC BALLISTICS AND TOOL MARKS

FS 344 **2-1-0-3**

Course Contents:
Unit I: Arms and Ammunition [7] Definition, Indian Arms Act, Forensic Importance; Nature of firearms, parts of a firearm, classification of firearm; Ammunition: Types, Bullet comparisons, cartridge case examination, class and individual characteristics of identification.
Unit II: Analysis and Reconstruction [8] Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, and primer residues; Reconstruction of the sequence of events in a shooting case. Presentation of evidence in the court. accidental firing
Unit III: Firearm injuries [7] Terminal Ballistics, Entrance wound, exit wound and internal wound, evaluation of firearm injuries.
Unit IV: Tool Marks [8] Definition, nature, types, significance, decipherment of tool marks and techniques; Examination of tool marks
Unit V: Tyre marks, Footprints, Shoeprints and other Impressions [9] Definition, nature, its types, skid marks, tread marks, significance and examination; Introduction to Footprints and Shoeprints: Definition, nature, its types, significance and Examination; Miscellaneous impressions: Lip print, Bite marks and their examination

Text:

1. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

1. James, S. H. And Nordby, J. J. (Ed), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
2. Modi, A Text Book of Medical Jurisprudence & Toxicology.
3. Saferstein, Richard, Criminalistics - An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
4. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.
5. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
6. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
7. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
8. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

SUMMER INTERNSHIP

FS 370 **Credits: 4**

Each student will be given a short term lab attachment during the summer vacation after completing two years of the course. They are supposed to submit a project report based on the lab visit they conduct. The same shall be evaluated out of a maximum marks of 100 and the student may be evaluated on Content, Presentation and Viva.

The presentation should preferably be performed in front of a panel.

Mody University of Science & Technology

B.Sc. (Hons) Physics
Session 2018-2019

Curriculum Structure

B. Sc. (Hons.) Physics

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)

No. of Seats: 20

Objectives:

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The programme offers core skills in physics as well as maths, which instills in the knowledge about the fundamental aspects of physics. With this course, Mody University aims to open many doors for their students by offering Courses in Atomic and Molecular Physics, Electronics, Applied Electronics, Nuclear Physics, Nano sciences, etc. The student will be able to select various options for higher studies like M.Sc. in Physics, Applied Physics, and Electronics. In addition, the programme provides good combinations to create interest of undergraduate students towards M. Tech. in Allied Sciences including Electronics, Astrophysics, Material Science, Laser Technology, Nuclear Science, Opto- electronics and Nanoscience. Further, they have scope for absorption in research Labs.

The first batch of this programme in MUST/ Mody University proposed to be admitted in the session 2015-16.

Input Qualification:

A pass in 10+2 examination of CBSE, or its equivalent from any Board, in Science stream with Physics and Mathematics as subjects and adequate proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of MUST/ Mody University shall be followed.

B. Sc.(Hons.) Physics

Three-Year Programme
Academic Curriculum (2015 – 16 onwards)

First Year

First Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total	**20/19**	**-**	**7/8**	**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

Second Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total	**15/17**	**-**	**11/ 12**	**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

Third Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total	**21/21**	**1/1**	**7/8**	**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

Fourth Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special Theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢	**16/15**	**2/2**	**7/8**	**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry****<u>Or</u>* ***Computer Science*** *may only be opted in first four semesters.*

B.Sc. (H) Physics
Batch 2016-17 and onwards
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 323	**Statistical Mechanics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 333	**Fiber Optics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 343	**Computational Physics**	**2**			**2**	3	25	25	50
	PH 321	**Physics Laboratory V**			**4**	**2**	4	25	25	50
	PH 353	**Computational Laboratory**			**4**	**2**	4	25	25	50
	PH 363	**Project (Minor)**				**2**				
		Total Credits				**20**				
	GE 301	Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	**Elements of Nuclear Physics**	**2**	**-**	**-**	**2**	3	25	25	50
	PH 334	**Microwaves**	**4**	**-**	**-**	**4**	3	25	25	50
	PH 372	Basics of Nanoscience and Exotic Materials	3	-	-	3	3	25	25	50
	PH 332	**Physics Laboratory VI**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 344	**Electronic Laboratory**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 354	**Project (Major)**				**4**				
		Sub Total	**14**	**-**	**8**	**20**				
	GE 302	Proficiency (Non-Credit) #				**1**				

Course Description

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata

McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)
2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields
2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics

3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions

using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable [13]

coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application)

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:

4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation [4]

(Basic Concepts only).

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic [6]

Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.

2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension [12]

Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis. [10]

Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces. [9]

Inner Product Space: Inner produt space, norm of a vector, Orthogality. [8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant [14]

coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems

and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as [8]

Traversal, Insertion, Deletion, Searching.

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, “Operating Systems”, New Delhi
2. Ritchie, “Operating System”, BPB Publication , New Delhi
3. Dhamdhere D. M. “System Programming and Operating System”, TMH New Delhi
4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi

3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of

corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint

2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in

crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.

3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population [5]

growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their

differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid

and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

Mody University of Science and Technology

BSc PCM
2018-19

Department of Science

B. Sc. (PCM/PMC)
Physics, Mathematics, Computer Science/ Chemistry
Three-Year Programme
Academic Curriculum (2012 – 13 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[$]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total				**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total				**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total				**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢				**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry*** *<u>Or</u>* ***Computer Science*** *may only be opted in each semester.*

Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 321	Physics Laboratory-V	-	-	4	2	4	25	25	50
		Mathematics								
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 221	Database Management System	3	-	-	3	3	25	25	50
	CA 261	Database Management System Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	4			
		Sub Total				**20.5/18**				
		Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	Elements of Nuclear Physics	2	-	-	2	3	25	25	50
	PH 332	Physics Laboratory VI	-	-	4	2	4	25	25	50
		Mathematics								
	MS 312	Special functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 222	Computer Networks	3	-	-	3	3	25	25	50
	CA 262	Windows Programming Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 392	Physical Chemistry-IV	2	-	-	2	*3*	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry–VI	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	4			
		Sub Total				**21.5/19**				
		Proficiency (Non-Credit) #				**1**				

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

$ *Evaluation of internship would comprise project report and viva-voce.*

Optional Courses

§ -***Chemistry courses***
¢ -**Computer Science**

Note: **1**.*The Programme includes two different combinations:*
(i) PCM (Physics, Chemistry and Maths) &
(ii) PMC (Physics, Maths and Computer Science)

2. *In addition to the compulsory courses, either all courses of* ***Chemistry Or Computer Science*** *may only be opted in each semester*

Overall Credits: Physics: 41; Mathematics:40; Chemistry: 41: Computer Science: 36 (+5)

Total Credits (With Chemistry as optional) 135
Total Credits (With Computer Science as optional) 130

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int E.dr$. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)
2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields
2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE [6]

modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response.

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional [12]

Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom.

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation [12]

of e.m. waves through Ionosphere.

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, [9]

Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law.

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, **S**. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its [6]

Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points. [8]

Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates. [8]

Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. [8]

Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes. [8]

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems. [7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, [13]

Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

MS 112 Abstract Algebra 3-0-0-3

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition.	[11]
Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group	[10]
Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem.	[10]
Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation.	[8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.

   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines.	[4]
First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form.	[14]
Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters	[12]
Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only)	[9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.

D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation [8]

formulae, Sterling, Bessel Formula.

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985

   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi

4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.

5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, “Information Systems for Modern Management”, PHI, New Delhi
2. Jawadkar, “Management Information System”, TMH, New Delhi

Reference Books:

1. Sadagopan, “Management Information System”PHI, New Delhi
2. Parker, Case, Thomas, “Management Information System: Strategies and Action”, TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between

critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D.

Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and **[8]**

chemical reactions of cycloalkenes.

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law

of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised

Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998,

Prentice Hall.

2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, [6]

Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India.

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge

Publications, UK.

CH 291	**Physical Chemistry-I**	**2-0-0-2**
	Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition.	**[7]**
	Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.	**[8]**
	Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects.	**[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213	**Inorganic Chemistry-I**	**2-0-0-2**
	Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[6]**
	Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[5]**
	Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.	**[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic .

substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept [8]

and embryonic induction. Embryo sexing and ageing.

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.

4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3-H_2O$) and ($CuSO_4-H_2O$) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-$HCl-H_2O$ and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass **[12]**

electrodes.

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides.

Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 **Laboratory Course in Chemistry-IV** **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

M.Sc. Biotechnology
Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2013 –14 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 511	Cytogenetics	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 531	General Microbiology	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 551	Microbiology and Cytogenetics Laboratory	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	1	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 512	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 522	Animal Biotechnology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3		-	3	3	25	25	50
	MB 532	Immunology	3		-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 552	Seminar	-	-	-	1	-	100		
	BT 514	Plant, Animal Biotechnology and Food Technology Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2013 – 14 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 621	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 641	Bioprocess Engineering	3	1	-	4	3	25	25	50
	BC611	Enzymology	3	-	-	3	3	25	25	50
	BT 661	Genetic Engineering and Environmental Biotechnology Laboratory	-	-	4	2	4	100		
	BT 613	Enzymology and Bioprocess Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**2**	**8**	**18**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				

Total Credits **83**

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Biotechnology)

BT 511 Cytogenetics 3-0-0-3

Cell Diversity: Cell as a basic unit of life, Cell theory, Cell size and shape. [2]

Cytology: Introduction to cell organelles (Structure and functions), Self-assembly and dynamic structure of cytoskeletal filaments and their cellular regulation, Molecular motors and cell behaviour, Microtubules motors and movement, Cell-cell interactions, Cell adhesion, Tight and gap junction, Plant cell adhesion and plasmodesmeta. [8]

Energy Metabolism: Chemotropic (mitochondria) and phototropic (chloroplast) energy metabolism of cell, Electron transport chain and proton pump, Evolution of electron transport chain. [5]

Membrane Biology: Structure, Chemistry and function of biological membrane, Transport across membrane- simple diffusion, facilitated diffusion, active transport, Energetics of transport, Signal transduction mechanism of cell-membrane potential, Action potential, Synaptic transmission, Messengers and receptors of signal transduction mechanism. [7]

Cellular Oncology: Cell cycle and its control, Molecular mechanism, Check points and cancer. [6]

Principles of Genetics: Introduction toMendelian and non-Mendelian genetics, Chromosomal theory of inheritance. Extra chromosomal inheritance. [4]

Linkage: Concept of linkage and crossing over, basic eukaryotic chromosome mapping, recombination of genes, two-point and three-point test cross, tetrad analysis, linkage maps, Interference. [4]

Mutation: Spontaneous and induced mutations, chromosomal aberrations, Cytological behavior and molecular basis. [4]

Population Genetics: The Sources of variation, Hardy Weinberg's Law, Genetic drift and change in gene frequency. [2]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean,median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean [6]

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, [9]

Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 531 General Microbiology 3-0-0-3

History and Scope of Microbiology: Spontaneous Generation vs. Biogenesis, Contributions of various scientists to the field of microbiology and development of microbiology as a scientific discipline. Avenues for microbiologists. [6]

Classification: Microorganisms and place of microbes in Whittakers' five kingdom classification, Eight kingdom classification, Phenetic and phylogenetic classification. Bergeys' manual for classification of bacteria, Structure and organization of Prokaryotic and Eukaryotic cells. Structure of bacterial cell wall-difference between Gram positive, Gram negative and archaebacteria, Cell membrane, Flagella, Pilli, Capsule, Endospore, Mesosome, Reserve food material. [10]

Microbial Growth: Bacterial growth curve, Factors affecting the microbial growth, One step growth curve of bacteriophages, Concepts of batch culture, Continuous culture, fed batch culture, synchronous growth and measurement of growth. [8]

Recombination in Bacteria and Viruses: Transformation, Conjugation and Transduction. [5]

Methods of Studying microorganisms: Microscopy- light microscopy (bright field, dark field, phase contrast, fluorescent) and electron microscopy (SEM & TEM), Pure culture techniques, Microbiological media (Liquid, solid, semi solid, defined, selective, maintenance, enrichment & differential), Sterilization, Disinfection, Aseptic techniques. [6]

General Properties of Microorganisms: Brief study of characteristics of viruses, algae, protozoa and fungi. Economic importance of microorganisms, Microbes as agents of diseases. [4]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates, [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, MichelisMenten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary electrophoresis. [6]

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 551 Microbiology and Cytogenetics Laboratory 0-0-4-2

Assignments based on BT 511 and MB 531 containing exercises on study of cell and its various structures and functions and general characteristics of microorganisms will be conducted.

BC 541 Biochemistry and Instrumentation Laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

BC 531 Biomolecules 3-0-0-3

Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [5]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates.Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway [8]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis,Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis. [7]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $–NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids.Classification of enzymes, MichelisMenten equation Km value, Linweaver-Burk equation. [8]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [6]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

BT 512 Plant Biotechnology 3-0-0-3

Plant Tissue Culture: Historical perspective, Tissue culture media, Totipotency, Organogenesis, Somatic embryogenesis- regulation and application, Artificial seed production, Micropropagation, Somaclonal variation, Androgenesis and its applications in genetics and plant breeding, Germplasm conservation and Cryopreservation. [5]

Protoplast Culture and Somatic Hybridization: Protoplast isolation, Culture and usage, Somatic hybridization-methods and applications, Cybrids and somatic cell genetics [6]

Agrobiology: *Agrobacterium*-plant interaction, Organization of virulence genes, Ti and Ri plasmids, Opines and their significance, T-DNA transfer mechanism, Disarming the Ti plasmid, *Agrobacterium* based vectors, Binary and shuttle vectors. [5]

Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co - integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Transgene stability and Gene silencing. [7]

Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance Plants as Biofactories. [8]

Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection. [8]

BT 522 Animal Biotechnology 3-0-0-3

Introduction: Brief account of animal tissue culture, Brief history and some established normal and transformed cell lines. [5]

Media formulations: Balanced salt solution, Semi-synthetic and synthetic media, Serum as a media supplement, Serum-free media, Feeder layers, Medium sterilization. [8]

Cell culture Methods: Disaggregation (mechanical, chemical and enzymatic), Primary culture, Secondary culture, Suspension and monolayer cultures, Immobilized cultures. [8]

Growth Characteristics of Animal Cells: Growth curve, Growth kinetics, Synchronization of cells, Differentiation of cells, Transformation, Bioreactors. [8]

Application of Animal Biotechnology: Tissue engineering, Production of monoclonal antibodies, Transgenic animals, Embryo culture and IVF, Gene therapy, Production of interferons and vaccines, Diagnostics. [10]

BT 592 Bioinformatics , Scientific Communication & Intellectual 3-1-0-4

Property Rights

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management.	6
Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions.	8
Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins.	8
Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index.	3
Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International)	7
Biotechnology and Intellectual Property Rights. Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy	7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 **Molecular Biology** **3-0-0-3**

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of

constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity**.** [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and

regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli*O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori* [10]
Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 552 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver

seminar on it.

BT 514 Plant, Animal Biotechnology and Food Technology Laboratory **0-0-4-2**

Assignments based on BT 514, BT 512 and BT 522 containing exercises on application of food microbiology and biotechnological techniques in animals and plants will be conducted.

BT 572 Molecular Biology and Immunology Laboratory **0-0-4-2**

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication **0-0-2-1**

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomycescereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

BT 621 Environmental Biotechnology 3-0-0-3

Agricultural Microbiology: Types of soils-physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere- general account, Microbial interactions- Study of positive and negative interactions among microbial populations, Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic (Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications, Biofertilizers, Biopesticides. [12]

Water Microbiology: Assessment of water quality- water purification, Potability standards, Major water borne diseases. [6]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles, Role of microbes in biodeterioration- Metal corrosion, Paper, Metal detoxification. [10]

Waste Treatment: Types of wastes-Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and Tertiary treatment), Trickling filter, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [10]

BT 641 Bioprocess Engineering 3-1-0-4

Microbial Growth and Product Kinetics: Microbial biomass, Enzymes and metabolites, Batch and Continuous culture, Feed back system, Comparison of batch and continuous culture, Fed batch system and its applications. [7]

Isolation, Preservation and Improvement of Industrially important Microorganisms: Enrichment culture technique, Storage at low temperature, Storage in Liquid nitrogen, Lyophlization, Strain improvement by mutation, Feed back inhibition and repression, Strain improvement by modifying the characteristics of inhibitor metabolite, Isolation of auxotrophic mutants, Resistant mutants, Revertant mutants, Use of Recombination methods and Improvement by modifying properties other than yield. [8]

Sterilization: Design of batch sterilization process, Calculation of Del factor, Holding time, Richard's rapid method for design of sterilization, scale up of batch sterilization process, Design of continuous sterilization process, Sterilization of air, Theory and design of depth filter. [5]

Mass Transfer in Microbial System: Fluid and its properties, Mass transfer co-efficient and its determination, Factor affecting mass transfer coefficient, Scale up and scale down. [7]

Downstream Processing: Introduction, Filtration, Product isolation and extraction– centrifugation, precipitation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, Drying, Crystallization and whole broth processing. [7]

Bioreactor and Control: Basic design of fermenter and control system: automatic and manual, off line and on line, Bioreactor– Packed bed, Fluidized bed, Tickle bed, CSTR, Plug flow reactor, Scale up of bioreactor. [5]

BC 611 Enzymology 3-0-0-3

Introduction: Units of activity, Specific activity of enzymes and methods of enzyme assay, Enzyme specificity, Uni substrate enzyme kinetics, Factors affecting the rate of enzyme catalyzed reaction, Derivation of Michelis-Menten equation, Significance of $V_{max}$and K_m, Enzyme inhibition- type of inhibition, Competitive non Competitive and uncompetitive kinetics. [5]

Enzyme Catalytic Efficiency: Factors associated with catalytic efficiency such as proximity, Orientation-distortion of strain, base nucleophilic catalysis with equation, Protein ligand binding co-operativity, Hill and Sat Chard plot protein sequencing. [6]

Immobilization: Immobilized enzymes and their industrial applications, Effect of partition on kinetics and performance with particular emphasis on change in pH and hydrophobicty. [6]

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

BT 661 Genetic Engineering and Environmental Biotechnology Laboratory 0-0-4-2

Assignments based on BT 611 and BT 621 containing exercises on genetic engineering and role of biotechnology in environment will be conducted.

BT 613 Enzymology and Bioprocess Laboratory 0-0-4-2

Assignments based on BC 611 and BT 641containing exercises on fermentation process and production of metabolites and role of enzymes in biotechnology will be conducted.

Mody University of Science & Technology

M.Sc. Forensic Science
Session 2018-2019

Curriculum Structure

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 501	Criminology, Criminal Law, Police Administration	2	1	-	3	3	25	25	50
	FS 511	Introduction to Forensic Science & Crime Scene Investigation (CSI)	2	-	-	2	3	25	25	50
	FS 521	Forensic Physics and Trace Evidences	2	1	-	3	3	25	25	50
	FS 531	Introduction to Digital Forensics	2	1	-	3	3	25	25	50
	FS 541	Forensic Ballistics	2	1	-	3	3	25	25	50
	FS 551	Statistics & Research Methodology	2	-	-	2	3	25	25	50
	FS 561	Forensic Practical I (CSI, Trace, DF, Ballistics)	-	-	8	4	4	25	25	50
		Foreign Language I	3	-	-	3	3	25	25	50
		Sub Total	**15**	**4**	**8**	**23**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 502	Elements of Forensic Medicine, Odontology	2	1	-	3	3	25	25	50
	FS 512	Instrumentation in Forensic Sciences (Chemical, Physical & Biological)	3	1	-	4	3	25	25	50
	FS 522	Introduction to Questioned Document Examination	2	-	-	2	3	25	25	50
	FS 532	Introduction to Forensic Chemistry, Toxicology & Pharmacology	2	-	-	2	3	25	25	50
	FS 542	Introduction to Forensic Biotechnology	2	-	-	2	3	25	25	50
	FS 552	Disaster Management and Victim Identification	2	1		3	3	25	25	50
	FS 562	Forensic Practical II (Instrumentation, Odontology)	-	-	6	3	3	25	25	50
		Foreign Language II	3	-	-	3	3	25	25	50
		Sub Total	**16**	**3**	**6**	**22**				

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 601	Fingerprinting and Forensic Photography	2	1		3	3	25	25	50
	FS 611	Applied Cognitive Psychology	2	1		3	3	25	25	50
	FS 621	Speech Analysis and Multimedia Forensics	2	1		3	3	25	25	50
	FS 631	Forensic Practical III (Fingerprinting, Photography, Multimedia Forensics)			6	3	4	25	25	50
	Elective A, or, **Specialization A: FORENSIC CHEMISTRY AND TOXICOLOGY**									
	FS 641	Advanced Forensic Chemistry	2			2	3	25	25	50
	FS 651	Advanced Forensic Pharmacology & Toxicology	2			2	3	25	25	50
	FS 661	Forensic Practical IV A(Chemistry, Pharmacology, Toxicology)			8	4	4	25	25	50
	Elective B, or, **Specialization B: FORENSIC BIOTECHNOLOGY and DNA PROFILING**									
	FS 671	Advanced Forensic Biology & Anthropology	2			2	3	25	25	50
	FS 681	Advanced Forensic Serology & DNA Profiling	2			2	3	25	25	50
	FS 691	Forensic Practical IV B(Forensic Biotechnology)			8	4	4	25	25	50
	Elective C **Specialization C: QUESTIONED DOCUMENT EXAMINATION**									
	FS 603	Advanced Questioned Documents Examination	2			2	3	25	25	50
	FS 613	Digital Image Processing	2			2	3	25	25	50
	FS 623	Forensic Practical IV C(QD and DIP)			8	4	4	25	25	50
		Sub Total	**10**	**3**	**14**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours
			L	T	P		
Spring Semester	FS 620	DISSERTATION				20	
		Sub Total				**20**	

‡ *Refer to the Foreign Languages Section*

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)

FIRST SEMESTER

CRIMINOLOGY, CRIMINAL LAW & POLICE ADMINISTERATION

FS 501 **2-1-0-3**

Course Contents:
Unit I: Introduction to Criminology [7] Criminology: Definition, Nature and Scope. Criminal Action and Criminal Behavior, Introduction of Victimology, Causes of crime: Social, Economic, Psychological, Political, Culture, and Geographical and their prevention, Juvenile Delinquency, Role of the Correctional Institutions.
Unit II: Theories of Criminology [8] Theory of Criminology: Theory of Criminology - Differential Association Theory, Self Concept and Containment theory, Labeling theory, Barrier Theory
Unit III: Type of Offences and Indian Courts structure [10] Criminal Offences, Nature and types, Framing of Charges, Terrorism, SexualOffences, White collar crime, Courts: Structure and types- criminal courts, Juvenile Courts.
Unit IV: Criminal Law [7] Criminal Law: Definition, Scope and development, Sections of I.P.C, Cr.PC related to Crime, Law of Evidences and Criminal Justice System in India: structural and functional process; Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b) Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), CrPC Sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176; IEA Sections: sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159.
Unit V: Police Administration system [7] Police duties and responsibilities, Structure of Police in India, role of Police in society, Police Investigation, Interrogation and Interviewing of criminals, maintenance of Law and order, Custodial crimes and death, Police and human rights.

Text:

1. Rama Ahuja: Social Problems in India

References:

1. Ahmad Siddique: Criminology Problems & perspectives.
2. Batuk Lal: Law of Evidence
3. Rao, S. Venugopal: Police Administration.

4. Nath, Trilok: Indian Police.
5. Mishra. S.C. : Police Administration in India
6. Government of India, Ministry of Home Affairs: Reports of National Police Commission
7. Sutherland and Cassey: Criminology

INTRODUCTION TO FORENSIC SCIENCE and CRIME SCENE INVESTIGATION

FS 511 **2-0-0-2**

Course Contents:
Unit I: Crime Scene Management [9] Definition and causation of crime, Types of crime scene, Crime scene survey, protection of crime scene, searching of physical evidences, Recording, documentation and presentation in the court, processing and reconstruction of the crime scene.
Unit II: Introduction to Forensic Science and Quality Management (ISO/IEC 17025)] [8] Introduction and History of Forensic Science, Basic principles and significance, Utilization of Forensic Science, Forensic Scientist at the scene of crime, Structure of Forensic Labs, General requirements for the competence of testing and calibration laboratories - Introduction, Scope, Management requirements: Organization, Quality System, Document Control, Service to the clients, Complaints, Corrective and preventive actions, Control of records, Internal Audits etc.
Unit III: Investigation and Interrogation [4] Law related to interrogation, interviewing of the criminals; methods used by the police in getting information from the criminal; the ethical issues related to the same; Examination in the Court, Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; Direct examination, re-examination and cross – examination of prosecution lawyer and defense lawyer.
Unit IV: Divisions and Scope of Forensic Investigations [3] Mobile Lab, CSI and its relevance, Toxicology, Forensic Chemistry, Arson, Explosives, NDPS, Scope, Serology, Forensic Biotechnology, Scope, DNA Profiling, Questioned Documents, Digital Forensics, Forensic Ballistics, Forensic Physics

Text:

- James, S.H., and Nordby, J.J., (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003

References:

8. Nabar, B. S., Forensic Sciene in Crime Investigation, Asian Law House, 2001.
9. Allison, R. , Investigation of Crime Scene, Global vision Publishing House, 2008.
10. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
11. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science - An Introduction to Criminalistics, McGraw Hill, New York, 1983.

12. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

FORENSIC PHYSICS and TRACE EVIDENCES

FS 521 **2-1-0-3**

Course Contents
Unit I:SOIL [7] Physical Evidence and Role of Probability**;** Formation and types of soil, composition of soil, particle size distribution, microscopic examination, density gradient analysis, interpretation of soil evidence, Discussion on important case studies related to soil evidence.
Unit II: GLASS [8] Types of glass and their composition, Forensic examination of glass fractures, determination of direction of impact: cone fracture, rib marks, hackle marks, colour and fluorescence, physical matching, refractive index, and interpretation of glass evidence.
Unit III: PAINT [7] Types of paint and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis, solubility test, pyrolysis chromatographic techniques, IR spectroscopy and X-ray diffraction, interpretation of paint evidence.
Unit IV: TOOL MARKS & RESTORATION OF ERASED / OBLITERATED MARKS [7] Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks . Method of making-cast, punch, engrave; methods of obliteration, method of restoration.
Unit V: SPEAKER IDENTIFICATION AND TAPE AUTHENTICATION [10] Vocal anatomy, Speech signal processing and pattern recognition – basic factors of sound in speech, acoustic characteristics of speech signal, Fourier analysis, analysis of audio-video signal for authenticity, Introduction to the techniques of pattern recognition and comparison.

Text

1. R. Saferstein, Forensic Science Handbook, Vols. I, II, (Ed), Prentice Hall, Eaglewood Cliffs, NJ; 1988.

References

1. B. Caddy, Forensic Examination of glass and paints analysis and interpretation, ISBN 078405749 2001.
2. Bengold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons, USA, 1999.

3. Bengold and Nelson Morgan,, Speech and Audio signal processing, John Wiley and sons, USA, 1999.
4. C.E. O 'Hara and J.W. Osterburg, An Introduction to Criminalistic, Indiana University Press, Blomington, 1972.
5. Denis Shaw, Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
6. F.W. Sears, M.W Zemansky, and H.D. Young, University Physics, Sixth Ed., Narosa, 1995.
7. Jenkins and White, Fundamentals of Optics, Mc Graw Hill, Fourth Ed, 1976.
8. Nickolls, L.C., Scientific Investigation of Crime, Bulterwest, London, 1956.

INTRODUCTION TO DIGITAL FORENSICS

FS 531 **2-1-0-3**

Course Content:

Unit 1: Cyber Crime in India [7]
Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.

Unit 2: Basics of Computers [8]
Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations

Unit 3: Incident Response Management [7]
Introduction to Incident Response Process, Preparing for Incident Response, detection of an Incident, IRM life cycle-preparation, Identification, Detection, Containment, Eradication, Recovery, lessons learnt, Investigations of Cyber Crime cases as per IRM cycles, opinion formatting for cyber-crime cases, court testimonies, case studies.

Unit 4: File Forensics [8]
Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.

Unit 5: Forensic Tools and Processing of Electronic Evidence [9]
Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images

Text:

13. Bernad Jahne: Digital Image processing, Springer Verlag (1993)

References:

1. James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
2. Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.
3. Tessarolo, A.A. and Marignani, A., Forensic Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.

FORENSIC BALLISTICS

FS 541 **2-1-0-3**

Course Contents:
Unit I: Introduction to Ballistics [10] Firearms, Indian Arms Act, Characteristic features of the firearms, various types of modern firearms, classification of firearms on different basis, bore characteristics.
Unit II: Ammunition (Cartridges and Bullets) [8] Definition, Classification and constructional features of different types of ammunitions (cartridges), types of primers and priming composition, propellants and their compositions, Various types of bullets and their compositional aspects, latest trends in their manufacturing and design, smooth bore and improvised ammunition.
Unit III: Arms and Ammunition Linkage (Cartridge Case and fired bullets) [7] Principles and practice of identification of firearms, different types of marks produced (class and individual characteristics) during firing process on cartridge case -firing pin marks, breech face marks, chamber marks, extractor and ejector marks, Different types of marks produced during firing process on bullet-number/direction of lands and grooves, width of lands and depth of grooves, angle and pitch of rifling, striation marks on lands and grooves, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics
Unit IV: Determination of Range of Firing [8] Ejecta, burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different methods employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system
Unit V: Explosives &Explosion Scene Investigation [6] Explosive Act, nature and classification, composition and characteristics of explosives, pyrotechnics, IEDs, Explosion process and affects, types of hazard, effect of blast wave on structures, human etc.Specific approach to scene of explosion, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residues in the laboratory

Text:

1. Gary J. Ordog, Management of Gunshot Wounds; Elsevier, New York, 1983.

References:

1. Brain J. Heard; Hand book of Firearms and Ballistics; John Willey, England, 1997.
2. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence; Stackpole Books, Harrisburg, PA, 1977.
3. D.A. Skoog, D.M. West and F.J. Holler; Analytical Chemistry: An Introduction; Saunders College Publishing, Philadephia, USA, (1994)
4. Dettean, J D; Kirk's Fire Investigation, 5th Ed, Prentice Hall, Eaglewood Cliffs, N.J (2002)
5. Working Procedure Manual: Chemistry, Explosives and Narcotics, BPR&D Pub (2000)

STATISTICS & RESEARCH METHODOLOGY

FS 551 **2-0-0-2**

Course Contents:
Unit I: Introduction to Research [7] Research– its definition and objectives, Types of Research, Research process, defining the research problem, research design.
Unit II: Sampling [8] Principles, methods: census and sample survey, sample design. Types of sampling, rationale for using a particular sampling procedure.
Unit III: Tools of Data Collection [7] Observation, interview schedule, questionnaire, Survey. case study methods
Unit IV: Statistics [8] Introduction, Descriptive Statistics: Frequency distribution, class intervals, graphical presentation: bar diagram, histogram, pie chart; Measures of Central Tendency: mean, median, mode; measures of dispersion: variance and std. deviation.
Unit V: Parametric and Nonparametric Statistics [9] Methods of correlation, skewness and Kurtosis variance, Types of correlation (Pearson r& Rho); Tests of significance. Level of significance, one sample, two samples and k-samples, Kruskall-Wallis ANOVA.

Text:

1. Creswell, John W. (2013). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. London: Sage

References:

2. Flick, Uwe (2009). An introduction to qualitative research. London:Sage.
3. Goertz, Gary & James Mahoney (2012). A tale of two cultures: qualitative and quantitative research in the social sciences.N.J. :Princeton University Press.
4. Hart, Chris (1998). Doing a literature review: releasing the social science research imagination. London: Sage.
5. Healey, J. F. (1993). Statistics: A Tool for Social Research.Belmont, CA: Wadsworth Publishing Company.
6. Scott, John (2000). Social Network Analysis: A handbook, London: Sage.
7. Yin, Robert (2009). Case study research: design and methods. London: Sage.

FORENSIC PRACTICAL-I

FS 561 **0-0-4-4**

14. Examination of physical properties of Soil.
15. Examination of physical properties of Glass.
16. Examination of physical properties of paints.

17. Physical examination of threads.
18. Comparison of different cloth pieces from crime scene.
19. Identification of fibers through chemical and instrumental analysis.
20. Sketching of the Indoor Crime scene (Indoor and Outdoor)
21. Sketching of the Indoor Crime scene
22. Photography of the Indoor crime scene
23. Photography of the Indoor crime scene
24. Collection, packaging and forwarding of trace evidences by Druggist Fold method.
25. Collection and preservation of various physical evidences (Fingerprint, blood, saliva, fiber, hair etc.).

SECOND SEMESTER

ELEMENTS OF FORENSIC MEDICINE, ODONTOLOGY

FS 502 **2-1-0-3**

Course Contents
Unit I: Introduction to Forensic Medicine [7] Definition of forensic medicine, Cause, manner and characteristics of death. Autopsy, Post mortem changes.
Unit II: Wounds and its medico legal significance [8] Basic injury production and healing mechanisms, Mechanical injuries (Abrasions, Bruises, Lacerations, Incised and stab wounds) and their medico legal significance.
Unit III: Causes and Manner of death [7] Deaths due to Asphyxia, Deaths due to fire, electrocution. Various Sexual offences including amendment in IPC
Unit IV: Forensic Odontology – I [8] Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification.
Unit V: Forensic Odontology – II [9] Bite marks: Types & forensic importance .Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law. Role of Forensic Odontology in mass disaster victim identification.

Text:

1. Modi's Medical Jurisprudence and Toxicology,23rd Edition, by K. Mathiharan & Amrit K. Patnaik, Third reprint, 2009, LexisNexis, Butterworth, New Delhi

References:

2. Essentials of forensic medicine, Dr. K. S. Narayan Reddy.
3. Forensic Medicine and toxicology, JB Mukherjee, Vol I & II.
4. Forensic Dentistry, Paul. G. Stimson & Curtis. A. Mertz, CRC
5. Forensic Odontology, Pramod .K. Dayal
6. Keith Simpson's , Forensic Medicine
7. Gleister's Medical Jurispridence and Toxicology, Churchill Livingstone Dental Anatomy Atlas, Whitaker

INSTRUMENTATION IN FORENSIC SCIENCE
(CHEMICAL, PHYSICAL and BIOLOGICAL)

FS 512 **3-1-0-4**

Course Contents:

Unit I: Chromatographic Techniques [10]

General principles, Paper chromatography, column chromatography, TLC, Adsorption chromatography, Partition chromatography, Gas chromatography, Gas- liquid chromatography, Ion-exchange chromatography, Exclusion (permeation) chromatography, Affinity chromatography, HPLC, HPTLC, Capillary Chromatography, Interfacing GC with IR spectrometry; High performance liquid chromatography, Electrospray ionization mass spectrometry Computer aided Analysis -Introduction, Computer organization - Hardware, Circuits for interfacing computers to Instruments, Computer Organization - software, Data representation, The Automated Laboratory.

Unit II: Spectroscopy [15]

Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection; Fluorescence and phosphorescence spectrophotometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods;
Atomic absorption spectrometry: Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis; Atomic emission spectrometry: Instrumentation and techniques, arc/spark emission, ICP-AES, comparison of ICP vs AAS methods, quantitative analysis, applications;
X-ray spectroscopy: X-ray absorption and fluorescence methods, X-ray diffraction, Auger emission spectroscopy (AES), electron spectroscopy for chemical analysis (ESCA);
Infrared spectrophotometry: Dispersive and Fourier Transform spectrophotometry, sample handling, quantitative analysis and interpretation of IR spectra;
Raman spectroscopy: Instrumentation, sample handling and illumination, structural analysis, polarization measurements and Dispersive & FT analysis; Radiochemical techniques: Basic principles and theory, introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis (NAA)

Unit III: Microscopy and Centrifugation Techniques [15]

Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges
Microscopy: Basic principles, Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infra red Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

Unit II: Mass Spectrometry [8]

Sample flow, Ionization methods, Mass Analyzer, Vaccum Systems, Data handling, Correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS), Ion Microprobe Mass Analyzer (IMMA), HR GCMS, LCMS, Secondary Mass Spectrometry, Laser Mass spectrometry, Fast Atom bombardment and liquid secondary Ion Mass spectrometry

Text:

26. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).

References:

1. Lindsay S; High Performance Liquid Chromatography, Wiley & Sons NY (1992)
2. Handbook of TLC, 2nd Ed, Marcel Dekker; NY (1995)

3. Jarris, KE, A.L. Gray etal, Handbook of Inductively Coupled Plasma Mass Spectrometry, Glasgow Blockie, (1992)
4. Maclaffrty F.W. & F. Turecek; Interpretation of Mass spectra, 4th Ed., Mill Valley, CA Univ Science Books, (1993)
5. Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993)
6. Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.
7. N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.

INTRODUCTION TO QUESTIONED DOCUMENTS EXAMINATION

FS 522 **2-0-0-2**

Unit I: Introduction [6]

Nature and problems of document examination, classification of documents, procurement of standard admitted/ specimen writings, handling and marking of documents, preliminary examination of documents, Basis of handwriting identification – individuality of handwriting, natural variations, process of comparison, various types of documents – genuine and forged documents, holographic documents, various writing features and their estimation, general characteristics of handwriting, individual characteristic of handwriting, basic tools needed for forensic documents examination and their use.

Unit II: Author Determination [7]

Disguised writing and anonymous letters - identification of writer, Examination of signatures – characteristics of genuine and forged signatures, Examination of alterations, erasers, overwriting, additions and obliterations, Decipherment of secret, indented and charred documents, Examination of seal impression and other mechanical impressions.

Unit III: Examination of Photocopies [6]

Examination of black & white, colour Xeroxed copies, carbon copies, fax messages Forgeries and their detection - Various types of forgeries and their detection, Examination of built up documents – determination of sequence of strokes, Physical matching of documents, Identification of type writings– identification of typist, identification of printed matter – Various types of printing of security documents, Printing of currency notes, examination of counterfeit currency notes, passports, visa, stamp papers, postal stamps etc.

Unit IV: Determination of Age [7]

Determination of age of documents by examination of signatures – Paper, ink and writing/signatures etc. Examination of computer printout, identification of dot-matrix, ink-jet and laser printers, electronic typewriter, credit cards, Forensic stylistics, forensic linguistics, e- documents, digital signatures, An introduction to computer forensics, opinion writing, reasons for opinion.

Text:

27. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.

References:

1. Osborn, A. S. (1998). Classes of Questioned Documents. Questioned Documents, 2nd edition, First Indian reprint, Universal law publishing co. Pvt. Ltd., New Delhi.
2. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.

3. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
4. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
5. Cossidy, M.J., Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada, 1980.
6. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
7. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
8. Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
9. Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
10. Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.
11. Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
12. Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.

INTRODUCTION TO FORENSIC CHEMISTRY, TOXICOLOGY and PHARMACOLOGY

FS 532 **2-0-0-2**

Course Contents
Unit I: Introduction to Forensic Chemistry [5] Forensic Chemistry: Introduction, types of cases/exhibits, preliminary screening, presumptive test (colour and spot test), inorganic analysis, micro – chemical methods of analysis, Analysis of petroleum products.
Unit I: Toxicology of alcohol &Examination of Alcoholic Beverages [5] The fate of alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, Examination of alcoholic beverages; country made liquor, illicit liquor.Analysis of blood for alcohol.
Unit III: Drugs of Abuse [5] Introduction, classification of drugs of abuse, drugs of abuse in sports and doping, narcotics drugs and psychotropic substances, designers drugs and their forensic examination, Drugs and Cosmetic Act, Excise Act, NDPS Act.
Unit IV: Introduction to Toxicology [5] Definition, Law relating to poison, Classification of poisons. Action of poisons & factors modifying its action, routes of administration of poisons.
Unit V: Forensic Pharmacology [6] Pharmacology and toxicology of Psychotropic Drugs: Sedatives, Stimulants, Opiates and drugs of abuse. Extraction, Isolation of drugs from viscera, tissues and body fluids.

Text:

1. Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.

References:

1. A Burger; Medicinal Chemistry, Vol. II, Wiley Interscience, New York; (1970)
2. A.I Vogel; Textbook of Practical Organic Chemistry including Qualitative Organic Analysis; ELBS, Essex (1971)
3. Boudreau, JE et al – Arson & Arson Investigation, Survey & Assessment National Institute of Law Enforcement, U.S Deppt of Justice, US Govt. Printing Press (1977)
4. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
5. Gleason, M.N. et.al, Clinical Toxicology of Commercial products, Williams and Williams, Baltimore,

INTRODUCTION TO FORENSIC BIOTECHNOLOGY

FS 542 **2-0-0-2**

Course Contents
Unit 1:HAIR & FIBER [6] Structure of hair and its biochemical properties, Phases of hair growth, types of hair. Differences between animal and human hair, Forensic examination of different types of hairs. Different Types of fibers and their identification.
Unit 2 : INTRODUCTION TO BOTANICAL EVIDENCES & DIATOMS [5] Different botanical evidences of forensic significance: seeds, pollens etc .Diatoms: Classification, basic structure and morphology, forensic significance of diatoms.
Unit 3: INTRODUCTION TO FORENSIC ANTHROPOLOGY [5] Definition and scope of forensic anthropology, Human skeletal system and Types of bones. Estimation of age from skull and long bones, site and side determination. Estimation of Stature from skeletal remains. Determination of sex from skull, mandible and pelvis.
Unit 4:INTRODUCTION TO FORENSIC SEROLOGY [5] Definition and scope of forensic serology. Nature, composition and functions of blood and other fluids. Collection, preservation and packing of Biological fluids. Introduction to ABO, Rh, MN systems, Lectins – their forensic significance, Determination of secretor/ non secretor status. Antigens- Antibody reactions.
Unit 5:INTRODUCTION TO DNA PROFILING [5] Introduction to DNA , DNA biochemistry, Nuclear DNA and Mitochondrial DNA,. Significance of DNA profiling, Fundamental concepts and techniques applied in specific DNA tests, Scientific principles of forensic DNA typing. FTA cards, DNA extraction/isolation from different samples.

Text:

28. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References:

29. Pandey, B. P., Plant Anatomy; S. Chand, New Delhi, 1998.
30. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
31. Byrd, J. H. & Castner, J. L., Forensic Entomology, The Utility of Arthorpods in legal Investigation, CRC Press, USA, 2000.
32. Catts, E.P & Haskell N.H., Entomology and death: A procedural guide, Joyce's Print Shop, 1990.
33. Mauersberger, Herbert R., & Mathews, Textile Fibres – Their physical, Microscopic and chemical properties, John Wiley, New York, 1954.
34. Smith; DGV; A manual of Forensic Entomology Ithaca New York Camstock Univ. Press, USA, (1986)
35. Glaister's Book of Hairs Seta: Hair
36. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

DISASTER MANAGEMENT and VICTIM IDENTIFICATION

FS 552 **2-1-0-3**

Unit 1: Understanding Disasters [10]

Meaning, nature, characteristics and types of Disasters, Causes and effects, Disaster:
A Global View, Disaster Profile of India, The Disaster Management cycle, Geological and Mountain Area Disasters-Earthquakes, Volcanic Eruption, Landslides, Snow Avalanches; Wind and Water Related Natural Disaster-Floods and Flash Floods, Droughts, Cyclones, Tsunamis; Man Made Disasters-Understanding Man-Made Disasters, Fires and Forest Fires, Nuclear, Biological and Chemical disaster and Road Accidents.

Unit 2: Roles & Responsibilities of Different Agencies and Govt. [10]

Roll of Information, Education, Communication & Training, Role and Responsibilities of Central, State, District and local administration, Role and Responsibilities of Armed Forces, Police, Para Military Forces, Role and Responsibilities of International Agencies, NGO's, Community Based Org. (CBO's).

Unit 3: Technologies for Disaster Management [10]

Role of IT in Disaster Preparedness, Remote Sensing, GIS and GPS, Use and Application of Emerging Technologies, Application of Modern Technologies for the Emergency communication, Application and use of ICST for different disasters, Human Behaviour and Response: Psychological Response and Psychological Rehabilitation, Trauma and Stress Management, Rumour and Panic Management, Medical and Health Response to Different Disasters, Role of Information and Communication Technology in Response Management.

Unit 4: Relief Measures and Victim Identification [9]

Minimum Standard of Relief, Relief Management- essential components, Funding Relief- short term and long term, Disaster Site Management, Recovery, Victim Identification and Biometrics, Bite Marks, methodologies, DNA Analysis and techniques, Ear prints, methodologies and analysis, Lip Prints, Fingerprints from dead bodies.

Text:

1. Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi.

References:

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
3. Central Water Commission, 1987, Flood Atlas of India, CWC, New Delhi.
4. Central Water Commission, 1989, Manual of Flood Forecasting, New Delhi.
5. Government of India, 1997, Vulnerability Atlas of India, New Delhi.
6. Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.

FORENSIC PRACTICALS II

FS 562 **0-0-3-3**

1. Dental patterns and Recognition
2. Identification of individual teeth based on the morphological features.
3. Estimation of age from the teeth.
4. Living subject
5. Maxilla & mandible
6. Comparison and Identification of Individuals from bite marks
7. Autopsy
8. UV-Visible Spectrophotometer-working, sample preparation, analyzing graphs
9. IR Spectrophotometer- working, sample preparation, analyzing graphs
10. TLC of Ink Samples
11. Paper Chromatography

THIRD SEMESTER

FINGERPRINTING and FORENSIC PHOTOGRAPHY

Course Code: FS 601 **Credit Units: 2-1-0-3**

Course Contents
Unit I: Introduction to Photography [7] Introduction to forensic photography; Required equipments for photography – Camera, lens, shutter, depth of field, film; Importance of Forensic photography in a crime scene investigation.
Unit II: Types of Photography & Photo Prints [8] History and Development of Photography. Basic principles and techniques of Black & White and colour photography. Developing techniques and methods of photography, Different kinds of developers and fixers, modern developments in photography, linkage of cameras and film negatives.
Unit III: Introduction and Classification of fingerprints [7] Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation; Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints
Unit IV: Classification Systems and AFIS [8] Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC; AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications
Unit V: Fingerprint Developmental Techniques [9] Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.

Text:

37. Redsicker, D. R., The Practical methodology of Forensic Photography, CRC Press, London, 1994.
38. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

References:

1. Henry Horeustein; Colour Photography -A working Manual, Little Brown Co. Boston (1995)
2. B.H.E. Jacobson, Ray GG Attridge; The Manual of Photography, Focal Press, London (1988)
3. Jahne B; Digital Image Processing, Heidelberg Springer (1996)
4. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press (2002)
5. David R. Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press LLC (2001)
6. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

7. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

APPLIED COGNITIVE PSYCHOLOGY

FS 611 **2-1-0-3**

Unit 1: Cognitive Neuroscience [13]

Introduction, Philosophical antecedents, Emergence of Cognitive psychology, Approaches and key issues, Organization of Nervous system: Cognition in the Brain, Sensation, to representation, Theoretical approaches to perception, Deficits in perception. Attention and consciousness.

Unit 2: Memory [10]

Models, Processes, Practical Applications of Cognitive Psychology in improving memory processes, Representations and manipulation of Knowledge in: Images and Propositions: Spatial cognition and Cognitive Map.

Unit 3: Language [8]

Nature and Acquisition: Bilingualism and Multilingualism Reading: Bottom-up and Top-down processes, Comprehension, Neuropsychology of Language. Problem-solving and Creativity: Practical applications of cognitive psychology. Decision-making and reasoning: Deductive reasoning and inductive reasoning,

Unit 4: Intelligence [8]

Information possessing and intelligence, alternative approaches to Intelligence. Computer Simulation, improving intelligence.

Text:

1. Durso, F. T. (2007). Handbook of Applied Cognition (2nd Ed). New West Sussex : Wiley & Sons.

References

1. Esgate, A. et al. (2005). An Introduction to Applied Cognitive Psychology. Psychology Press: New York.
2. Sternberg, R. J. (Ed.) (2000). Handbook of intelligence. New York: Cambridge University Press.
3. Sternberg, R. J. (2009). Applied Cognitive Psychology: Perceiving Learning and Remembering. Australia:
4. Cengage Learning

SPEECH ANALYSIS and MULTIMEDIA FORENSICS

FS 621 **2-1-0-3**

Unit I: Speech [10]

Speech Anatomy, Mechanism of speech Production, Acoustic Properties of Vocal Tract, Uniqueness in person's voice, interspeaker and intraspeaker variation; Articulation- Manner & Place of Articulation, Phonemes, Vowel, Consonant and Glides; Phonetics in Speaker Identification, IPA (The International Phonetic Alphabets), Forensic Phonetics, Effect of context, Supra segmental (Prosodic features). Audio-enhancement, Sound Recording/Playback Devices: Analog Tape recorders, Digital recorder, Microphone types, Digital audio formats. Apex Court Judgments on Speaker Identification. Court presentation of report based on speaker identification.

Unit II: DSP [10]

Digital Signal Processing, A to D Conversion- Sampling, Quantization, Digital Audio Formats, Pulse Code Modulation, Coding and Decoding, Computer Representation of Speech Speaker Recognition: Principles of speaker recognition/identification, Methods on Speaker Recognition. Various approaches in Forensic Speaker Identification, Interpretation of result, Statistical interpretation of probability scale, Objective/Subjective methods, discriminating tests, closed test, open test, likelihood ratio calculation, Concept of test and error in Speaker Identification. Introduction to Pattern Recognition, Pattern Recognition application in Automatic Speaker Identification and Verification System, Different algorithm of automatic speaker identification.

Unit III: Audio Evidence [10]

Audio Evidence Examination: Handling of audio recording evidences, Procedure for preparation of working copies, Phonetic transcription, Analysis of linguistic & phonetic characteristics, Temporal measurement, Text-dependent and text-independent speaker recognition. Instrumental Analysis of speech sample: Verbatim, Clue words, IPA marking, CSL & Linear predictive coding technique, Fourier transformation, Examination using SPID, Vocal behaviors, alcohol speech relationships. Authentication of recorded audio: Type of alterations, Auditory Examination by Critical Listening. Waveform analysis, Speech Spectrographic analysis, Magnetic developing, Optical Method.

Unit IV: Video Evidence [9]

Introduction to video technology: Video standards, Recording formats- Analog and Digital, Introduction to video devices, Linear and Non-linear editing, Concept of video film production, Graphics and animation technique. Image perception, Colour space & representation, Storage, Image processing application. Introduction to image enhancement, Image restoration, Concept of digital water marking, Image compression, Retrieval of video files, Integrity of images, Facial image recognition. Forensic analysis of audio/video in video recording: Authentication of video recording, Visual examination technique on video frame sequence, Video image analysis- object, costumes, Facial image recognition from video frame image, Video signal analysis.

Text:

1. Philip Rose; Forensic Speaker Identification, Taylor and Francis, Forensic Science Series, ondon (2002)

References:

1. Arthur R Weeks Jr; Fundamentals of Electronic Image. SPIE Press, (2003)
2. Bengold & Nelson Moryson; Speech and Audio signal processing, John Wiley & Sons, USA (1999)
3. D.B. Fry; The Physics of Speech, Cambridge University Press. (2004)
4. David Cheshire; The Complete Book of Video Techniques Subjects Equipment, Dorling Kindersley, London (1992)
5. Des Lyver & Graham Swainson; Basics of Video Production, 2nd Ed. Focal Press (1999)
6. Dwight Bolinger et. al.; Aspects of Language, Third Edition, Harcourt Brace Jovanovich College Publishers, USA. (1981)
7. Gloria J. Borden et. al. Speech Science Primer (Physiology, Acoustics and perception of Speech), 6th Ed, a Wolters Kluwer Company, USA. (2011)
8. Harry Hollien; Forensic Voice Identification, Academic Press, London. (2001)
9. Harry Hollien; The Acoustics of Crime- The New Science of Forensic Phonetics, Plenum Press, New York and London (1990)
10. Husrev Taha Sencar, Nasir Memon; Digital Image Forensics: There is More to a Picture than Meets the Eye. Springer (2013)
11. John C. Russ; Forensic Uses of Digital Imaging CRC Press, (2001)
12. Martin Uren; BKSTS Illustrated Dictionary of Moving Image Technology, 4th Ed, CRC Press, (2013)
13. Oscar Tosi; Voice Identification-Theory of Legal Applications, University Park Press, Baltimore (1979)
14. O'Shaughnessy, Douglas; Speech Communication, Hyderabad Universities Press (2001)
15. Patricia Ashby; Speech Sounds, 2nd Ed. Routledge, London and New York (2005)
16. Randy Crane; A Simplified Approach to Image Processing, Prentice Hall. (1996)

17. Simon J. Godsill; Digital Audio Restoration, Springer, (1998)
18. Gary H. Anderson; Video Editing and Post-Production- A Professional Guide, 4th Ed,Focal Press, (1998)

FORENSIC PRACTICAL III

FS 631 **0-0-3-3**

1. Taking Photographs
2. Photography of Outdoor Crime Scene
3. Indoor photography including the laboratory
4. Presentation of Evidence through Photograph and charts.
5. Photography of documents and fingerprints (Transmitted light/Oblique light/U.V. Light Photography).
6. Taking of fingerprints on fingerprint chart.
7. Development of latent Finger Prints using powder methods.
8. Examination and comparison of security documents, fake currency and stamp papers.
9. Development of latent finger prints by Chemical methods and photography.
10. Development of latent finger prints by physical methods and photography.
11. Comparison of fingerprints, palm prints along on the basis of ridge characteristics and ridge details.
12. Recording of speech samples using tape recorder & digital recorders and measures for keeping it in the safe custody.
13. Speaker wise segregation of speech sample of recorded conversation spoken between two speakers.
14. Transfer of audio file from a digital media to other media using standard software and authentication of recorded speech.
15. Comparison of linguistic and phonetic features of audio recording voice samples of two speakers
16. Spectrographic analysis of voice samples of two speakers using voice spectrograph and comparison of their spectrographic features.
17. Video analysis and detection of tampered video files using Video analyzing tool.

ELECTIVES

Specialization A: Forensic Chemistry and Toxicology

ADVANCED FORENSIC CHEMISTRY

FS 641 **2-0-0-2**

Course Contents:
Unit I: Arson [5] Arson: Chemistry and Behavior of fire, origin and cause and their methods of investigation and evaluation of clue material, analysis of arson exhibits by various methods: Management of Arson cases.
Unit II: Motor Vehicle Fires [5] Causes, investigation, collection, preservation, packaging and analysis of evidences
Unit III: Analysis of Petroleum Products, Organic and Inorganic Substances [5] Examination of petroleum products: distillation and fractionation, various fractions and their commercial uses, standard methods of analysis of petroleum products for adulteration, Forensic analysis of organic and inorganic Industrial products, chemical fertilizers, insecticide, metallic and non-metallic products, consumer items.

Unit IV: Expert Witness [5] The role of Chemist as an expert witness. Presentation of the report in the court, Cross-examination of the expert
Unit V: Explosives [6] Classification, composition and characteristics of explosives, pyrotechnics, IEDs, systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, Explosives Act.

Text:

1. James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

References:

1. Carper, K. (ed.), Forensic Engineering, 2nd Edn. CRC Press, Bocarida, Florida, 2001.
2. Field, J., and Carper, K., Construction Failure, 2nd Edn. John Wiley and Sons, New York, 1996.
3. SAE Handbook, Vol. 4, On-Hghway and Off-Highway Machinery, Society of Auto mobile Engineers, 2000

ADVANCED FORENSIC PHARMACOLOGY & TOXICOLOGY

FS 651 **2-0-0-2**

Course Contents:
Unit I: Pharmacology-I [5] Sites and mechanisms of action of drugs, Dose-effect relationships; agonists, partial agonists and antagonists. Factor that modify drug actions; side effects, overdose, idyosincratic and allergic reactions; teratogenesis and foetal toxicity. Drug interactions.
Unit II: Pharmacology-II [5] The movement of drug molecules across cell membranes, the blood-brain barrier and the placental filter. Routes of administration and drug adsorption. Binding to plasma proteins. Drug distribution, metabolism and elimination. Drug bioavailability and half-life.
Unit III: Toxicology and Isolation techniques of toxins [5] Definition of Toxicology, Principle of Toxicology, Isolation of Toxic substances from viscera and other relevant materials. The role of drug recognition expert.
Unit IV: Different Toxins-I [5] Nature, administration, sign & symptoms, Fatal dose, postmortem findings, Detection and medicolegal aspects of- **a) Metallic poisons** Arsenic, Mercury **b) Vegetable poisons** Abrus Precatorius, Calotropis Gigantia,Castor ,Oleander, Aconite.
Unit V: Different Toxins-II [6] • **Insecticides** Organophosphorous compounds, Organochloro Compounds and Carbamates

- **Volatile Poisons** Methyl alcohol, Chloroform,
- **Asphyxiants** Cyanide, Carbon monoxide
- **Animal Poisons** Snake venom, Cantharide, Insect bite.

Text:

1. Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986

References:

39. Text book of pharmacology, Lawrence
40. A. Stolemen, Progress in Chemical Toxicology: Acad. Press, New York, 1963.
41. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
42. Gleason, M.N. et.al, Clinical Toxicology of Commercial products, Williams and Williams, Baltimore, USA, 1969.
43. Modi, Jaishing P, Textbook of Medical Jurisprudence & Toxicology, M.M. Tripathi Pub.2001.
44. Working Procedure Manual – Toxicology, BPR&D Publication, 2000

FORENSIC PRACTICAL IV A

(Chemistry, Pharmacology, Toxicology)

FS 661 **0-0-4-4**

45. Isolation techniques of different toxic substances.
46. TLC of insecticides, Barbiturates and other drugs.
47. Analysis of volatile and non-volatile poisons.
48. Analysis of vegetable poisons.
49. Spot test of nitrates, nitrites, carbonates, sulphates, sulphites, chlorates.
50. Spot test of mercury, iron, copper, Aluminum and cadmium and zinc and other metallic poisons

Specialization B: Forensic Biotechnology and DNA Profiling

ADVANCED FORENSIC BIOLOGY & ANTHROPOLOGY

FS 671 **2-0-0-2**

Course Contents
Unit I: Introduction to Wild Life Forensics [5] Introduction to wildlife forensics, Examination of pug marks, horn, skin, fur, hair, nail and teeth. Identification of some endangered species of plants and animals.. Wildlife life protection Act.
Unit II: Forensic Entomology & Forensic microbiology [5] Collection of insects, Shipment of collected insects, Identification of insect and its stage of growth. Determination of the postmortem interval or "time since death" in homicide investigations, forensic entomotoxicology. Introduction to forensic microbiology
Unit III: Forensic Anthropology [5]

Somatometry, osteometry & Craniometry. Identification of individuals from skeletal remains, Collection, Handling, preservation of skeletal remains of forensic science and report writing.
Unit IV: Forensic Taphonomy, Forensic Radiology [5] Forensic Taphonomy. Fire modification of bones .Assessment of antemortem and postmortem skeletal trauma. Artefacts in the skeletal remains. Application of radiology in forensic anthropology
Unit V:, Super Imposition &Facial Reconstruction [6] .Superimposition techniques. Facial reconstruction; three dimensional and computer assisted facial reconstruction

Text:

51. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References:

1. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
2. Byrd, J. H. & Castner, J. L., Forensic Entomology, The Utility of Arthorpods in legal Investigation, CRC Press, USA, 2000.
3. Encyclopedia of Forensic Sciences, Volume, I, II, II & IV, Edited By Jay A. Siegel, Geoffrey C. Knupfer & PekkaSaukko,AcamicPress,2000
   A laboratory manual on Biological Anthropology, Anthropometry, Indera P. Singh, M.K. Bhasin,: Kamla Raj Enterprises,1989
4. Advances in Forensic Taphonomy: Method, Theory, and Archaeological Perspectives ,William D. Haglund , Marcella H. Sorg, CRC Press; 1 edition, 2001
5. Brogdon's Forensic Radiology, Second Edition, Edited by Michael J. Thali, Mark D. Viner, B.G. Brogdon, Published November 22nd 2010 by CRC Press – 654 pages

ADVANCED FORENSIC SEROLOGY & DNA PROFILING

FS 681 **2-0-0-2**

Course Contents
Unit 1:Forensic Characterization of Blood Catalytic tests & crystal tests, Spectrophotometric method, chromatographic method, immunological methods, electrophoresis methods. Typing of blood antigens from dried stains. Lattes test, Absorption Elution, Absorption Inhibition, Mixed agglutination
Unit 2: Forensic Characterization Body Fluids Forensic characterization of semen, saliva, urine, faeces, milk and other biological fluids. Their identification and examination.
Unit 3: Determination of Species of Origin Determination of species origin. Extraction of species specific antigens from blood stains, and other body fluids .Tube technique (Precipitin test/Ring test), Diffusion methods; single diffusion, double diffusion,

and crossed-over electrophoresis, rocket electrophoresis.
Unit 4: Serogenetic Markers Introduction to isozymes and Polymorphic proteins. Typing of isozymes, like Phospho Glucomutase (PGM), Glyoxylase I(GLO), Esterase D(EsD), Adenylate Kinase (AK) .Typing of polymorphic serum proteins like Haptoglobin(Hp) &Transferrin (Tf) Introduction to Human Leucocyte Antigen. HLA Classification, HLA typing, Mol.based HLA typing.
Unit 5: DNA Profiling RFLP analysis, analysis of STR, SNP and Mitochondrial DNA, YSTRs, PCR amplifications, FTA cards, DNA chips. Forensic applications of DNA profiling, limitations of DNA profiling

Text:

1. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References

1. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
2. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
3. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida, 1999.
5. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
6. Blood grouping on man R.R. Race and Sanger. Blackwell Scientific Publications, Oxford, England. 1950.
7. Boorman K, Dodd B, Lincoln P. Blood group serology: Theory and Techniques: Practical Applications. 5th ed.

FORENSIC PRACTICAL IV B

FS 691 **0-0-4-4**

52. Determination of species of origin from blood &other biological evidences using precipitin test
53. Extraction /Isolation of Diatoms from water/soil, tissues &Identification
54. Identification of bones based on its morphology and anatomical planes
55. Sex Determination from Skull, Mandible, Pelvis & long bones
56. Presumptive and Confirmatory tests for blood
57. Examination and Identification body fluids
58. Microscopic Examination of Hair for the determination of species
59. Gel-Immuno Diffusion tests for species origin
60. Blood grouping from dried stains by Absorption Inhibition or Absorption Elution
61. Craniometry & Osteometry
62. Somatometry & Somatoscopy
63. Stature estimation from bones
64. Age Estimation from Skull, Mandible, Long bones

65. Sexing from Barr Bodies
66. Isolation of DNA from various sources-plants, bacteria and blood
67. PCR
68. RFLP and DNA Sequencing
69. DNA Estimation through Spectroscopic Methods
70. ImmunoElectrophoresis
71. Radial Immuno diffusion
72. ELISA
73. Double Diffusion Assay
74. Quantification of RNA

Specialization C: Questioned Document Examination

ADVANCED QUESTIONED DOCUMENT EXAMINATION

FS 603 **2-0-0-2**

Unit I: Graphology and Psychological Autopsy [5]

Police Psychology, Victimology, Criminal Profiling, Cognitive Psychology and Applications, Uses, Graphology: Introduction, Writing Systems, Graphology Learning Systems, Criminal Profiling through Handwriting, Lie Detection through Handwriting, Behavioral Estimations through Handwriting

Unit II: Stylistics and Linguistics [5]

Writing Systems, Historical Linguistics, Field Linguistics, Linguistic Phonetics, Phonology, Morphology, The Lexicon, Syntax, Generative Grammar, Functional Linguistics, Typology, An Introduction to Formal Semantics, Pragmatics: Language and Communication, Discourse Analysis, Linguistics and Literature, First Language Acquisition, Linguistics and Second Language Acquisition, Multilingualism, Natural Sign Languages, Sociolinguistics, Neurolinguistics, Computational Linguistics, Applied Linguistics, Educational Linguistics, Linguistics and Reading, Clinical Linguistics

Module III: Automated Signature/Handwriting Recognition Systems [5]

Introduction, Latest Trends in Automated System Development, Image Acquisition, Image Processing, Feature Quantification, Feature Extraction, Feature Processing, Comparison, Behavioral Biometrics, Introduction, Verification and Identification, Basic working of Biometric Matching, Accuracy, False Match Rate, False Non-match Rate, Failure to Enroll Rate.

Module IV: Advanced Detections of Forgeries [5]

Handwriting comparisons using Individual Characteristics, Fractured/cut edge comparisons (paper, tape, postage stamps, dryer sheets), Plastic bag comparisons, Printing process examinations (document authentication/typewriting classification), Charred and liquid soaked document preservation, Indented writing examinations, Alternate light source examinations (ink discrimination, alterations, enhancements), Office machine artifact comparisons; Database queries (Anonymous Letter File, Automated Counterfeit Identification Database, Bank Robbery Note File, Testimony in legal proceedings

Module V: Art Forgery [3]

Introduction, History, Artist Forgers, Dealer Forgers, Examination, Carbon Dating, White Lead Dating, X-Ray based Techniques, Dendrochronology, Stable Isotope Analysis, Thermo-luminescence, Craquelure, Digital Authentication, Morellian Analysis, Atomic Absorption Spectrophotometry, Inductively Coupled Plasma, Mass Spectrometry, Wavelet Decomposition, Photographic Forgery, Victorian Waifs, The Rospigliosi Cup Case Study, Etruscan Terracotta Warriors Case Study, Flower Portrait, Michelangelo's "Cupid" Case Study, Samson Ceramics, Getty Kouros, Copying vs. Forging, Pastiche, Association Research into Crimes against Art, Racketeer Influenced and Corrupt Organizations Act, Postal Fraud, Archaeological Forgery, Archaeoraptor, Neutron Activation Analysis

Module VI: Electronic Document Analysis [3]

Data and Evidence Recovery, Computer and cyber forensic basics, Cell Phones / Mobile Forensics, Bluetooth, Computer Ethics and Application Programs, Data and Evidence Recovery- Formatted Partition Recovery, Data Recovery Tools, Data Recovery Procedures and Ethics, Fine Transfer Protocol (FTP), Preserve and safely handle original media, Recover Internet Usage Data, Recover Swap Files/Temporary Files / Cache Files

Text:

1. Roy A Huber, A.M. Headrick; Handwriting Identification- Facts and Fundamental, CRC Press (1999)

References:

1. Rev ED, Ordway Hilton; Scientific Examination of Questioned Documents, Elsevier, NY (1982)
2. Albert S. Osborn; Questioned Documents, 2nd Ed., Universal Law Pub., Delhi (1998)
3. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998)
4. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971)
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001)
6. Hard less H.R; Disputed Documents, Handwriting and Thumbs – Print Identification, profusely illustrated, Law Book, Allahabad (1988)
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001)
8. Kurtz Sheila; Grapholypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983) w.e.f. 2005-2006
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001)
10. Mcmenamin, Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington, D.C. (2002)
11. Ellen David; Questioned Documents- Scientific Examination, Taylor & Francis, Washington (1997)
12. Andrea McNichol, Jeffrey A, Nelson; Handwriting Analysis-Putting It to Work for You, Jaico Books, Delhi (1994)
13. Vacca John R; Computer Forensics, Computer Crime Scene Investigation, Firewall Medial, An imprint of Laxmi Pub. (2002)
14. Casey Eoghan; Handbook of Computer Crime Investigation, Forensic Tools & Technology, Academic Press (2002)

DIGITAL IMAGE PROCESSING

FS 613 **2-0-0-2**

Unit I: Introduction and Fundamentals [5]

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain; Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit II: Image Enhancement in Frequency Domain [5]

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.

Unit III: Image Restoration [5]

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit IV: Registration and Segmentation [5]

Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements. Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit V: Feature Extraction [6]

Representation, Topological Attributes, Geometric Attributes, Boundary-based Description, Region-based Description and Relationship. Object Recognition; Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

Text:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.

References:

1. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
2. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ

FORENSIC PRACTICAL IV C

FS 623 **0-0-4-4**

1. Image enhancement
2. Image compression
3. Color image processing
4. Image segmentation
5. Image morphology
6. Image Restoration
7. Edge detection
8. Comparison of forged (disputed) signature with the specimen signatures.
9. Comparison of disguised (disputed) signature with specimen signatures.
10. Examination and comparison of disputed anonymous letter with specimen of suspect/suspects.
11. Identification of altered/added/obliterated/erased/handwriting on cheques and deeds.

FOURTH SEMESTER
DISSERTATION: RESEARCH WORK BASED PROJECT

FS 620 **Credits: 20**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curriculae where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

75. A short account of the activities that were undertaken as part of the project;

76. A statement about the extent to which the project has achieved its stated objectives;

77. A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;

78. Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;

79. Any problems that have arisen and may be useful to document for future reference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

Title or Cover Page

The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.

Acknowledgement(s)

Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.

Abstract

A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.

Conclusion(s) & Recommendations

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:

1. Did the research project meet its aims (check back to introduction for stated aims)?
2. What are the main findings of the research?
3. Are there any recommendations?
4. Do you have any conclusion on the research process itself?

Implications for Future Research

This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.

Appendices

The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References

References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples:

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect* , **8** (suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

The Layout Guidelines for the Project File & Project Report:

1. A4 size Paper
2. Font: Arial (10 points) or Times New Roman (12 points)
3. Line spacing: 1.5
4. Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following ***assessment objectives:***

1. Range of Research Methods used to obtain information
2. Execution of Research
3. Data Analysis (Analyze Quantitative/ Qualitative information)
4. Quality Control
5. Conclusions

Assessment Scheme:
Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.

Mody University of Science & Technology

MSc Maths

Session 2018-2019

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M. Sc. Mathematics

(Session 2016-2017 Onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20

Objectives: The proposed PG programme in Mathematics is a highly interesting and promising with broader opportunity for absorption in teaching, research and industry for students. The M.Sc. Mathematics programme offers core fundamental skills in Mathematics which incorporate the ideas of applied mathematical knowledge as well as provide platform to the student's regarding research oriented programmes in various interdisciplinary areas of mathematics.

Scope: The programme will generate interest of students towards fundamental mathematical research and will be able to qualify eligibility test for various fellowships.. Student will be able to select various options for higher studies like doctoral programmes in Computational numerical analysis, Advanced graph and pebbling theory, Algebraic and numerical topology, Approximation theory, Optimization techniques , Economics Fluid dynamics, Financial mathematics, Theory of computation and artificial intelligence, Mathematical modeling and simulation etc. Further, they have scope for absorption in research Labs in India like BARC, IISc, TIFR, IITs, ISRO, DRDO etc. as well as may get opportunity for doctoral or post doctoral research in India and abroad.

Input Qualification:

Bachelor's Degree in Science from any recognized university with Mathematics as a core subject for three years/six semesters, with 50% of aggregate marks and adequate proficiency in English.

Evaluation Procedure: All the Rules and Regulations as a provided in the Ordinance and regulations of the Undergraduate/postgraduate programmes of Mody University shall be followed. The first batch of this programme is proposed to be admitted in the session 2016-2017.

	M.Sc. Mathematics									
	Two-Year Programme									
	Academic Curriculum(Session 2016-2017 onwards)									
	First Year									
Autumn Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 511	Computer Based Advanced Numerical Analysis	3	1	-	4	3	25	25	50
	MS 521	Discrete Mathematics	3	1	-	4	3	25	25	50
	MS 531	General Topology	3	1	-	4	3	25	25	50
	MS 541	Operations Research	3	1	-	4	3	25	25	50
	MS 551	Statistics and Probability -I	3	1	-	4	3	25	25	50
	MS 561	Ordinary Differential Equations	3	1	-	4	3	25	25	50
		Sub Total	**18**	**6**	**-**	**24**				
		Foreign Language-I** (Non-Credit)	3	-	-	3	3	25	25	50
Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 512	Advanced Abstract Algebra	3	1	-	4	3	25	25	50
	MS 522	Complex Analysis and Integral Transform	3	1	-	4	3	25	25	50
	MS 532	Mathematical Modeling and Simulation	3	1	-	4	3	25	25	50
	MS 542	Partial Differential Equations	3	1	-	4	3	25	25	50
	MS 552	Statistics and Probability - II	3	1	-	4	3	25	25	50
	MS 562	Modeling and Simulation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**5**	**4**	**22**				
		Foreign Language-II **(Non-Credit)	3	-	-	3	3	25	25	50

** Refer to Foreign Language Section.

M.Sc.(Mathematics)

Two-Year Programme (2016- 17 and onwards)

Second Year

Autumn Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 611	Advanced Linear Algebra	3	1	-	4	3	25	25	50
MS 621	Advanced Graph Theory and Combinatorics	3	1	-	4	3	25	25	50
MS 631	Real Analysis and Measure Theory	3	1	-	4	3	25	25	50
MS 641	Special Functions and Integral Equations	3	1	-	4	3	25	25	50
	Elective-I	3	1	-	4	3	25	25	50
	Sub Total	**15**	**5**	**-**	**20**				

Spring Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 612	Functional Analysis	3	1	-	4	3	25	25	50
MS 622	Inequality and Continued Fractions	3	1	-	4	3	25	25	50
MS 632	Basics of MATLAB	-	-	4	2	4	100		
	Elective-II	3	1	-	4	3	25	25	50
MS 642	Dissertation	-	-	-	8		100		
	Sub Total	**9**	**3**	**4**	**22**				

Total Credits: 88 (I Year +II year)

Elective- I	**Elective- II**
MS 651 Magneto Hydrodynamics	MS 652 Viscous Fluid Dynamics
MS 661 Sequence and Series	MS 662 Summability and Approximation Theory
MS 671 Tensor Analysis	MS 672 Mechanics and Calculus of Variations
MS 681 Reliability Theories	MS 682 Fourier Analysis
MS 691 Advanced Number Theory	MS 692 Differential Geometry

* CW (Course work): It would include attendance, assignments, class /quiz test.

Note: Combinations of electives are: MS 651 & MS 652; MS 661 & MS 662; MS 671 & MS 672; MS 681 & MS 682; MS 691 & MS 692.

(Above II year is taken from AC 30, syllabus in AC 30 minutes)

MS 511 Computer Based Advanced Numerical Analysis 3-1-0-4

1. Algebraic and Transcendental Equations: General iterative methods, Newton-Raphson method for finding multiple roots, system of non linear equations, convergence of Newton-Raphson method, Graeffe's root squaring method, Muller's method , Bairstow iterative method. **[08]**

2. System of Linear Equations: Existence of solution, ill-conditioned system, Gauss elimination with pivoting, Gauss-Jordan method, triangular factorization method, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. **[08]**

3. Boundary Value and Eigen Value Problems: Solution of Eigen values problems by power method, Jacobi method, finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method. **[08]**

4. Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations. **[09]**

5. Difference Equations and Curve Fitting: Homogeneous difference equations with constant coefficients, particular solutions of a difference equations, curve fitting and regression, least square method, fitting of straight line and second order polynomials. **[06]**

Text Books:

1. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
2. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.
3. Jain M.K. and Iyenger S.R.K.(2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.

MS 521 **Discrete Mathematics** **3-1-0-4**

1. Relation and Function: Definition of set, different forms, properties and operations, principle of inclusion and exclusion, partition of a set, definition and types of a relation, composition, properties, graphical representation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice, different forms, properties, definition and kinds of a function, composition and properties of functions, recursively defined functions. **[10]**

2. Logics and Proofs: Propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, notion of a proof and methods for constructing proofs, normal forms (disjunctive and conjunctive), proof methods and strategy, statements of Fermat's last theorem, the $(3x + 1)$ conjecture and Godel's incompleteness theorem, program correctness. **[10]**

3. Induction and Counting: Mathematical induction, strong induction and well-ordering, recursive definitions and structural induction, recursive algorithms, basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

4. Graphs and Finite Automata: Graph and digraphs,, Konigsberg bridge problem, finite and infinite graphs, incidence and degree, isolated vertex, pendant vertex, and null graph, isomorphism, sub graphs, walk, path and circuits, connected graphs, disconnected graphs and components, Euler graphs, operation on graphs, Hamiltonian paths and circuits, traveling salesman problem, types and properties of tree, matrix representation of graphs; deterministic and non-deterministic finite automata, transition table and transition diagram, Mealy and Moore machines, minimization of finite automation. **[10]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International.

Reference Books:

1. Tremblay(1997), Discrete Mathematical Structures with Application to Computer Science, 35th reprint 2008,Mc Graw Hill Education,
2. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd ed., Mc Graw Hill Education, New Delhi.
3. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.

MS 531 **General Topology** **3-1-0-4**

1. Metric and Topological Spaces: Definition and examples of metric spaces, open sets, closed sets, convergence, completeness and Baire's theorem, continuous mappings, spaces of continuous functions, Euclidean and unitary spaces, definition and examples of topological spaces, elementary concepts, open bases and open subbases, weak topologies, function algebras. **[08]**

2. Compactness: Compact spaces, products of spaces, Tychonoff's theorem and locally compact spaces, compactness for metric spaces, Ascoli's theorem. **[08]**

3. Separation: T_1 – spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohn's lemma and the Tietze extension theorem, Urysohn's imbedding theorem, Stone – Cech compactification. **[08]**

4. Connectedness: Connected spaces, the component of spaces, totally disconnected spaces, locally connected spaces. **[08]**

5. Approximation: Weierstrass approximation theorem, Stone-Weierstrass theorems locally compact Hausdrorff spaces, extended Stone-Weierstrass theorems. **[07]**

Text Books:

1. George F. Simmons (2015), Topology and Modern Analysis, reprint ed., McGraw Hill Education, New Delhi
2. Sharma J. N. and Vashistha A. R.(2010), Topology, 37th ed., Krishna Prakashan Media, Meerut.
3. Adams (2008), Introduction to Topology: Pure and Applied, 3rd reprint ed., Pearson.

Reference Books:

1. Cain L.(2012), Introduction to General Topology,1st impression. Pearson.
2. Armstrong (2014), Basic Topology, reprint ed., CBS Publication.
3. Seymour Lipschutz(1965), Schaum's Outline of Theory and Problems of General Topology, 1st ed.,McGraw Hill Education.

MS 541 **Operations Research**

3-1-0-4

1. Linear Programming: Dual simplex method, parametric linear programming, game theory, two person zero sum game, game with mixed strategies, graphical solution, solution by linear programming. **[10]**

2. Inventory and Replacement Models: Deterministic models purchase and manufacturing models, probabilistic models, replacement of items that deteriorate and whose maintenance and repair costs increases with time. **[10]**

3. Job Sequencing and Queuing Theory: N jobs two machines, N jobs three machines, two jobs N machines; elements of a queuing system, Kendall's notation, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞) models. **[10]**

4. Dynamic Programming and PERT-CPM: Bellman's principal, employment smoothing problem, cargo loading problem; project planning and scheduling using PERT-CPM. **[09]**

Text Books:

1. Gupta Prem Kumar and Hira D.S.(2007), Operations Research,4th ed., S. Chand & Company Ltd., New Delhi.
2. Kanti Swarup, Gupta P.K. and Man Mohan (2006), Operations Research, 3rd ed., Sultan Chand & Sons, New Delhi.
3. Hillier F.S. and Lieberman G.J. (2005), Introduction to Operations Research, 8th ed., McGraw Hill, New Delhi.

Reference Books:

1. Taha H.A. (2010),Operations Research-An Introduction, 9th ed., Macmillan Publishing Co., Inc., New York.
2. Hadly G.(1964), Nonlinear and Dynamic Programming , 2nd ed., Addison-Wesley, Reading Mass.

MS 551 **Statistics and Probability - I** **3-1-0-4**

1. Introductory Ideas: Recapitulation of basic probability theory, law of addition and multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[06]**

2. Random Variables: Theorems on random variables, distribution function, properties of distribution, discrete random variable, probability mass function (pmf), discrete distribution function, continuous random variable, probability density function (pdf), cumulative distribution function(cdf), moments, covariance, moments generating function, two-dimensional random variables (discrete and continuous), transformation of random variables. **[12]**

3. Distributions: Discrete-binomial, Poisson, geometric, uniform distributions, continuous-uniform, exponential, gamma, weibull, normal distributions. **[12]**

4. Correlation and Regression: Simple and partial correlations, linear and non-linear regressions, regression coefficients, properties, angle between two lines of regression, standard error of estimate rank, regression curve correlation. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
4. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
4. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

1. Second Order Differential Equations: Review of the general solution of the second order homogeneous differential equations, use of a known solution to find another solution, homogeneous equations with constant coefficients, method of undetermined coefficient and method of variation of parameters. **[08]**

2. Non-Linear Ordinary Differential Equations: Two dimensional autonomous systems and phase space analysis- critical points, proper and improper nodes, spiral points and saddle points, definition of stability, Lyapunov function, stable, unstable and center subspaces, Riccati's equation-general solution and the solution when one, two or three particular solutions are known. **[10]**

3. Total Differential Equations: Different forms and solutions, necessary and sufficient condition, geometrical meaning of equation containing three and four variables, total differential equations of second degree. **[07]**

4. Power Series Solutions: Review of power series, series solutions of first order equations (Taylor series method), second order linear equations, solution near a regular singular point (method of Forbenius) for different cases, particular integral and the point at infinity. **[08]**

5. Existence and Uniqueness of Initial Value Problems: The existence and uniqueness of solutions, method of successive approximations, Picard's theorem, solution of initial-value problems by Picard method. **[06]**

Text Books:

1. Deo S. C., Lakshmikantham and Raghvendra V.(2000), Text book of Ordinary Differential Equations, 2nd ed.,Tata Mc-Graw Hill.
2. Dennis G. Zill, Michael R Cullen (2009), Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.
3. M. Rama Mohana Rao (1980), Ordinary Differential Equations: Theory and Applications, 2nd ed., Affiliated East-West Press Pvt. Ltd., New Delhi.

Reference Books:

1. Birkhoff and Rota G., G.C. (1978) , Ordinary Differential Equations , 4th ed., John Wiley and Sons Inc., NY.
2. Boyce, W.E. and Diprima, R.C.(1986), Elementary Differential Equations and Boundary Value Problems ,4th ed., John Wiley and Sons Inc., NY.
3. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations , 18th ed.,S. Chand Limited.

MS 512 **Advanced Abstract Algebra** **3-1-0-4**

1. Groups: Introduction and preliminaries (equivalence relation, integers modulo n), group definition and basic axioms, examples (dihedral, symmetric, matrix, quaternion groups), subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, centralizers and normalizers, nilpotent groups, direct products. **[10]**

2. Homomorphism and Group Actions: Definition and examples, isomorphism theorems, groups acting on themselves by left multiplication (Cayley's theorem), groups acting on themselves by conjugation (the class equation), automorphisms, Sylow p-groups and Sylow theorem. **[10]**

3. Ring: Basic definitions, examples (polynomial rings, matrix rings, group rings), ideals, ring homomorphism, integral domains and fields, maximal and prime ideals, Euclidean domain, principal ideal domains, unique factorization domains, polynomial rings over fields, introduction to modules (vector space as a special case). **[10]**

4. Field: Basic theory of field extensions, algebraic extensions, splitting fields and algebraic closures, separable and inseparable extensions, finite fields, field automorphisms, fundamental theorem of Galois theory, Galois groups of polynomials, cyclotomic extension. **[09]**

Text Books:

1. Fraleigh J. B. (2003), Abstract Algebra, 7th Edition, Pearson.
2. Dummit and Foote(1991), Abstract Algebra,3rd ed., John Wiley & Sons, Inc.
3. Khanna and Bhambri (2009), A Course in Abstract Algebra , 3rd ed., Vikas Publishing.
4. Herstein I. N.(1996), Topics in Algebra, 3rd Edition, Wiley India.

Reference Books:

1. Thomas W. Hungerford (2012), AbstractAlgebra, 4th Edition, Springer.
2. Vashistha, Modern Algebra(2011), 4th ed., Krishna Prakashan Mandir, Meerut.
3. Artin(2012), Algebra, 7th Edition, PHI.

MS 522 **Complex Analysis and Integral Transform** **3-1-0-4**

1. Basics of Complex Analysis: Complex numbers, complex function and its derivative, basic transcendental functions, power series of functions, integration in the complex plane, residues and their use in integration. **[10]**

2. Laplace Transforms and Stability of Systems: Laplace transform and their inversion, introduction of stability, Nyquist stability criterion, generalized functions, Laplace transforms and stability. **[10]**

3. Mellin Transform: Definition and properties of Mellin transform, evaluation of Mellin transform complex variable method and applications. **[09]**

4. Hankel Transform: Elementary properties, inversion theorem, transform of derivatives of functions, transform of elementary functions, Parseval's relation, relation between Fourier and Hankel transforms, use of Hankel transform in the solution of partial differential equations, dual integral equations and mixed boundary value problems. **[10]**

Text Books:

1. David Wunsch A.(2009), Complex Variables with Applications, 3rd Edition, Pearson.
2. H.K. Pathak(2004), Complex Analysis , 3rd ed., Shiksha Sahitya Prakashan, Meerut.
3. Gupta and Vashistha(2010), Integral Transform,4th ed., Krishna publication Media, Meerut.
4. Ian N. Sneddon(1972), The Use of Integral transforms by, 2nd Printing Edition, McGraw Hill.

Reference Books:

1. Ahlfors(1987), Complex Analysis,3rd ed., McGraw Hill Education.
2. Rudin(2006), Real and Complex Analysis,2nd reprint , McGraw Hill Education.
3. Andrews & Shivamoggi(2007) , Integral Transforms for Engineers,3rd ed., PHI Learning.

MS 532 **Mathematical Modeling and Simulation** **3-1-0-4**

1. Introduction to Simulation and Modeling: System concepts and theories, attributes and types of systems, discrete and continuous, deterministic and stochastic, open and closed, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, developing system dynamic equations - first order (+ve, -ve) systems, pure second order (+ve, -ve) systems and general feedback systems, simulation of equations for different systems. **[14]**

2. Random Numbers and Random Variates: Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods. **[10]**

3. Discrete Event Simulation: Concepts, event scheduling versus time advance scheduling, list processing. **[05]**

4. Verification and Validation of Simulation Models: Introduction, input modeling, identifying the distribution of data, parameter estimation, goodness of fit tests, model building, , verification calibration and validation of models, output analysis- measures of performance and their estimation. **[10]**

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2013), Discrete- Event System Simulation , 5th ed.,, Pearson, 2013.
2. Averill M. Law(2006), Simulation Modeling and Analysis, 4th ed., McGraw Hill Education.
3. V.P. Singh (2009), System Modeling and Simulation, 3rd ed., New Age International Publishers.
4. Frank L. Severance (2009) System Modeling and Simulation: An Introduction , 4th ed., Wiley.

Reference Books:

1. Taha(2012), Operations Research: An Introduction, 15th Indian reprint, PHI.
2. Geoffrey Gordon (2012), System Simulation, 2nd ed.,, PHI.
3. J.N. Kapoor (1994), Mathematical Modeling, 2nd ed.,Wiley Eastern Limited, Fourth reprint.

MS 542 **Partial Differential Equations** **3-1-0-4**

1. Second Order Partial Differential Equations: Preliminaries of partial differential equations, review of the classification of second order partial differential equations to hyperbolic, elliptic and parabolic forms, reduction of linear and quasi-linear equations in two independent variables to their canonical forms, characteristic curves. **[06]**

2. Laplace equation: Solution by method of separation of variables, mean value property, weak and strong maximum principle, Poisson's formula, Dirichlet's principle, solution of Laplace equation in cylindrical and spherical polar coordinates. **[06]**

3. Heat Equation: Solution by method of separation of variables, initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results. **[06]**

4. Wave Equation: Solution by method of separation of variables, uniqueness, D'Alembert's method, solution by spherical means and Riemann method of solution. **[06]**

5. Green's Functions: Introduction, Green's function for Laplace equation, method of images, eigenfunction method, Green's function for the wave and diffusion equations, Helmholtz theorem. **[08]**

6. Laplace and Fourier Transforms: Basics of Laplace transform solutions of diffusion and wave equations, basics of Fourier transform solution of diffusion, wave and Laplace equations. **[07]**

Text Books:

1. Sankara Rao K. (2003), Introduction to Partial Differential Equations , 4th ed., PHI Pvt. Ltd.
2. Asmar(2010), Partial Differential Equations and Boundary Value Problems with Fourier series, 2nd ed., Pearson.
3. Sundarapandian(2012), Ordinary and Partial Differential Equations, 3rd ed.,McGraw Hill Education, New Delhi.
4. Bhamra (2013), Partial Differential Equations: An Introductory Treatment with Applications ,4th ed., PHI Learning.

Reference Books:

1. Raisinghaniya M.D. (2008) , Ordinary and Partial Differential Equations , 3rd ed.,S. Chand Limited.
2. Zauderer(E. 1989), Partial Differential Equations of Applied Mathematics , 2nd ed., John Wiley and Sons, New York.
3. L Debnath(2007), Nonlinear PDE's for Scientists and Engineers , Birkhauser, Boston.
4. Sneddon I.N. (1957) , Elements of Partial Differential Equations, 2nd ed., McGraw Hill Book Company.

MS 552 **Statistics and Probability -II** **3-1-0-4**

1. Tests of Hypotheses: Simple hypothesis versus simple alternative, composite hypotheses, sampling from the normal distribution, tests on the mean and variance, tests on several means and variances, Chi-square tests, tests of hypotheses and confidence intervals, sequential tests of hypotheses. **[10]**

2. **Sampling and Sampling Distributions:** Sampling-inductive inference, populations and samples, distribution of samples, statistics and sample moments, sample mean and variance, law of large numbers, central limit theorem and its applications, sampling from the normal distributions, role of the normal distribution in statistics, sample mean, Chi-square distribution, F distribution, student's t distribution. **[10]**

3. Random Processes: Basics of random process, random process concept, continuous and discrete, statistics of random process, classification of random process, stationary and evolutionary random processes, cross-correlation, Markov process and Markov chain, binomial, Poisson, normal, Ergodic, random telegraph , sine wave random processes. **[11]**

4. Time Series Analysis: Introduction, characteristics movements in a time series, time series models, measurement of trends, secular trend, seasonal movements, cyclical movement, irregular movements, long cycles and applications. **[08]**

Text Books:

5. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
6. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
7. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
8. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

5. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
6. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
7. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
8. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

MS 562 **Modeling and Simulation Laboratory** **0-0-4-2**

Modeling and Simulation Laboratory related to Course Code MS 532 (Mathematical Modeling and Simulation).

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MS 611 **Advanced Linear Algebra** **3-1-0-4**

1. Vector Spaces and Linear Equations: Fields, vector spaces, subspaces, bases, dimension, span, coordinates, row reduced echelon matrices, invertible matrices, row and column space, system of linear equations, direct sum, determinants. **[08]**

2. Linear Transformations: Definition of linear transformations, kernel, range, rank-nullity theorem, algebra of linear transformations, representation of transformations by matrices, eigenvalues, eigenvectors, diagonalization, invariant subspaces, invertibility and isomorphisms, linear functional, transpose of a linear transformation, dual spaces. **[08]**

3. Inner Product Space and Norms: Definition of an inner product and its properties, (including the Cauchy Schwartz inequality), orthogonality, Gram-Schmidt orthogonalization process, orthogonal projections, minimization problem (least squares), adjoints. **[08]**

4. Operators on Inner Product Spaces: Unitary and orthogonal operators and their matrices, normal and self-adjoint operators, bilinear and quadratic forms on inner product spaces, spectral theory. **[08]**

5. Rational and Jordan Forms: Cyclic subspaces and annihiliators, Jordon canonical form, minimal polynomial, block matrices and matrix factorization, SVD and pseudoinverse. **[07]**

Text Books:

1. Friedbeg, Insel, Spence (2011) Linear Algebra, 4th Edition, PHI.
2. David C. L. (2002) Linear Algebra and its Applications, 3rd Edition, Pearson.

Reference Books:

1. Kumaresan S. (2000) Linear Algebra: A Geometric Approach, PHI.

2. Charles. W. C. (2012) Linear Algebra: An Introductory Approach, 3rd Edition, Springer.
3. RomanS. (2008) Advanced Linear Algebra, 3rd Edition, Springer.
4. Cheney, Kincaid (2012) Linear Algebra: Theory and Applications, 2nd Edition, Jones and Bartlet.

MA 621 Advanced Graph Theory and Combinatorics 3-1-0-4

1.Preliminaries: Graphs(undirected and directed), sub graphs, degree-sum formula, graphic sequences, matrix representations of a graph, path and circuits, bipartite graphs, graph isomorphism, decomposition,Euler graph and its properties,operations on graphs, Hamiltonian paths and circuits, traveling –salesman problem. **[08]**

2. Trees, Cut-Sets and Cut-Vertices: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's and Prim's algorithms, cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism. **[08]**

3. Planarity, Matching, Coloring and Covering: Combinatorial versus geometric graphs, geometric and combinatorial duals of a graph, planar embeddings, Euler's formula, triangulation, Kuratowski's theorem, dual graphs, factors and matching (in bipartite and non-bipartite graphs), Hall's matching theorem, chromatic number, chromating partitioning, chromatic polynomial, matching, coverings, the four color problem. **[08]**

4.Pebbling on Graph: Pebbling on undirected graph with properties, pebbling number, cover pebbling, the staching theorem, pebbling on directed graph with properties, pebbling on isomorphic graphs, pebbling of cyclic graph, alternating wheel graph, alternating fan graph and alternating complete graph with their properties, extension of graph pebbling. **[08]**

5. Advance Counting Techniques: Recurrence relations, solving linear recurrence relations, divide-and-conquer algorithms and recurrence relations, generating function, inclusion-exclusion with applications. **[07]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science,

PHI.
2. Chartland G., Zhang P. (2006)Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. Yerger C.R.(2005) Extensions of Graph Pebbling, Thesis.
4. Ore O. (1991) Theory of Graphs, Volume 38, American Mathematical Society, Colloquium Publications.
5. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.
6. Kenneth H R. (2007) Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7thEdition, Mc Graw Hill Education.

MS 631 **Real Analysis and Measure Theory** **3-1-0-4**

1. Metric Spaces: Review of the real number system (supremum, infimum, field, order and completeness axioms, extended real number system, basic notions of sets, relation and functions), finite, countable and uncountable sets, open and closed sets, adherent and accumulation points, Bolzano-Weistrass theorem, Heine-Borel covering theorem, compactness in R^n and in general metric spaces, connectedness. **[08]**

2. Limits and Continuity: Convergent sequences, Cauchy sequences, complete metric spaces, limit of a function, continuous functions, uniform continuity, convergence of series, rearrangements, Abel's and Dirichlet's theorem, sequence of functions, point wise and uniform convergence, sequential compactness, Ascoli-Arzela theorem, real power series, Weistrass theorem. **[08]**

3. Differentiation and Riemann Integration: Algebra of derivatives, the chain rule, differentiation of monotone functions (leading to the mean value theorem and intermediate value theorem), upper and lower integrals, oscillations, integrality of continuous functions, fundamental theorem of calculus, interchange of limit and integration operations, vector valued differentiation and integration. **[08]**

4. Measure Theory: Indicator functions, fields and σ-fields, definition and fundamental properties of a non-negative measure, measurable sets, measure zero sets, positive Borel measures,Lebesgue measure,algebra of measurable functions, almost everywhere convergence, convergence in measure. **[08]**

5. Integration Theory on General Measure Spaces: The Lebesgue integral, Fatou's Lemma, the monotone and dominated convergence theorems, continuous functions with compact support, Tonelli and Fubini's theorems, comparison of proper and improper Lebesgue and Riemann integrals. **[07]**

Text Books:

1. Rudin W.(1976)Principles of Mathematical Analysis, 3rd Edition, TMH.
2. Bartle R. G., Donald R. S. (2011)Introduction to Analysis, 2nd Edition, Wiley and Sons.

Reference Books:

1. Royden H.L. (2017)Real Analysis , 2nd Edition, PHI
2. Apostle (1997)Mathematical Analysis , 2nd Edition, Narosa Publishing House,
3. Carothers N. L. (2000) Real Analysis, 2nd Edition, Cambridge University Press.
4. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.

MS 641 **Special Functions and Integral Equations** **3-1-0-4**

1. Hypergeometric Functions: Definition, convergence, gamma and beta functions, Gauss hypergeometric function and its properties, series solution of Gauss hypergeometric equation, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, Kummer's confluent hyper geometric function and its properties, integral representation. **[10]**

2.Bessel and Legendre Functions: Definition, connection with hypergeometric function, differential and pure recurrence relations, generating function, integral representation, orthogonal properties. **[10]**

3.Linear Integral Equations: Definition and classification, conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions, solution of homogeneous and general Fredholm integral equations of second kind with separable kernels. **[10]**

4.Solution of Integral Equations: Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations, Resolvent kernel and its results, conditions of uniform convergence and uniqueness of series solution, solution of Volterra integral equations of second kind with convolution type kernels by Laplace transform. **[09]**

Text Books:

1. Kanwal R.P. (1971)Linear Integral Equations: Theory and Techniques,Academic Press, New York.
2. Miller LieW. Jr. (1968)Theory and Special Functions,Academic Press, New York and London.

Reference Books:

1. Rainville E.D. (1960) Special Functions, Macmillan Company, New York.
2. Wazwaz A. M. (2011)Linear and Non Linear Integral Equations: Methods and Applications,Higher Education Press, Springer.
3. Banerjee P.K., Goyal M.C. (2003) Special Functions and Calculus of Variations, Ramesh Book Depot. Jaipur, India.
4. Swarup S., Singh S. J. (2014) Integral Equation, 22nd Edition, Krishna Prakashan Meerut.

MS 612 **Functional Analysis** **3-1-0-4**

1. General Theory: Introduction of topological vector spaces, separation properties, linear mappings, finite-dimensional spaces, metrization, boundedness and continuity, seminorms and local convexity, quotient spaces, completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

2. Completeness and Compactness: Completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

3.Duality in Banach Spaces and Applications I: The normed dual of a normal space, adjoints, compact operators, continuity theorem, closed subspaces of Lp-spaces, the range of a vector-valued measure, **[10]**

4.Duality in Banach Spaces and Applications II: Generalized Stone-Weierstrass theorem, two interpolation theorems, Kakutani's fixed point theorem, Haar measure on compact groups, uncomplemented subspaces, sum of Poisson kernels, two more fixed point theorems. **[09]**

Text Books:

1. Rudin W. (2006) Functional Analysis, McGraw Hill Education (India).
2. Limaye B.V.(2013)Functional Analysis, 3rd Edition, New Age International.

Reference Books:

3. Somasundaram D. (2014) First Course in Functional Analysis, 1 Edition, Narosa Book Distribution Pvt. Ltd.
4. Corlson, Robert (2006) Concrete Introduction to Real Analysis, Vikas publishing House Pvt. Ltd.
5. Kreyszig E. (2007) Introductory Functional Analysis with Applications John Wiley & Sons.

MS 622 **Inequality and Continued Fractions** **3-1-0-4**

1. Inequalities: Definition and important properties**,** maximum and minimum values of algebraic functions and expressions with and without constraints, some important inequalities, Weirstrass inequality, Schwarz's or Cauchy's inequality,Tchebychef's inequality, important proofs and theorems. **[10]**

2. Continued Fractions I: Definition and different form of continued fractions, simple, infinite or non terminating and terminating continued fractions, continued fractions with positive quotients, conversion of fraction into continued fraction, successive convergent, law of formation of successive convergent of simple continued fraction. **[10]**

3. Continued Fractions II: Difference between the fraction and its convergent, equivalent numbers and periodic continued fractions, some special quadratic surds, recurring continued fraction. **[10]**

4. Continued Fractions III: Different theorems based on odd and even convergent, limits to error in convergent for the continued fraction, series of fractions and approximation. **[09]**

Text Books:

1. Hardy G. H., Littlewood J. E., Polya G. (1952) Inequalities, Cambridge University Press.
2. Hardy G. H., Wrihgt E.M. (1979) An Introduction to Theory of Numbers, 5th Edition, Oxford, University Press.

Reference Books:

1. Niven, Zuckerman H. S., Montgomery H. L. (2004) An Introduction to the Theory of Numbers, 5th Edition, John Wiley and Sons, Inc., New York.
2. Bruce C. B. (2005)Ramanujan's Note Books Volume-1 to 5, Springer.
3. ApostolT. M. (2013)Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi.

MS 632 **Basics of MATLAB** **0-0-4-2**

1. Introduction: MATLAB interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. **[08]**

2. Functions and Files: Elementary mathematical functions, user defined functions, additional functions, working with data files. **[06]**

3. Decision-Making Programs: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[06]**

4. Advanced Plotting and Model Building: *xy* Plotting functions, additional commands and plot types, interactive plotting, function discovery, regression, basic fitting interface, three dimensional plots. **[06]**

Text Books:

1. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.
2. William J. Palm III (2012), A Concise Introduction to MATLAB, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.
2. Stormy A. (Edition 4), MATLAB: A Practical Introduction to Programming and Problem Solving, BH Publication.

MS 651 **Magneto Hydrodynamics** **3-1-0-4**

1. Fundamental Equations of MFD: Electromagnetic field equations(charge conservation equation, constitutive equations, Maxwell's equations, generalized Ohm's law),fluid dynamics field equations(equation of state, equation of motion, equation of energy), MFD approximation, magnetic field equation, magnetic Reynolds number, Alfven's theorem, magnetic energy, electromagnetic stresses, force free magnetic fields. **[10]**

2. Basic Equations of MHD Flow: Boundary conditions, flow between parallel plates, Hartmann flow, Couette flow with velocity and temperature distributions, flowin a tube of rectangular cross section, pipe flow, flow in a annular channel, flow between two rotating coaxial cylinder. **[10]**

3. Boundary Layer Approximation: Two dimensional boundary layer equations for flow over a plane surface for fluids of large electrical conductivity, flow past a semi infinite rigid flate plate in an aligned and transverse magnetic field, two dimensional thermal boundary layer equations for flow over a plane surface, heat transfer in MHD boundary layer flow past a flate plate in an aligned magnetic field. **[10]**

4. Magneto Hydrodynamics Waves: Waves in an infinite fluid of infinite electrical conductivity, Alfven waves, waves in a compressible fluid, waves in the presence of dissipative effects, stationary plane shock waves in absence of magnetic field. **[09]**

Text Books:

1. Cramer R.K., Pai S.I.(1973) Magnetofluid Dynamics for Engineers and Physicists, Scripta Publishing Company, Washington D. C.
2. Charlton P.(1985) Text Book on Fluid Dynamics, CBS Publications, Delhi.

Reference Books:

1. Shereliff J.A. (1965) Magneto Hhydrodynamics, Pergamon Press, London.
2. Rathy R.K. (1976)an Introduction to Fluid Dynamics Oxford and IBH Publishing Company, New Delhi.

MS 652 **Viscous Fluid Dynamics** **3-1-0-4**

1. Fluid Motion: Introduction and continuum hypothesis, constitutive equations for Newtonian fluids, viscosity, Navier Stoke's equation for viscous compressible flow, vorticity and circulation, equation of energy, flow between two concentric rotating cylinders, stagnation point it two dimensional flow, flow due to plane wall suddenly set in motion(Stoke's first problem). **[10]**

2. Temperature Distribution: Physical importance of non-dimensional parameters. Renold's number, Prandtl number, Mach number, Froude Number, Nusselt number , plane couette flow, plane poisseullecouette flow, plane poissuille flow, Haigen poissuille flow in a circular pipe, Stoke's equation of very slow motion, Stoke's stream function, flow past a sphere. **[10]**

3. Laminar Flow: Two dimensionalincompressible boundary layer equation, Blasuis Topfer solution of boundary layer on a flat plate, wedge flow, flow in a convergent channel, flow in the wake of flat plate, two dimensional plane jet flow. **[10]**

4. Boundary Layer Theory: Thermal boundary layer in two dimensional incompressible flows, Crocco's integrals, forced convection in laminar boundary layer on a flat plate, free convection from a heated vertical plate, Karman momentum and kinetic energy integral equations. **[09]**

Text Books:

1. Schliching H., Boundary Layer Theory, McGraw Hill.
2. Pai, S.I, Nostrand D.V. (1956) Viscous Flow Theory, Vol.I, Laminar Flow, Company, New York.

Reference Books:

1. BansalJ.L. (2004)Viscous Fluid Dynamics, Oxford and IBH.
2. Frank M. W. (1991)Viscous Fluid Flow,2nd edition, McGraw Hill.

MS 661 **Sequence and Series** **3-1-0-4**

1. **Real and Complex Numbers:**Introduction, field and order structures, bounded and unbounded sets with supremum and infimum, completeness, absolute value, limit points, closure, countable and uncountable sets,complex number system, triangle inequality, functions of single variable. **[12]**

2. Sequences: Sequences of real and complex numbers, limit points, limits, convergence and non-convergence, Cauchy's general principle of convergence, algebra of sequences, monotonic, point wise convergence, uniform convergence on an interval, tests for convergence, properties, Weierstrass approximation theorem. **[11]**

3.Infinite Series I: Introduction, series of real and complex numbers, positive term series, comparison, Cauchy's root, D'Alembert's ratio, Raabe's, Logarithmic, integral, Gauss's tests, series with arbitrary terms, rearrangement of terms. **[08]**

4.Infinite Series II: Properties of uniform convergent series, power series, properties of functions expressible as power series, Abel's theorem, Taylor's and Lauren's series with convergence. **[08]**

Text Books:

1. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.
2. Rudin W.(1976) Principles of Mathematical Analysis, 3rd Edition, TMH.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trignometric Series, Vol. 1, Cambridge University Press.
3. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.
4. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
5. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 662 **Summability and Approximation Theory** **3-1-0-4**

1. Transformation and Summability Means: Matrix and linear transformation, definition of summability, Norlund means and its regularity condition, Cesaro means (C, 1) means, Cesaro and holders matrices, consistency of methods, examples and related theorems. **[15]**

2.Convergence of Fourier Series: Convergence of Fourier series, Dirichlet's integral, Riemann-Lebesgue theorem, (C, 1) summability of Fourier series, Fejer theorem, Fejer-Lebesgue theorem. **[08]**

3. L_p Space: Definition of L_2space, L_p space, Bessel's inequality, Holders inequality and Minkowski inequality. **[08]**

4.Approximation Theory: Best approximation in normed space, linear operators, Weierstrass's approximation theorem, Stone Weierstrass theorem, Chebyshev polynomials, trigonometric polynomials, error approximation function, Bernstein polynomial. **[08]**

Text Books:

1. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
2. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trigonometric Series, Vol. 1, Cambridge University Press.
3. PetersonG. M (1966) Regular Matrix Transformation, Mc-Graw Hill.
4. Boss J. (2000) Classical and Modern Methods in Summability, Oxford University Press.
5. Mursaleen M. (2014) Applied Summability Methods, Springer.
6. Hrushikesh N., Haskar M, Pai D.V. (2000) Fundamentals of Approximation Theory, Narosa Publishing House.
7. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 671 **Tensor Analysis** **3-1-0-4**

1. Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors. **[10]**

2. The Tensor Concept: Zeroth-order tensors, first-order tensors, second-order tensors, higher-order tensors, transformation of tensors under rotation about a coordinate axis, invariance of tensor equations, curvilinear coordinates, tensors in generalized coordinate systems. **[10]**

3. Tensor Algebra: Addition of tensors, multiplication of tensors, contraction of tensors, symmetry properties of tensors, reduction of tensors to principal axes, invariants of tensors, pseudotensors. **[10]**

4. Vector and Tensor Analysis: Field concept, Gauss, Green And Stokes theorem, scalar fields, vector fields, second-order tensors fields, the operator ∇ and related differential operators. **[09]**

Text Books:

1. Vector and Tensor Analysis by A. I. Borisenko and I. E. Tarapov, Dover, 1979.
2. Introduction to Vector and Tensor Analysis by R. C. Wrede, Dover, 1972.

Reference Books:

1. DavisH. F., SniderA. D. (1995) Introduction to Vector Analysis, 7thEdition, Brown Publishers.
2. Schey H.M. (1997) Div, Grad, Curl and All That: An Informal Text on Vector Calculus, 2nd edition, W.W. Norton.
3. Bourne D.E., KendallP.C. (1977) Vector Analysis and Cartesian Tensors, Nelson.
4. Tensor Calculus by J. L. Synge and A. Schild, Dover, 1978.

MS 672 **Mechanics and Calculus of Variation** **3-1-0-4**

1. Generalized Coordinates: Holonomic and non holonomic systems, Scleronomic and Reonomic systems, generalized potential, Lagrange's equations of first kind, Lagrange's equations of second kind, uniqueness of solution, and energy equation of conservative fields. **[10]**

2. Hamilton's Variables: Donkin's theorem, Hamilton canonical equations, cyclic coordinates, Routh's equation, Poisson's bracket, Poisson's identity, Jacobi- Poisson theorem. **[10]**

3. Calculus of Variations: Motivating problems of calculus of variations, Brachistochrone problem, isoperimetric problem, geodesic, fundamentals lemma of calculus of variations, Euler's equation of one dependent function and its generalization to (i) 'n' dependent functions, (ii) higher order derivatives, conditional extremum under geometric constraints and integral constraints. **[10]**

4. Hamilton-Jacobi Theory: Hamilton's principal, principal of least action, Poincare Cartan integral invariant, Whittaker's equations, Jacobi's equations, statement of Lee Hwa Chung's theorem, Hamilton-Jacobi's equation, Jacobi's theorem, method of separation of variables. Lagrange's bracket and Poisson brackets, invariance of Lagrange's bracket and Poisson brackets under canonical transformations. **[09]**

Text Books

1. Ramsey A.S.(1941)Dynamics Part II, Cambridge University Press.
2. Goldstein H. (2002) Classical Mechanics, 3rd edition, Narosa Publishing House.

Reference Books:

1. Loney S.L. (2016) An Elementary Treatise on Statics, First paperback edition, Cambridge University Press.
2. Louis N. H., Janet D. F.(1999)Analytical Mechanics, Cambridge University Press.
3. Gelfand I M., Fomin S.V., Richard A. S. (2000) Calculus of Variations PHI.
4. Tiwari R.N., Takhur B.S. (2007) Classical Mechanics: Analytical Dynamics, PHI.

MS 681 **Reliability Theory** **3-1-0-4**

1. Basic Concepts of Reliability: Introduction, reliability and quality, failure and failure modes, causes of failures and unreliability, maintainability and availability, reliability analysis, mathematical models and numerical evaluation, designing for higher reliability, redundancy techniques, equipment hierarchy, reliability and cost. **[07]**

2. Reliability Mathematics: Random experiments and probability, random variables, discrete distribution (Binomial and Poisson) and Continuous distributions (uniform, exponential, Rayleigh, Weibull, gamma, normal, log normal, truncated normal, inverse Gaussian), numerical characteristics of random variables and Laplace transform. **[08]**

3. System Reliability and Hazard Models: Component reliability from test data, mean time to failure, time-dependent hazard models, stress-dependent hazard models, derivation of reliability function using Markov model, treatment of field data, system with components in series and parallel, k-out-of-m systems,non series-parallel systems, system with mixed-mode failures, fault-tree technique. **[08]**

4. System Design and Reliability Redundancy: Component versus unit redundancy, weakest-link technique, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy, maintainability and availability concepts with two-unit parallel system with repair, preventive maintenance. **[08]**

5. Reliability Testing Demonstration and Acceptance: Problem of life testing, estimation of parameters and reliability using standard probability models using complete and censored samples, properties of these estimators, probability plotting and graphical procedures for estimating the parameter and testing validity of model by some standard statistical tests, life test acceptance sampling plans in exponential case, sequential life test in exponential case, accelerated life tests. **[08]**

Text Books:

1. Ebeling C. E. (2015), An Introduction to Reliability and Maintainability Engineering, Eighteenth reprint, McGraw Hill Education.

Reference Books:

1. Balagurusamy E. (2008) Reliability Engineering, Sixth reprint, TMH.
2. Srinath L.S., Reliability Engineering, Fourth Edition, EWP.

MS 682 **Fourier Analysis** **3-1-0-4**

1. Fourier Series: Recapitulation about piecewise continuous functions, odd and even functions, periodic and non-periodic functions, orthogonal and orthonormal functions, orthonormal sets, Dirichlet's conditions, Fourier series, change of interval, Fourier cosine series, Fourier sine series, complex form of Fourier series, convergence of Fourier series, generalized Fourier series, practical harmonic analysis,Fourier–Bessel series, Fourier – Legendre series. **[10]**

2. Fourier Integral and Applications: The Fourier integral formula, Dirichlet's integral, Fourier integral theorem, cosine and sine integrals, Eigen value problems on unbounded intervals, superposition of solutions, steady temperature in a semi-infinite strip, temperature in a semi-infinite solid, temperature in an unlimited medium. **[10]**

3.Fourier Transform and Applications I: Definition and properties of Fourier transform, Fourier cosine and sine transforms, complex Fourier transform, convolution theorem, Parseval's identities, finite Fourier transforms, solution of some partial differential equations. **[10]**

4. Fourier Transform and Applications II: Discrete Fourier Transform (DFT), approximation of Fourier coefficients of a periodic function, inverse DFT, properties of DFT, cyclical convolution and convolution theorem for DFT, Parseval's theorem for DFT, matrix form, N-point inverse DFT, fast Fourier transform(FFT). **[09]**

Text Books:

1. Ward Brown J., ChurchillR. V. (2015) Fourier Series and Boundary Value Problems, McGraw Hill Education.
2. Davis H.F. (1989) Fourier series and Orthogonal Functions, Dover Books on Mathematics.

Reference Books:

1. Spiegel (2015) Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series), McGraw Hill Education.
2. Jain R.K., Iyengar S.R.K. (2003) Advanced Engineering Mathematics, Narosa Publishing House.
3. Tolstov G.P. (1976) Fourier series, Dover Books on Mathematics.
4. JamesI.F. (2002) A Student's Guide to Fourier Transform with Applications in Physics and Engineering, 3rd edition, Cambridge.

MS 691 **Advanced Number Theory** **3-1-0-4**

1. Divisibility Theory and Factorization: Prime numbers and their distribution, greatest common divisor and the Euclidian algorithm, linear Diophantine equation, sieve of Eratosthenes, Mersenne primes and perfect numbers, sums of two squares. **[08]**

2. Theory of Congruences: Basic properties of congruences, linear congruences and the Chinese remainder theorem, Fermat's little theorem and pseudoprimes, $\varphi(n)$ (Euler's phi function), Euler generalization of Fermat's theorem, Wilson's theorem. **[08]**

3. Primitive Roots and Quadratic Reciprocity: Multiplicative orders of integers modulo$n$, primitive roots of primes and composites, Legendre and Jacobi symbols, quadratic reciprocity and quadratic congruences with multiple moduli. **[08]**

4. Special Functions and Recent Applications: Fermat numbers, amicable numbers, the Mobius inversion formula, sums of more than two squares, public key cryptosystems, primalty testing and factorization, Diffie-Helman key exchange, finite fields, cyclotomic polynomials, Gaussian integers, continued fractions, Pells equations, valuations, Deedkind domain, the Riemann zeta(ζ) function, modular (quadratic) forms, quadratic number fields. **[15]**

Text Books:

1. BurtonD.M. (2011) Elementary Number Theory, 2nd Edition, Tata Mc Graw Hills.
2. Telang S.G. (1996) Number Theory, 6th Edition, Tata Mc Graw Hills.

Reference Books:

1. Murty V. K. (1998) Contemporary Mathematics (Number Theory), Wald Schmidt AMS Society.
2. Lang S. (1994) Algebraic Number Theory, 2ndEdition, Springer Textbooks.
3. LandauE. (1966)Elementary Number Theory, 2nd Edition, AMS.
4. Frohlich, Taylor, Taylor (1991) Algebraic Number Theory, 2nd Edition, Cambridge University Press.
5. Niven I., Zuckerman (1991) Introduction to Theory of Numbers, 5th Edition Montgomery, Wiley.

MS 692 **Differential Geometry** **3-1-0-4**

1. Space Curves I: Definition of space curves, arc length, natural equation of a line, and intersection of curves, intersection of curve and surface, order of contact, tangent, normal, osculating plane. **[10]**

2. Space Curves II: Principal normal and binormal at a point of a curve, curvature, torsion, Frenet – Serret formulae, plane curves, osculating circle and osculating sphere, fundamental theorem for space curves, helices, evolutes and involutes. **[10]**

3. Surfaces I: Definition of a surface, tangent plane and normal at a point of a surface, surfaces of revolution, conicoids and helicoids, envelopes and developable surfaces, ruled surfaces. **[10]**

4. Surfaces II: First fundamental form(metric), metric potentials, direction coefficients and angle between two curves on a surface, second fundamental form, lines of curvatures, principal curvatures, Meusnier's theorem, Euler's theorem, Dupin's indicatrix, means curvature, Gaussian curvature. **[09]**

Text Books:

1. Hsiung C. C. (1997) A First Course in Differential Geometry, International Press, and Cambridge, MA.
2. Willmore T.J. (1964) An Introduction to Differential Geometry, Oxford University Press,

Reference Books:

1. Carmo M. P. D. (1976) Differential Geometry of Curves and Surfaces, Prentice-Hall, Englewood, NJ.
2. Abate M., Tovena F. (2012) Curves and Surfaces, Springer.
3. PetersA. K. (2010) Differential Geometry of Curves and Surfaces, Ltd., Natick, Mass.
4. Struik D.J. (1988) Lectures on Classical Differential Geometry, 2nd Edition, Addison-Wesley.

Mody University of Science & Technology

MSc Microbiology
Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.- Microbiology

Two-Year Programme

Academic Curriculum (2013 – 14 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Autumn Semester	MB 511	Bacteriology and Phycology	3	-	-	3	3	25	25	50
	MB 521	Virology and Mycology	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 541	Laboratory Course in Study of Microorganisms	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**1**	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Spring Semester	MB 512	Microbial Physiology and Metabolism	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3	-	-	3	3	25	25	50
	MB 532	Immunology	3	-	-	3	3	25	25	50
	MB 631	Microbial Genetics	3	-		3	3	25	25	50
	MB 542	Seminar	-	-	-	1	-	100		
	MB 524	Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section.

M.Sc.-Microbiology
Two-Year Programme
Academic Curriculum (2013 – 14 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	MB 611	Medical Microbiology	3	1	-	4	3	25	25	50
	MB 681	Environmental and Agricultural Microbiology	3	1	-	4	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	MB 651	Medical, Environmental and Agricultural Microbiology Laboratory	-	-	4	2	4	100		
	MB 671	Genetic Engineering and Fermentation Technology Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**3**	**8**	**19**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	MB 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				
		Total Credits				**84**				

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Microbiology)

MB 511 Bacteriology and Phycology 3-0-0-3

General Concepts of Microbiology: History and development of Microbiology as a discipline of science, spontaneous generation vs biogenesis, Koch's postulates Basic features of microscopy-Compound, fluorescence, dark field, phase contrast, SEM and TEM, Staining methods-simple, differential and sample preparation for electron microscopy. [6]

Morphology and Ultrastructure of Bacteria: Basic ultrastructure, morphological types, cell walls of gram positive, gram negative and archeobacteria, cell wall biosynthesis, cytoplasmic membrane-structure, composition and functions, L-forms, Ultrastructure and types of flagella, capsule and its function, pilli. [8]

Cultivation of Bacteria: Aerobic and anaerobic cultivation, Nutrient media-selective and differential, Nutrient types of bacteria, Growth curve and kinetics of growth, Batch culture, fed-batch culture and continuous culture, synchronous growth, Factors affecting growth, Control of bacteria-physical and chemical agents. [10]

Classification: Bacterial classification, Hackle's three kingdom, Whittaker's five kingdom, Eight kingdom classification, Phenetic and phylogenetic classification, Outlines of Bergeys manual, Use of molecular approaches for classification of bacteria. [7]

Algae: General Characteristics, Classification, Nutrition, Reproduction, Algal ecology, Economic importance of Diatoms, Rhodophyta and Green algae. [8]

MB 521 Virology and Mycology 3-0-0-3

General Concepts of Viruses: Discovery of viruses, Distinctive features, Morphology and Ultrastructure, Envelope and its properties, Virus related agents (Viroids and Prions). Classification-General properties, Nomenclature and classification of bacterial, plant and animal viruses. [5]

General Methods of Diagnosis of Viruses: Cultivation methods-embryonated eggs, experimental animals, cell cultures (Primary and secondary), Serological methods- heamagglutination, complement fixation, immunofluoresecnce, ELISA and RIA, infectivity assay (end point method); Role of electron microscopy in study of viruses. [8]

Bacterial and Plant Viruses: Bacteriophage structure- general characteristics, Life cycle- Lytic and Lysogeny, One step growth curve, Regulation of lytic cycle, brief details of M13, Mu, Lambda and T4, Effect of viruses on plant appearance, histology, cytology, Transmission of plant viruses- Vector(insects, nematodes) and without vector, Common diseases of Paddy, Cotton, Tomato and Sugarcane, Life cycles- TMV, CMV and Potato Virus X. [10]

Animal Viruses: Life cycle and pathogenecity of RNA viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota and HIV, Oncogenic viruses, DNA viruses- Pox, Herpes, Adeno, SV 40, Hepatitis viruses, Basic concepts of viral vaccine. [8]

General Concepts of Mycology: General features of fungi, Classification of fungi, Life cycles of *Aspergillus*, *Saccharomyces*, *Deuteromycetes*, Mycorrhiza: Ecto, endo and VAM, Lichens- general features, Fungal diseases- Systemic and Sub cutaneous Mycoses, Candidiasis, Dermatomycosis. [8]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Molarity and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance. [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates. [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, Michelis Menten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary [6]

electrophoresis.

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean, median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean [6]

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis [9]

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 541 Laboratory Course in Study of Microorganisms 0-0-4-2

Assignments based on MB 511 and MB 521containing exercises on staining and isolation of different microbial types on the basis of cultural and microscopic methods will be conducted.

BC 541 Biomolecules and Instrumentation laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

MB 512 Microbial Physiology and Metabolism 3-0-0-3

Transport Mechanisms: Basic features of transport- Role of cell membrane in transport, Thermodynamics of transport, Types of transport- passive diffusion, facilitated diffusion, active transport, group translocation, uniport, symport and antiport, Transport of siderophores. [8]

Respiratory Metabolism: Glucose Metabolism- Reactions and control of Glycolysis, Pentose Phosphate Pathway, Gluconeogenesis, Citric acid cycle, Oxidative and Substrate level phosphorylation, Glyoxylate cycle, Homo and heterolactic fermentation, Pasteur effect. [10]

Photosynthesis: Brief account of photosynthetic and accessory pigments- Chlorophyll, Bacteriochlorophyll, Carotenoids and Phycobiliproteins, Details of Oxygenic and Anoxygenic photosynthesis, Major groups of photosynthetic bacteria, Fixation of CO_2- Calvin cycle, C3 and C4 pathway; Photorespiration. [10]

Nitrogen and Lipid Metabolism: Nitrogen cycle, Assimilation of nitrogen, Biosynthesis of amino acids, Nitrogen fixation- basic concepts, nitrogenase enzyme, Fatty acid oxidation- □-oxidation, Fatty acid biosynthesis. [6]

Sporulation and Morphogenesis: Endospore formation- structure, properties and germination; Dormancy in selected microbes [5]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens*, *Campylobacter jejuni, Helicobacter pylori* [10]

Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 592 Bioinformatics , Scientific Communication & Intellectual Property Rights **3-1-0-4**

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management. 6

Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions. 8

Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins. 8

Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index. 3

Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International) 7

Biotechnology and Intellectual Property Rights.
Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy 7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 Molecular Biology 3-0-0-3

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity. [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 631 Microbial Genetics 3-0-0-3

Mutations: Basic concepts of mutation, Molecular nature of mutations, Spontaneous mutation, Reverse mutation, Frameshift mutation, Site directed mutagenesis- deletions, insertions, localized point mutation, Mutations by synthetic oligonucleotides, Evolutionary role of mutation. [8]

Gene Transfer: Transformation, Transduction- specialized and generalized, Conjugation- interrupted mating, Transfection. [8]

Vectors: Plasmids, Colicins and col factors, Plasmids as vectors for gene cloning, Transposons and their use in genetic analysis, Mechanisms of antibiotic resistance by transposons. [6]

Bacteriophage Genetics: Life cycle and uses of following phages in microbial genetics- Lytic phages- T4 and T7, Lysogenic phages- P1, M13, ΦX174, fd [9]

Gene Expression: Gene expression in eukaryotes and prokaryotes and its regulation [8]

MB 542 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver seminar on it.

MB 524 Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory 0-0-4-2

Assignments based on MB 512 MB 514 and MB 592 containing exercises on microbial physiology, genetics and metabolisms of microorganisms and their role in food production and spoilage will be conducted.

BT 572 Molecular Biology and Immunology Laboratory 0-0-4-2

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication 0-0-2-1

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

MB 611 Medical Microbiology 3-1-0-4

Normal Flora of Human Body: Skin, Oral cavity, Gastrointestinal tract, Respiratory tract, Urinogenital tract, Concept of opportunistic pathogens. [3]

Infection: Sources of infection for man, Vehicles or reservoirs of infection, Vertical and horizontal transmission of infection, Pathogenesis of infecting microorganisms-Virulence factors (adhesions, enzymes-coagulases, fibrinolysins, mucinases, lipase, proteases, nucleases, collagenase, neuraminidase). Toxins-endotoxins and exotoxins as agents of disease. [5]

Microbial Strategies for Evading Immune Response: Evading phagocytosis, Survival in phagocytes, Immunosuppression, Induction of ineffective antibodies, Antigenic variation, Avoiding induction of immune response. [5]

Bacterial Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of bacterial diseases caused by- *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Vibrio, Yersinia, Mycobacterium, Treponema, Mycoplasma, Campylobacter, Helicobacter, Rickettsiae and Chlamydiae.* [9]

Viral Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of viral diseases- Pox viruses (Small pox), Herpes viruses (HSV, Epstein-barr virus), Adenoviruses, Picorna viruses (Polio, Rhinoviruses), Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, RSV), Arboviruses (Dengue, Yellow fever,), Rhabdoviruses (Rabies), Hepatitis viruses, Rubella, Reovirus, Rotavirus, Viral Haemorrhagic Fevers, HIV, Oncogenic Viruses. [9]

Fungal and Protozoan Diseases: Pathogenesis, laboratory diagnosis and treatment of fungal and protozoan (Malaria, Kala Azar) diseases. [5]

Antimicrobial Agents: Mode of action of important antibacterial, antifungal, antiviral and antiprotozoan agents. [3]

MB 681 Environmental and Agricultural Microbiology 3-1-0-4

Aerobiology: Droplet nuclei, aerosols, Assessment of air quality- solid, liquid impingment, Air borne transmission of microbes [3]

Types of Soils- physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere [3]

Water Microbiology: Fresh water and marine habitats- general characteristics, Types of microbes, Microbial activity, Eutrophication and its effects, Assessment of water quality- water purification, Potability standards. [7]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles; Role of microbes in biodeterioration- Metal corrosion, Paper; Metal detoxification, Biopesticides. [10]

Microbes in Waste Treatment: Types of wastes- Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and

Tertiary treatment), Trickling filter, Biocontactor, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [8]

Nitrogen Fixation: Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic(Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications. [8]

MB 641 Industrial Microbiology and Fermentation Technology 3-0-0-3

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feed back repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (□-lactam, aminoglycosides). [12]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids. [5]

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomyces cereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

MB 651 Medical, Environmental and Agricultural Microbiology laboratory 0-0-4-2

Assignments based on MB 611 and MB 621 describing role of microorganisms in disease causing and prevention and their positive and negative role in environment and agriculture will be conducted.

MB 671 Genetic Engineering and Fermentation Technology laboratory 0-0-4-2

Assignments based on MB 641and BT 611 containing exercises on genetic engineering of microorganisms and their role in industrial production of various metabolites like antibiotics, vitamins and enzymes will be conducted.

Mody University of Science & Technology

M.Sc. Chemistry
Session 2018-2019

Curriculum Structure

MASTER OF SCIENCE IN CHEMISTRY
M. Sc. – Chemistry
(2014-2015 onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20
M Sc First Year curriculum will be common for ALL specialization

History:

There has been rapid increase in demand of Chemical science professionals. Considering such a requirement, it is proposed to start a new postgraduate programme namely Master of Science in Chemistry with aim of acquiring the knowledge and developing the skills to plan, design and build complex applications which are highly valued in all sectors like pharmaceutical, fertilizer, education, chemical, biotechnology etc.
The first batch of the programme in MITS is proposed to be admitted in the session 2010-2011.

Input Qualification:

Bachelor's degree with Chemistry as a subject for three years / six semesters/ B. Sc. Applied Chemistry / B. Sc. Biochemistry / B.Sc. Industrial Chemistry with 50 % of marks.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of Postgraduate Programmes of MITS shall be followed.

M. Sc.-Chemistry
Academic Curriculum (2014-2015 onwards)
First Year-Common to ALL Specialization

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 511	Inorganic Chemistry-I	3	-	-	3	3	25	25	50
	CH 513	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 531	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH 523	Spectroscopy-I	3	-	-	3	3	25	25	50
	CH 551▲/ CH 561▲▲	Mathematics for Chemists▲/ Biology for Chemists ▲▲	3	-	-	3	3	25	25	50
	CH 571	Inorganic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 581	Organic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 591	Physical Chemistry Laboratory -I	-	-	4	2	4	25	25	50
		Sub Total	**15**	-	**12**	**21**	-	-	-	-
		Foreign Language –I ‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 512	Inorganic Chemistry-II	3	-	-	3	3	25	25	50
	CH 514	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH 532	Physical Chemistry-II	3	-	-	3	2	25	25	50
	CH 524	Spectroscopy-II	3		-	3	3	25	25	50
	CH 534	Colloids and Surface Chemistry	3		-	3	3	25	25	50
	CH 562	Inorganic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 572	Organic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 582	Physical Chemistry Laboratory -II	-	-	4	2	4	25	25	50
		Sub Total	**15**		**16**	**21**	-	-	-	-
		Foreign Language-II‡	3	-	-	3	-	25	25	50

Total Credits 42

▲ *For students without Mathematics in B. Sc.*

▲▲ *For students without Biology in B. Sc.*

‡ *Refer to Foreign Language Section*

M. Sc.-Chemistry
(Specialization in Organic Chemistry)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 611	Photochemical Reactions	3	-	-	3	3	25	25	50
	CH 621	Bioorganic Chemistry	3	-	-	3	3	25	25	50
	CH 631	Organic Synthesis-I	3	-	-	3	3	25	25	50
	CH 641	Separation Techniques and Data Analysis	3	-	-	3	3	25	25	50
	CH 651	Environmental and Green Chemistry	3	-	-	3	3	25	25	50
	CH 661	Advanced Organic Chemistry Laboratory-I	-	-	4	2	4	25	25	50
	CH 671	Advanced Organic Chemistry Laboratory-II	-	-	4	2	4	25	25	50
	CH 681	Advanced Organic chemistry Laboratory-III	-	-	4	2	4	25	25	50
		Sub Total	**15**	**-**	**12**	**21**	**-**	-	-	-

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 612	Organic Synthesis-II	3	-	-	3	3	25	25	50
	CH 622	Heterocyclic Chemistry	3	-	-	3	3	25	25	50
	CH 632	Chemistry of Natural Products	3	-	-	3	3	25	25	50
	CH 642	Medicinal Chemistry	3	-	-	3	3	25	25	50
	CH 652	Dissertation[#]	-	-	-	10	-	100		
		Sub Total	**12**	**-**	**-**	**22**	**-**	-	-	-
		Total Credits				**87**				

[*] *Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.*

[#] *Student will perform project work for a period of 2 months and submit two copies of Dissertation report to the department. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

COURSE DESCRIPTION
M. Sc. (Chemistry)

CH 511 **Inorganic Chemistry-I** **3-0-0-3**

Stereochemistry and Bonding in Main Group Compounds: Walsh diagrams (tri-atomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. [9]

Metal-Ligand Equilibria in Solution : Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. [8]

Reaction Mechanism of Transition Metal Complexes : Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. [15]

Metal-Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. [7]

Suggested Books:

1. Advanced Inorganic Chemistry; F.A. Cotton and G. Wilkinson, 6th Edn. John Wiley & Sons.
2. Inorganic Chemistry; James E. Huheey, 4th Edn. Addison-Wesley Pub. Co.
3. Physical Methods in Inorganic Chemistry; R. S. Drago, International Edn. East-West Press.
4. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.

CH 513 **Organic Chemistry-I** **3-0-0-3**

Nature of Bonding in Organic Molecules: Delocalized chemical bonding, conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. [6]

Stereochemistry: Conformational analysis of cycloalkanes, Decalines. Chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. [10]

Reaction Mechanism, Structure and Reactivity: Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation. [8]

Aliphatic Nucleophilic Subsitution: The SN2, SN1 mixed SN1 and SN2 and SET mechanism. Neighbouring group participation mechanism by σ and π bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The SN i mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Ambident nucleophile, regioselectivity. [5]

Aliphatic Electrophilic Substitution: Bimolecular mechanisms SE2 and SEi, The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving groups and the solvent polarity on the reactivity. [6]

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction. [4]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, 5th Edition. John Wiley & Sons.
2. A Guide book to Mechanism in Organic Chemistry; Peter Sykes, 6th Edition, Orient Longman Ltd..
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Organic Chemistry; R.T. Morrison and R.N. Boyd, Prentice- Hall of India.

6. Organic Reactions and Their Mechanisms; P.S. Kalsi, New Age International Publication.

CH 531 Physical Chemistry-I 3-0-0-3

Quantum Chemistry:

A. Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

C.Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

D. Molecular Orbital Theory: Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

[15]

Thermodynamics:

A. Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; Partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems, second order phase transitions.

B. Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translational, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics; distribution Law and application to helium.

C. Non Equilibrium Theromodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity

relations, electrokinetic phenomena, diffusion, electric conduction. [15]

Symmetry and group theory in chemistry: Symmetry elements and symmetry operations, definitions of group, subgroups, relation between orders of a finite group and its subgroup, similarity transformation and classes, point groups, Schonflies symbols, representation of groups by matrices(representation for the Cn, Cnv, Cnh, Dnh, etc. groups to be worked out explicity), character of a representation, the great orthogonality theorem (without proof) and its importance, character tables and their use. [9]

Suggested Books:

1. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
2. Chemical Kinetics; K. J. Laidler, Harper & Row.
3. Physical Chemistry; P. W. Atkins, Oxford University Press.
4. Physical Chemistry; I.N. Levine, Tata McGraw Hill Pub. Co. Ltd.
5. Kinetics and Mechanism of Chemical Transformations; J. Raja Ram and J.C. Kuriacose, MacMillan Indian Ltd.
6. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.

CH 523 Spectroscopy-I 3-0-0-3

Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, applications [8]

Vibrational Spectroscopy: Symmetry and shapes of AB2, AB3, AB4, AB5 and AB6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins. [8]

Raman Spectroscopy: Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS). [8]

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. [7]

Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of
(1) Bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin.
(2) Sn^{+2} and Sn^{+4} compounds; nature of M-L bond, coordination number, structure.

(3) Detection of oxidation state and inequivalent MB atoms. [8]

Suggested Books:

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. NMR, NQR, ESR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
3. Physical Methods in Chemistry, R.S. Drago, Saunders College.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
5. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
6. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.

CH 551 **Mathematics for Chemists** **3-0-0-3**

Vectors and Matrix Algebra: A. Vectors: Vectors, dot, cross and triple products etc The gradient, divergence and curl, Vector Calculus.

B. Matrix Algebra: Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

[12]

Differential and Integral Calculus: Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus.Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar).

[8]

Elementary Differential equations: Exact First-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc, second order differential equation and their solutions.

[10]

Permutation and Probability: Permutations and combinations, probability and probability theorems, average, root means square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc) with a general polynomial fit.

[9]

Suggested Books:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemists, Doggett and Suiclific, Longman.
3. Mathematical preparation for Physical chemistry: F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Bararnte, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.

CH 561 **Biology for Chemists** **3-0-0-3**

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP - the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules. [8]

Carbohydrates: Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides; cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway. [8]

Lipid: Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-β-oxidation of fatty acids. [8]

Amino-acids, Peptides and Proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. Force responsible for holding of secondary structures. α- helix, -β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure, Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical / enzymatic / mass spectral, racemization / detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH). [8]

Nucleic Acids: Purine and pyrimidine bases of nucleic acids, base pairing via H -bonding. Structure of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside [7]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 571 Inorganic Chemistry Laboratory - I 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $VO(acac)_2$
b) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
c) $Na[Cr(NH_3)_2(SCN)_4]$
d) $Mn(acac)_3$
e) $K_3[Fe(C_2O_4)_3]$
f) Prussian Blue, Turnbull's Blue

II. Qualitative and Quantitative Analysis; Two metal ions in cationic/ anionic forms.

Rare elements: Tl, W, Se, Mo, Ti, Zr, Ce, Th, V, U, Li
Insolubles: Oxides, sulphates and halides

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experimens, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 581 Organic Chemistry Laboratory - I 0-0-4-2

Qualitative Analysis: Separation, purification and identification of compounds of binary mixture (one liquid and one solid / two liquids / two solids) using TLC and Column Chromatography, chemical tests. IR spectra to be used for functional group identification.

Organic Synthesis:

a) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.
b) Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol
c) Grignard reaction : Synthesis of triphenylmethanol from benzoic acid
d) Aldol condensation: Dibenzal acetone from benzaldehyde.
e) Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.

CH 591 Physical Chemistry Laboratory - I 0-0-4-2

a) To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
b) To determine the electron polarization and electron polarizability of a liquid refractometrically.
c) To determine the concentration of a given solution of an optically active substance by polarimetric measurements.
d) To determine the specific and molar rotation of an optically active substance, like cane sugar at a number of concentrations and hence find the intrinsic rotation of the substance.
e) To verify the Beer's law for the solution of the potassium permanganate and determine the concentration of the given aqueous solution of unknown concentration of this salt.
f) To determine the equilibrium constant of the given reaction, potentiometrically.
g) To determine the heat of neutralization of hydrochloric acid using a classical calorimeter.
h) To determine the stability constant of a $FeSCN^{2+}$ complex ion keeping ionic strength constant.
i) To determine the solubility of Ca $(IO_3)_2$ in deionized water and in dilute solution of potassium chloride at room temperature. Also evaluate the thermodynamic solubility product.
j) To determine the formula and the stability constant of a metal ion complex (Lead oxalate complex.)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 512 **Inorganic Chemistry-II** **3-0-0-3**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of D_q, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

[10]

Metal π-Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation,important reactions of metal carbonyls; preparation, bonding, structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphene as ligand.

[8]

Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes compounds with metal metal multiple bonds

[5]

Role of metal ions in biological processes: Brief study of various metal ions (Fe, Mo, Cu, Co, Ni, V, Cr, Mn, Zn, Se, B, Na, K and Ca) in biological processes.

[10]

Isopoly and Heteropoly Acids and Salts: Brief study

[6]

Suggested Books:

1. Mechanism of Inorganic Reactions; F. Basalo and R.G. Pearson, Wiley Eastern Ltd.
2. Inorganic Chemistry; D. F. Shriver and P. W. Atkins, ELBS.
3. Advanced Inorganic Chemistry; F. A. Cotton and G. Wilkinson, Edn. John Wiley & Sons.
4. Electronic Absorption Spectroscopy and Related Techniques; D.N. Sathyanarayana, Universities Press (India) Ltd.
5. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.
6. Inorganic Reaction Mechanisms; Martin L. Tobe and John Burgess, Longmans.

Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1 mechanism, Reactivity; effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet - Hauser, and Smiles rearrangments. [5]

Free Radical Reactions: Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction. [7]

Addition to Carbon Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation. [7]

Addition to Carbon-Hetero Multiple bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. [7]

Elimination Reactions: The E2, E1 and E1CB mechanisms and their spectrum. Orientation of the double bond. Mechanism and orientation in pyrolytic elimination. [5]

Pericyclic Reactions: Molecular orbital symmetry, Electrocyclic reactions, cycloaddition reactions and sigmatropic reactions, FMO and PMO approach. Correlation diagram, selection rules. Claisen, Cope and aza-Cope rearrangements, Ene reaction [8]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, John Wiley & Sons.
2. A Guide Book to Mechanism in Organic Chemistry; Peter Sykes, Orient Longman Ltd.
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Mechanism and Theory in Organic Chemistry; S.M. Mukherjee and S.P. Singh, Mac Millan India.

6. Organic Reactions and Their Mechanisms; P. S. Kalsi, New Age International Pub.

CH 532 Physical Chemistry II 3-0-0-3

Surface Chemistry:

A. Adsorption -Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of dropletes (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).

B. Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles. [12]

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures. [8]

Electrochemistry: Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham- Devanathan - Mottwatts, Tobin, Bockris, Devanathan models, Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance. [10]

Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions). [9]

Suggested Books:

1. Modern Electrochemistry; J.O'M. Bockris and A. K. N. Reddy, Plenum Press.
2. Physical Chemistry; P. W. Atkins Oxford University Press.
3. Physical Chemistry; I. N. Levine, Tata McGraw Hill Pub. Co. Ltd.
4. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.
5. Text Book of Polymer Science; F.W. Billmayer, Wiley-Interscience.
6. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
7. Chemical Kinetics; K. J. Laidler, Harper & Row.

CH 524 Spectroscopy-II 3-0-0-3

Ultraviolet and Visible spectroscopy: Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. [7]

Infrared Spectroscopy: Instrumentation and Sample handling.Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. [7]

Nuclear Magnetic Resonance Spectroscopy: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplifications of complex spectranuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE). [8]

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic , alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOSY, DEPT, INEPT, APT and INADEQUATE techniques. [6]

Mass Spectrometry: Introduction ion production EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Example of mass spectral fragmentation of organic compounds with [6]

respect to their structure determination.

Problems: Structure elucidation based on spectroscopic data. [5]

Suggested Books:

1. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J. Martin, Heyden.
2. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
3. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 534 Colloids and Surface Chemistry 3-0-0-3

Introduction: Introduction: Colloid & surface science - small particles, association structures, surfaces, interfaces, interphases and macromolecules, Survey of technologies reliant upon colloid and surface science. [5]

Particulate Dispersions (solids dispersed in fluids): Single particles, Scattering of electromagnetic radiation from matter, Single particles in external fields (gravity, electrical, etc.), Particle sizing (microscopy, scattering (ILS, DLS, x-ray, neutron), sedimentation, centrifugation, chromatography, acoustics, adsorption), Particles in fluids, Particle trajectories' Transport phenomena; Brownian motion, diffusion; Rheology & rheology of dispersions; Particle-particle interactions, potential energy diagrams; Colloid stability - aqueous, non-aqueous; Consequences of colloid stability (dispersal, flocculation, coagulation, phase separation); Measuring colloid stability; Particle-particle interactions: Dispersion forces (Hamaker theory); Solid-liquid interfaces (charging of surfaces, Electrical Double Layer, adsorption); Particle-particle interactions: Electrostatic forces; Analysis of surface charge and surface chemistry (electrokinetics [electrophoresis, streaming; potential, electro-osmosis, sedimentation potential], electroacoustics, surface spectroscopy, ESR); Particle-particle interactions: steric forces & polymer-mediated forces'' Particle-particle interactions: hydrophobic forces, Analysis of particle interactions (rheometry, AFM, CFM, MASIF, SFA); Flocculation & coagulation - Schulze-Hardy rule, inorganic coagulants, polymeric flocculants ; wastewater treatment

[15]

Wetting & Capillarity: Surface and interfacial tension; Phenomena of liquid surfaces - Phenomena of liquids near solid surfaces Wetting, spreading, penetration, film formation, adhesion, detergency and floation; Contact angles, their analysis and interpretation - component analysis; Surface roughness, chemical heterogeneity, contamination; Surface energy methods on planar, particulate, hollow and fiber surfaces; Relation of capillarity to phase diagrams; Adhesion & Contact mechanics.

[10]

Bubbles and Foams (gases dispersed in liquids): Foam stability; Film drainage; Film rupture; Film rheology; Emulsion and pseudo-emulsion films; Phase diagrams; Measuring thin film properties - disjoining pressure, thin film balance, Frothing agents', Foam breaking, Antifoaming agents & mechanisms, Flotation. [9]

Suggested Books:

1. Colloidal Dispersions: Suspensions, Emulsions, and Foams I.D. Morrison and S. Ross (2002, Wiley Interscience, NY; ISBN: 0-471-17625-7).
2. Basic Principle of Colloid Science, D.H. Everett (1988, Royal Society of Chemistry, London, ISBN : 0-85186-443-0)

CH 562 Inorganic Chemistry Laboratory - II 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $[Co(NH_3)_6]\ [Co(NO_2)_6]$
b) Cis-$[Co(trien)\ (NO_2)_2]\ Cl.H_2O$
c) $Hg[Co(SCN)_4]$
d) $[Co(Py)_2Cl_2]$
e) $[Ni(NH_3)_6]Cl_2$
f) $Ni(dmg)_2$
g) $[Cu(NH_3)_4]SO_4H_2O$

II. Qualitative and Quantitative Analysis; Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

III. Chromatography; Separation of cations and anions by
Paper Chromatography.
Column Chromatography : Ion exchange

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experiments, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 572 Organic Chemistry Laboratory - II 0-0-4-2

I. Organic Synthesis:

a) Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.
b) Friedel Crafts reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
c) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. The Products may be Characterized by Spectral Techniques
d) Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation

II. Quantitative Analysis:

a) Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
b) Estimation of amines/phenols using bromate bromide solution/or acetylation method.
c) Determination of lodine and Saponification values of an oil sample.
d) Determination of DO, COD and BOD of water sample.
e) To estimate the percentage of sulphur in the given organic sample by Messenger's method
f) To estimate the percentage of nitrogen in the given organic sample by Kjeldahl's method.
g) To estimate a halogen in the given sample by the alkaline reduction method (Modified Stepenow method).

Suggested Books:

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

CH 582 Physical Chemistry Laboratory - II 0-0-4-2

a) To determine the molecular weight of a macromolecule by viscometry.
b) To determine the order with respect to Ag(I) in the oxidation of Mn(II) by $S_2O_8^{2-}$ and the rate constant for the uncatalyzed reaction.
c) To determine the formation constant for the $[Ce^{IV}\text{-}H_3PO_2]$ intermediate complex and also the rate constant of its decomposition at 45° C.
d) Study the effect of hydrogen ion on the $H_2O_2 - I^-$ reaction and to determine the rate constants K_1 and K_2 of the given rate equation.
e) To determine the equivalent conductivity of an electrolyte at infinite dilutions, and to determine the dissociation constant of an acid at different dilutions.
f) To determine the standard electrode potential of the ferrous ferric system by titrating ferrous ammonium sulphates against potassium dichromate potentiometrically.
g) To determine the surface tension of an organic liquid (Ethyl acetate) at different temperatures by double capillary method and hence test the constancy of parachor.
h) To determine the critical micelle concentration of a soap (sodium laurate, sodium palmitate etc.) by surface tension measurements.
i) To determine the solubility and solubility product of sparingly soluble salts e.g. PbSO4, BaSO4) conductometrically.
j) To determine the strength of the given acid conductometrically using standard alkali solution. Select suitable pair for titration. (SA-SB, SA-WB, WA-SB, WA-WB)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 611 Photochemical Reactions 3-0-0-3

Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. [7]

Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy state; determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. [8]

Photochemistry of Alkene: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. [5]

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. [8]

Photochemistry of Aromatic Compounds: Isomerisations, additions and substitutions. [5]

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction, Singlet molecular Oxygen reaction, Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. [6]

Suggested Books:

1. Fundamentals of photochemistry, K.K. Rohtagi - Mukherjee, Wiley-Eastern.
2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.

CH 621 Bioorganic Chemistry 3-0-0-3

Introduction: Basic considerations, Proximity effects and molecular adaptation. [4]

Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and

enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver - Burk plots, reversible and irreversible inhibition.

[11]

Mechanism of Enzyme Action: Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase A. [6]

Kinds of Reactions Catalysed by Enzymes: Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisation reactions, β-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. [9]

Industrial Applications of Enzymes : Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-Brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. [9]

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

CH 631 Organic Synthesis-I 3-0-0-3

Reagents and reactions: Gilman's reagent – Lithium dimethylcuprate, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DDC), 1,3-Dithiane (Umpolungreagent), trimethylsilyliodide, Petersons synthesis, Bakers yeast, Organophosphorus compounds (Wittig reaction), Sulphur ylides, Phase transfer catalysts: Quaternary

ammonium and Phosphonium salts, Crown ethers. Heck reaction, Suzuki coupling and Mukaiyama reaction. [9]

Oxidation: Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate. [9]

Reduction: Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Epoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis. [8]

Rearrangements: General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil – Benzillic acid. Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. [8]

Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds: General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene, fluorine and undone). [5]

Suggested Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Uni. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier

CH 641 Separation Techniques and Data Analysis 3-0-0-3

Adsorption and partition chromatography:
(a) Definition of terms, techniques and chemical concepts
(b) Column adsorption chromatography
(c)Partition chromatography-column, paper and TLC [8]

High performance liquid chromatography -
Introduction, choice of the system, instrumentation and applications. [5]

Gas liquid chromatography: Introduction, choice of the system, instrumentation, qualitative and quantitative analysis of mixtures. [5]

Gel permeation/size exclusion Chromatography: Introduction, theory and applications. [5]

Ion exchangers: Theory, action of ion-exchange resins, ion exchange chromatography, exchange capacity, ion-exchange resins and liquid ion-exchange resins, applications of cation and anion ion exchangers. [5]

Solvent Extraction: - Introduction, principles, factors that influence solvent extraction, ion association complexes and applications of solvent extraction. [5]

Data analysis: Types of errors, propagation of errors, accuracy and precision, and least- square analysis, average standard deviation. [6]

Suggested Books:

1. Principles of Instrumental Analysis; D.A. Skoog, Saunders College Publishing.
2. Instrumental Methods of Chemical Analysis; G.W. Ewing, McGraw Hill Books Co.
3. Modern Methods of Chemical Analysis; R. L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, John Wiley.
4. Analytical Chemistry: Principles; J.H. Kennedy, Saunders Holt.

CH 651 Environmental and Green Chemistry 3-0-0-3

Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in the atmosphere, stratospheric chemistry: The chemistry of ozone layer, The role of chemicals in ozone destruction, The green-house effect and Global warming, El-Nino phenomenon. [8]

Hydrosphere : Complexation in natural water and waste-water, Micro-organism in aquatic chemical reactions, Eutrophication, Re-cycle of waste-water in process industry, Treatment of sewage and reuse of water in industry and agriculture, Microbiology mediated redox reactions and Nitrogen transformation by bacteria. [8]

Lithosphere : The terrestrial environment, Soil formations, soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, waste classification and disposal. [8]

Chemical Toxicology: Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monooxide, nitrogen oxides, sulphur oxides, ozone, PAN, cyanide, pesticides, insecticides and carcinogens. [7]

Green Chemistry: Green chemistry – Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. Microwave induction, ultrasound assisted, green solvents- reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen , citral, urethane, adipic acid and styrene. [8]

Suggested Books:

1. Green Chemistry, P. Anastas, RSC.
2. Environmental Chemistry, S.E. Manahan, Lewis Pub.
3. Environmental Chemistry, Sharma and Kaur, Krishna Pub.
4. Environmental Chemistry, A.K. De, Wiley Eastern
5. Environmental Chemistry, C. Baird, W.H. Freem

CH 661 Advanced Organic Chemistry Laboratory - I 0-0-4-2

I. Qualitative Analysis: Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

II. Multi –step Synthesis of Organic Compounds: The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques. (Any Five)

a) Photochemical reaction Benzophenone - Benzpinacol - Benzpinacolone
b) Beckmann rearrangement : Benzanilide from benzene Benzene - Benzophenone - Benzphenone oxime - Benzanilide
c) Benzilic acid rearrangement : Benzilic acid from benzoin Benzoin - Benzil -Benzilic acid.
d) Synthesis of heterocyclic compounds Skraup synthesis: Preparation of quinoline from aniline Fisher Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine.
e) Enzymatic synthesis; Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ehtyl-3-hydroxybutanoate and determine its optical purity.
f) Biosynthesis of ethanol from sucrose.
g) Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
h) Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethylacetoacetate with an alkyl halide.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R.Tatchell,J.Wiley

CH 671 Advanced Organic Chemistry Laboratory - II 0-0-4-2

Extraction of Organic Compounds from Natural Sources. (Any Five)

a) Isolation of caffeine from tea leaves.
b) Isolation of benzoic acid from tea leaves.
c) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins).
d) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf values reported).
e) Isolation of nicotine dipicrate from tobacco.
f) Isolation of cinchonine from cinchona bark.
g) Isolation of piperine from black pepper.
h) Isolation of lycopene from tomatoes.
i) Isolation of β-carotene from carrots.
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
k) Isolation of eugenol from clove.
l) Isolation of (+) limonine from citrus rind.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

CH 681 Advanced Organic Chemistry Laboratory - III 0-0-4-2

I. Separation and identification of the sugars and Amino acids present in the given mixture by paper chromatography and determination of Rf values

II. Identification of organic compound with the help of spectral datas.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley
3. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J.

Martin, Heyden.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
5. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
6. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
7. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 612 Organic Synthesis-II 3-0-0-3

Disconnection Approach: An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis. [8]

Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. [6]

One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis. [6]

Two Group C-C Disconnections: Diels-Alder Reaction, 1,3-difunctionalised compounds, α, β- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation. [6]

Ring Synthesis: Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings. aromatic heterocycles in organic synthesis. [5]

Synthesis of Some Complex Molecules: application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A. [8]

Suggested Books:

1. Designing Organic Synthesis, S.Warren. Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O. House, W.A Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

CH 622 Heterocyclic Chemistry 3-0-0-3

Aromatic Heterocycles: Nomenclature, General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. [6]

Non-aromatic Heterocycles: Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1, 3-diaxial interaction. Stereo-electronic effects, anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions. [7]

Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes. [4]

Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofuranes and benzothiophenes. [4]

Meso - ionic Heterocycles: General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. [4]

Six - Membered Heterocycles with one Heteroatom: Synthesis and reactions of pyrilium salts and pyrones and their comparison with pyridinium & thiopyrilium salts and pyridones. Synthesis and reactions of quinolinium and benzopyrylium salts, coumarins and chromones. [6]

Six Membered Heterocycles with Two Heteroatoms: Synthesis and reactions of diazines, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines. [8]

Suggested Books:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Techinal.

5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M.Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

CH 632 Chemistry of Natural Products 3-0-0-3

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Gereniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene. [9]

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-Coniine, Nicotine, Atropine, Quinine and Morphine. [9]

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of Steroids. [9]

Flavonoids and Anthocyanins: Occurrence, nomenclature, biogenesis and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidine, Hirsutidin. [9]

Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll. [3]

Suggested Books:

1. Natural Products : Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.
2. Organic Chemistry: Vol. 2 1L. Finar, ELBS
3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers.
7. New Trends in Natural Product chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic

Publishers.

CH 642 Medicinal Chemistry 3-0-0-3

Structure and activity : Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery.	[9]
Antibiotics and antibacterials: Introduction (i) Antibiotic β-Lactam type Penicillins, Cephalosporins (ii) Antitubercular Streptomycin(iii)Broad spectrumantibiotics-Tetracyclines (iv)Anticancer-Dactinomycin (Actinomycin D) (v)Antifungal –polyenes(vi) Antibacterial Ciprofloxacin,Norfloxacin(vii) Antiviral – Acyclovir	[9]
Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine.	[4]
Non-steroidal Anti-inflammatory Drugs : Diclofenac Sodium, Ibuprofen and Netopam	[4]
Antihistaminic and antiasthmatic agents: Terfenadine,Cinnarizine, Salbutamol and Beclomethasone dipropionate	[4]
Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurines. Recent development in cancer chemotherapy. Hormone and natural products.	[9]

Suggested Books:

1. Medicinal Chemistry; Burger, Wiley Interscience Publications.
2. Principles of Medicinal Chemistry; W. O. Foye Lea & Febiger: Varghese Publishing House
3. The Organic Chemistry of Drug Synthesis; D. Lednicer and L. A. Mitscher Wiley Interscience.

Medicinal Chemistry

Mody University of Science & Technology

M.Sc. Food and Nutrition
Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc-Food & Nutrition
Two Year Programme
Academic Year (2016-17) and onwards

Intake: 10

The specialists in F& N play a vital role in promoting the quality of life of individuals and communities, which contributes significantly to the economic and overall development of the nation. This achieved through a blend of academics, research training and extension as well as industrial applications. The post graduate programme in this discipline has been designed to provide the students intensive and extensive theoretical and experimental learning. The programme allows flexibility in the choice of thrust areas, which students can select, based on their career goals. It is envisaged that the current scenario at the regional and national level require trained professional in areas such as Public Nutrition, Dietetics and clinical Nutrition, Institutional Food administration as well as food science and quality control. Alternatively a broad-based programme covering several varied aspects in this discipline is also possible.

Objectives

The curriculum integrating several courses to provide professionally competent manpower for:

1. Academic and research institutions.
2. Hospital, food service intuitions and industry
3. Managerial roles in agencies and intuitions-both government and NGO sector
4. Planning & monitoring health programme
5. Ensuring food safety and quality for consumers
6. Entrepreneurial ventures
7. Advocacy and consultancy.

Careers

Nutritionists and dieticians could find employment in hospitals, health and recreation clubs, canteens, nursing care facilities; teach the science of nutrition and dietetics in colleges and universities, catering departments of star hotels, research labs of food manufacturers, in health departments of government etc. Moreover they could find openings in the mass media where top priority is given to disseminating vital information on healthy living. The main fields in which a dietician or nutritionists can work is in Food service field, Institutional Catering, Health Care field, Research & Development and Social Welfare. Food service field include food Catering service, Restaurants etc where professionals can do menu planning, monitoring the food preparation etc. Institutional Catering is another field where Nutrition and dietetics professionals are needed to plan, supervise and prepare nutritious and well-balanced meals for schools, colleges, factories or office cafeterias etc. Their work may also include the estimation and purchase of food supplies and equipment; receiving, checking and taking inventories of provisions etc. In Health Care field, people suffering from certain diseases such as diabetics, heart diseases, obesity etc, need to take extra care of their eating habits and the kind of food they eat. Research and Development involves conducting research on various food items to ensure their quality as well as studying the effects of various types of diet on the body chemistry in labs.

Eligibility

Pass with 50% aggregate marks in Bachelor's degree (Sciences, Medical and Applied Medical Sciences, Health and Allied health/Agriculture/ Food Sciences/ Bio-Sciences) or equivalent.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Post graduate Programmes of MITS shall be followed.

Resource Requirement:

One or two faculty of F&N specialist (depends on intake)
Consumables: Rs. 5 Lakhs per year

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2016 –17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FN 511	Basic Principle of Ayurvedic Diet	1	-	-	1	2	20	-	80
	FN 521	Basics of Human Physiology	3	-	-	3	3	25	25	50
	FN 531	Human Nutrition	3	-	-	3	3	25	25	50
	BC 511	Chemistry of Biomolecules	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	FN 541	Basic Research Methodology	2	-	-	2	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	-	-	100
		Sub Total	**18**	1	**4**	**21**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BC 522	Nutritional Biochemistry	3	-	-	3	3	25	25	50
	FN 512	Food Packaging and Quality Control	3	-	-	3	3	25	25	50
	FN 522	Women Nutrition and Health	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	FN 532	Nutrition For Health And Fitness	3	-	-	3	3	25	25	50
	FN 542	Nutraceuticals & Functional Foods	3	-	-	3	3	25	25	50
	FN 552	Seminar	-	-	-	1	-	-	-	100
	FN 562	Food and Nutrition Laboratory -I	-	-	4	2	4	-	-	100
		Sub Total	**18**	**-**	**4**	**21**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2016 –17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	FN 611	Public Health and Nutrition	3	1	-	4	3	25	25	50
	FN 621	Institutional Food Administration	3	1	-	4	3	25	25	50
	FN 631	Clinical and Therapeutic Nutrition	3	1	-	4	3	25	25	50
	FN 641	Food Service Management	3	-	-	3	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	FN 651	Food and Nutrition Laboratory -II	-	-	4	2	4	100		
		Sub Total	**15**	**3**	**4**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	-	-	**20**				
		Total Credits				**80**				

$Evaluation of proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Dissertation and presentation will carry 50% weightage each.

FN 511 BASIC PRINCIPLES OF AYURVEDIC DIET 1-0-0-1

History of Ahara Nutrition, Vedic and Madhyayugin diet and its processing, Basic Principle: Ayurveda and Aharashastra, Ayurvedic components, Ritucharya (Seasonal regimen) [4]

Ayurvedic Principles: Lokpurushasamya (Doctrine of Macrocosm and Microcosm), Karyakarana Siddhanta (Principles of Caouse and Effect), Samanya-Vishesh Siddhanta (Principles of Similarity and Dissimilarity), **Panchamahabhoota Siddhanta** (Theory of Five Elements), Swabhavoparmvada Siddhanta (Theory of Healing)- in relation with diet and its importance [5]

Fundamentals of Dosha-Dhatu-Mala: Doshavigyana Dhatuvigyana - Tissue/ Cell metabolism, Malavigyana – Excretary, Vigyana Strotovidyana – Systematic circulation, Dhatusharta - Cell replenishing, Prakriti – Constitution, Dosha-Dhatu-Mala vigyana – The importance of diet in physiological process. [4]

Text Book:

1. Tripathi B. (2007) (Ed.) Acharya Charaks' Charak Samhita, Chowkhamba Surbharati Prakashan Varanasi.
2. Panda S.K. (2006) Basic Principles of Kriya Sharira, Chaukhamba Orientalia, New Delhi.

References:

3. Lochan Kanjiv (2007). Astanga Hridayam, (Sutrasthana), Chowkhamba Sanskrit Bhawan Varanasi
4. Srikanthamurthy K.R. (2005), (Ed.) Acharya Vagbhatas' Ashtanga Samgraha, Chaukhamba Orientalia, Varanasi.
5. Lochan Kanjiv, Dietary Rules & Prohibitions in Different Diseases, Chowkhamba Sanskrit Bhawan Varanasi. 2004
6. Sushruta, Sushruta Samhita (1994) 5th Edition, Motilal Banarasidas , New Delhi.
7. Brahmavarchas (2005) Ayurved Darshan,Vedmata Gayatri Trust, Shantikunj, Haridwar.
8. Radhakrishnan Sarvapalli (1999) Indian Philosophy, Vol.1, Oxford University Press, London.

FN 521 BASICS OF HUMAN PHYSIOLOGY 3-0-0-3

Cell structure and function

Levels of cellular organisation and fucntion-organelles, tissues, organs and systems-Brief review. Cell membrane, transport across cell membrane and intercellular communication. Regulation of cell multiplication. [4]

Nervous system [4]

Review of structure and function of neuron, conduction of nerve impulse, synapses, role of neurotransmitters.

Organisation of central nervous system, structure and function of brain and spinal cord, afferent and efferent nerves, Blood brain barrier, CSF. Hypothalamus and its role in various body function-obesity, sleep, memory.

Endocrine system [4]

Endocrine glands-structure, function, role of hormones, regulation of hormonal secertion. The neuroendcrime axis.Disorders of endocrine glands. Emphasis on physiology of diabetes and stress hormones.

Sense organs [3]

Review of structure and function. Role of skin, eye, ear, nose and tongue in preception of stimuli.

Digestive System [4]

Review of structure and function. Secretory, Digestive and absorptive functions. Role of liver, pancreas and gall bladder and their dysfunction. Motility and hormones of GIT

Respiratory system [4]

Review of structure and function. Role of lings in the exchange of gases. Trasport of oxygen and CO_2. Role of haemoglobin and buffer sstems. Cardio-respiratory response to excercise and physiological effects of training.

The circulatroy system [3]

Structure and function of heat and blood vessel. Regulation of cardic output and blood pressure, heart failure, hypertension.

Blood formation, compsotion, blood clotting and haemostasis [3]

Formation and function of plasma proteins. Erythropoesis. Blood groups and histocompatibility. Blood indices. Use of blood for investigation and diagnosis of specific disorders. Anemia.

The excretory system [2]

Structure and function of nephron. Urine formation. Role of kidney in maintaining ph of blood. Water, electrolytes and acid base balance, diuretics

The Musculo-skeletal system [2]

Structure and function of bone, cartilage and connective tissue. Disorders of the skeletal system. Types of muscles, structure and function.

Immune System [3]

Cell mediated and humoral immunity. Activation of WBC and production of anitbodies. Role in inflammation and defence.

Reproduction [3]

Menstrual cycle, spermatogenesis, physiological changes in pregnancy

Text Book:

1. Jain A.K. (2010) Textbook of Physiology, Vol. I and II, Avichal

publishing co., New Delhi.

2.

References:

1. Applied Physiology, MFM 001 Course, Indira Gandhi National Open University

2. Vander A.J., Sherman J.H., Luciono D.S. (2000) Human Physiology. 7th edition, New York, McGraw Hill

3. Guyton A.C. and Hall J.B. (1996) Textbook of Medical Physiology. 9th edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.

FN 531 HUMAN NUTRITION 3-0-0-3

Energy: Energy content of foods. Physiological fuel value-review. Measurment of energy expenditure: BMR, RMR, Thermic effects of feeding and physical activity, methods of mesaurment. Estimating energy requirments of individuals and groups. Regulation of energy metabolism: control of food intake, digetio, absorption and body weight. [4]

Carbohydrates: Types, calssification, digestion and transprt-review, dietry fibre, fructo-oligosaccharides, resistant strach-chemical copmposition and physilogical effects. Glycemic index of food. Sweeteners-nutritive and non-nutritive. [5]

Proteins: Classification, digestion, absorption and transport – review. Metabolism of proteins: Role of muscle, liver, and gastro intestinal tract. Protein quality, metods of evaluating protein quality. Protein and amino acid requirements. Therapeutic applications of specific amino acids: Branched chain, glutamine arginine, homocysteine, cysteine, taurine. [4]

Lipids: Classification, digetion, absorption, transport-review. Functions of EFA. Role of n-3, n-6 fatty acids in health and disease. Requirements of total fat and fatty acids. Trans fatty acids. Prostaglandins. [6]

Water: Regulation of intra and extra cellular volume. Osmolality, water balance and its regulation. [7]

Minerals: (Note: For each nutrient sources, bioavailability, metabolism, function, requirements, RDI/ESDDI, deficiency and toxicity, interactions with other nutrients are to be discussed).

Macro minerals: calcium, phosphorus, magnesium, sodium, potassium and chloride.

Micro minerals: Iron, copper, zinc, manganese, iodine, fluoride.

Trace minerals: selenium, cobalt, chromium, vanadium, silicon, boron, nickel.

Vitamins: Historical background, structure, food sources, absorption and transport, metabolism, biochemical function, assrssment of status. Interactions with other nutrients. Physiological, pharmacological and [7]

therapeutic effects, toxicity and deficiency with respect to the following:

a) *Fat soluble:* Vitamins A,D, E & K.
b) *Water soluble:* Thiamine, riboflavin, niacin, biotin, pyridoxine, folic acid, pantothenic acid, ascorbic acid, cyanocobalamin, choline, inositol.

Non-nutritive food components with potential health effects: Polyphenols, tannins, phytate, phytoestrogens, cyanogenic compounds, lectins and saponins. [6]

Nutritional regulation of gene expression.

Nutrition management in special conditions: Space travel, high altitudes, low temperatures, submarines.

Text Book:

1. Bamji M.S., Rao N.P., Reddy V. Eds. (2009). Textbook of Human Nutrition. 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.

References:

2. ICMR (1990). Nutrient Requirements and Recommended Dietary Allowances for Indians.
3. FAO/WHO/UNU (2004). Human Energy Requirements. Report of a Joint Expert Consultation.
4. WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.
5. Nutrition in Developmental Transition. (2006). NFI-WHO (SEARO) Symposium. NFI
6. ICMR. A Manual of Laboratory Techniques.
7. Gibney M.J., Margetts B.M., Kearney J.M., Arab L. (2004). Public Health Nutrition. The Nutrition Society. Blackwell Publishing, Oxford, UK.
8. Sundararaj P. and Siddhu A. (2006). Qualitative tests and quantitative procedures in Biochemistry- A Practical Manual. Third edition. Elite Publishers, New Delhi.
9. AOAC (1997). Official Methods of analysis. 16th edition. Association of official Analytical Chemists.

FN 541 BASIC RESEARCH METHODOLOGY 2-0-0-2

Research Methodology- Meaning, objectives and Significance of research. Types of research, research approaches and scientific methods. [2]

Research process and criteria of good research

Definition and identification of a research problem- Selection of research problem, Justification, development of hypothesis, basic assumptions. Limitations and delimitations of the problem, Methods of data collection [4]

Research design- Meaning and needs, Different research designs- exploratory, descriptive and diagnostic (epidemiology and clinical trials). Pilot studies. Qualitative vs quantitative research [5]

Sampling design- Steps in sampling design, Criteria for selecting a sampling procedure, Different types of sampling techniques- Merits and demerits of sampling [5]

Basic principles and regulations in humans and animal research. [3]

Report writing – Significance of report writing, Different steps in writing report, Types of reports, Mechanics of writing reports and precautions to be taken while writing research reports [7]

Text Book:

1. Kothari C.R. (2004) Research Methodology, Methods & Techniques, 2nd ed. New Age International Publishers.

References:

2. Best J.W. and Kahn J.V. (1992) Research in Education.6th ed. New Delhi, Prentice Hall of India Pvt. Ltd,
3. Goode W.J. and Hatt P.K. (1981) Methods in Social Research, McGraw Hill International Editions, Sociology Series.
4. Kerlinger F.N. (1983) Foundations of Educational Research. 2nd ed.
5. Marjory L. Joseph, William D Joseph (1996) Research Fundamentals in Home Economics / Human Ecology. Plycon Press.
6. WHO (2001) Health Research Methodology – A Guide for Training in Research Methods.
7. Stennberg R. J. (1991) The Psychologist's Companion: A Guide to Scientific Writing for students and Researchers. Cambridge: CUP.
8. Scrimhshaw N.S. and Gleason G.R. (2009) Rapid Assessment Procedures, Qualitative Methodologies for Planning and Evaluation of Health Related Programmes. International Nutrition Foundation for Developing Countries, Boston.

BC 522 NUTRITIONAL BIOCHEMISTRY 3-0-0-3

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements. [5]

Specific dynamic action of proteins.

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions. [10]

Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. [5]

Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins. [5]

Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing. [10]

Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. [2]

Obesity – Definition, Genetic and environmental factors leading to obesity [2]

Text Book:

1. Devlin T M. (2002) Text Book of biochemistry with Clinical Correlations 5th ed. John Wiley and Sons.

References:

2. Berg J M, Tymoczko J L and Stryer L. (2002) Biochemistry 5th ed. W.H. Freeman.
3. Horton R. H., Moran L. A., Ochs R. S., Rawn J. D. and Scrimgeour.(2002) Principles of Biochemistry 3rd ed. Prentice Hall.
4. Murray R.K., Granner D.K., Kayes P.A. and Rodwell V.W.(2003) Harper's Illustrated Biochemistry. 26th ed. McGraw-Hill. Asia.
5. Voet D. and Voet J.G. (2004) Biochemistry. 3rd ed. John Wiley and Sons.

FN 512 FOOD PACKAGING AND QUALITY CONTROL 3-0-0-3

[6]

Packaging- Concepts, Definition, Significance, Classification.
Packaging-development, Unit/Retail.
Packaging of food(s)- fresh and processed, general characteristics & food

preservation.

Primary Packaging Media- Properties and applications

a) Paper boards, metals, plastics, wood & plywood, glass, flexible etc.

b) Labels, caps & closures & wads, adhesives, inks & lacquers, cushioning materials, reinforcements etc.

Testing & evaluation of packing media – retail packs (including shelf life evaluation) and transport packages. [9]

Packaging systems and methods for food products- vacuum packaging, gas flush. Packaging, CAP & MAP, Aseptic & retort packing, Bag-in Box etc.

Food products- General classification and packing types, varieties and trends.

Storage, handling and distribution of packages (foods) – including palletisation & Containerizetion.

Food marketing and role of packaging.

Packaging Aesthetic & graphic design.

.

Packaging – Laws & Regulations - FDA, PFA, Packaging commodity Rules, Weight & Measures Act etc [3]

Introduction to quality assurance and food safety assurance. Current concepts of quality control.

Quality assurance programme: Quality plan, documentation of records, product standards Product and purchase specifications, process control and HACCP hygiene and housekeeping, corrective action, quality and programme and total quality process.

Quality costs: Measurement and analysis.

[10]

Product Evaluation: [11]

- Sampling for product evaluation and line control.
- Statistical quality and process control.
- Specifications and food standards. International, national-Mandatory, Voluntary.
- Sample Preparation.
- Reporting results and reliability of analysis.
- Tests for specific raw food ingeredients and processed. Foods including additives:
  a) Proximate principles
  b) Nurient analysis
  c) Quality parameters and test of adulterants.

Consumer protection.

Text Book

1. Joshi, V.K. and Pandey, A. Ed. (2009). Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.

References

2. Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford. Crueger, W. and Crueger A. 1984.
3. Knorr, D. 1982. Food Biotechnology. Marcel Dekker, New York.
4. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
5. Pomeranz, Y. and MeLoan, C.E. (1996): Food Analysis: Theory and Practice, CBS Publishers and Distributor, New Delhi.

FN 522 WOMEN NUTRITION AND HEALTH 3-0-0-3

Role of women in National Development.

Women in Family and Community

- Demographic Changes, menarche, marrige, fertility, morbidity, mortality, life-expactancy, sec ratio, aging and wodowhood, female-headed families.

Women and Work

- Environmental stress, production activities, nutrition, health and gender, living conditions, occupational health, health facilities.

Women's nutritional requirements and food needs.

Women and Society

- Women's role, their resoures and contribution to family and community and effect on nutritional status.
- Effect of urbanisation on women.
- Impact of economic policies, industrializzation, and globlization on women.

Women and Health

- Health facilities
- Disease patterns and Reproductive health
- Gender and health
- Health seeking behaviour
- Women- pregnancy and lactation

Safe motherhood

Care of at-risk mothers

Family planning

Women and aging- Special concerns in developed and developing societies: Menopause, osteoporosis, chronic degenerative diseases, neurological problems.

Women and AIDS

Women and Nutrition

- Situation of women in global, national and local context. Improving the nutritional and health status. Intervantions throughout the life cycle.

Policies and Legislations

- CEDAW (Convention on elimination of all forms of Discrimination Against Women), Women's Right to Life and Health (WRLH).

Empowerment of Women-Role of Education and various national schemes

Text Book:

1. Gopalan, C. and Kaur, S (Eds) (1989): Women and Nutrition in India, Nutrition Foundation of India

References

2. ACC/SCN Policy Discussion papers.
3. Wallace, H.M. and Giri,K. (1990): Health care of women and children in developing countries, Third party Publishing Co., Oakland, California.
4. UNICEF: The Urban Poor and Household Food Security, UNICEF
5. NGO committee on UNICEF (1997): Women and children in Urban Poverty-What Way Out?
6. Census Reports, Government of India.
7. UNICEF-State of the world children.
8. International Nutrition Foundation-Micronutrient Initiative (2010): preventing Iron Deficiency in Women and Children; Technical Consensus on Key issues.

MB 514 FOOD TECHNOLOGY 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of [10]

fermented food products,
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation: [10]
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).

Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens, Campylobacter jejuni, Helicobacter pylori* [10]

Packaging and Quality Control: [9]
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane.
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

Text Book:

1. Prescott L.M., Harley J.P., Klein D.A. (2008) Microbiology. 6th ed. WMC Brown Publishers

References

2. Banwart G.J. (1987) Basic Food Microbiology. CBS Publishers and Distributors.
3. Frazier W.C., Westoff D.C. (1998) Food Microbiology. 4th ed. Tata McGrawHill Publishing Co. Ltd.
4. Garbutt John (1997) Essentials of Food Microbiology. Arnold

London.
5. Jay J.M., Loessner D.A., Martin J. (2005) Modern Food Microbiology. 7th ed. Springer
6. Pelczar M.J., Chan E.C.S., Krieg N. (1993) Microbiology. 5th ed. Tata McGraw-Hill Publishing Co. Ltd.

FN 532 NUTRITION FOR HEALTH AND FITNESS 3-0-0-3

Definition, components and assessment criteria of age: Specific fitness and health status. [8]

Holisitic approache to the management of fitness and health: Enrgy input and output. Diet and exercise. Effect of specific nutrient on work eperformance and physical fitness. Nutrition, exercise, physical fitness and health inter-relationship

Review of fifferent energy system for endurance and power activity: Fuel and nutrients to support physical activity. Shifts in carbohydrates and fat metabolism. Mobilization of fat stores during exercise. [6]

Nutrition in sports: Sports specific requirments. Dient manipulation. Pre-game and post game meals. Assessment of different nutragenic aids and commercial supplements. Diets for persons with high enrgy requirments, stress, fractures and injury.

Water and electrolytesbalances: Losses and their replenishment during excerse and sports events, effects of dehydration, sports drinks. [7]

Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer**.**

Nutrition and exercise regimes for management of obesity: Critical review of various dietary regimes for weight and fat reduction. Prevention of weight cycling. [8]

Definign nutriitonal goals.guidelines approporiate to health, fitness and prevention and management of the above chronic degenerative disorders.

Nutrition and exercise regimes for pre-post-natal fitness: Alternative systmes for health and fitness lile ayurveda, yoga, meditation, vegetarianism and traditional diets. [10]

Text Book:

1. Mahan L.K. & Ecott-Stump S. (2000): Krause's Food, Nutrition and diet Therapy, 10th Edition, W.B. Saunders Ltd.

References:

2. Sizer F. & Whitney E. (2000): Nutrition-Concepts and controversies, 8th Edition, Wadsworth Thomson Learning.
3. Whitney E.N. & Rolfes .R. (1999): Understanding Nutrition, 8th

Edition, West/Wadsworth, An Internation Thomson Publishing Co.
4. Parizkova J. Nutrion, Physical activity and health in early life, Ed. Wolinsky, I., CRC press.
5. Ira Wolinsky (Ed) (1998): Nutriton in Exercise and sports, 3rd Edition,CRC Press

FN 542 NEUTRACEUTICALS AND FUNCTIONAL FOODS 3-0-0-3

Nutraceuticals: Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases. [4]

Definition, Classification, food and non food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [8]

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [9]

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [8]

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India. [10]

Text Book:

1. Geoffrey P. Webb. (2006). Dietary supplements and functional foods. Blackwell Publishing.

References:

2. Losso, J.N. (2007). Angi-angiogenic functional and medicinal foods. Press.
3. Cupp, J and Tracy, TS. (2003). Dietary supplements: Toxicology and C Pharmacology. Humana Press.
4. Manson, P. (2001). Dietary supplements (2nd Ed) Pharmaceutical Press.
5. Campbell, JE and Summers, JL. (2004). Dietary Supplement Labeling Compliance .
6. Shi, J.(2007). Functional Food Ingredients and Nutraceuticals:

Processing Technologies. Taylor & Francis Publ. CRC Press.
7. Goldberg, I (1994). Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall.
8. Robert E.C. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

FN 562 FOOD AND NUTRITION LABORATORY -I 0-0-4-2

Practical exercises related to BC 522, MB 514 and FN 542

FN 641 FOOD SERVICE MANAGEMENT 3-0-0-3

UNIT-I [9]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel.

UNIT-II [5]

Theories about approaches to food service management -
Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules.

UNIT-III [5]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques

UNIT-IV [6]

Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-V [5]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance.
Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of kitchen records

UNIT-VI [4]

Financial management – Budgeting, costing and cost control, accounting

UNIT-VII [5]

Marketing and advertising, Changing food trends and marketing-influencing factors: Life style changes: economic, socio-cultural, psychological influences and marketing influences, Compatibilities/Challenges in Food Storage and its commercialization, Means of Marketing, National and International measurements

Text Book

1. Sethi, M. (2005): Institution Food Management New Age International Publishers.
2. Taneja S and Gupta SL (2001) Entrepreneurship development, Galgotia Publishing

Reference

3. Bessie, W.B. and Levelle, W. (1988): Food Service in Institutions 6th Edition Revised By Hargar FV, Shuggart SG, &Palgne Palacio June,

Macmillian Publishing Company New York.

4. Kazarian, E. A. (1977): Food Service facilities Planning 3rd Edition Von Nostrand Reinhold New York
5. Kotas Richard and Jayawardardene. C (1994) Profitable Food and Beverage Management Hodder& Stoughton Publications
6. Kotler Philip Marketing management (2001) Millennium Edition Prentice Hall of India

FN 611 PUBLIC HEALTH AND NUTRITION **3-1-0-4**

UNIT-I [9]

Concept of public nutrition - Relationship between health and nutrition, role of public nutritionists in the health care delivery system. Population dynamics- Demographic transition, population structure, population policy, fertility behaviour, nutrition and quality of life interrelationship. Nutritional status -methods for assessing nutritional status – Indirect methods – demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR) - Direct – anthropometry, biochemical, clinical, dietary and functional methods of assessments.

UNIT-II [4]

Nutrition during life span – pregnancy, lactation, infancy, preschool age, school going and adolescents, adults and old age.

UNIT-III [9]

Assessment and surveillance of nutritional status in emergency affected populations- Scope for malnutrition assessment, indicators and simple screening methods. Organization for nutritional surveillance. Nutritional relief and rehabilitation- Assessment of food needs, food distribution strategy, targeting food aid, mass and supplementary feeding, special foods/rations for nutritional relief, organization for mass feeding/food distribution, transportation and storage, feeding centers, sanitation and hygiene and public nutrition approach to tackle nutritional and health problems in emergencies, ethical considerations.

UNIT-IV [8]

Approaches and strategies for improving nutritional status and health - Programmatic options – their advantages and demerits. Intervention Programmes – Health based interventions, Food – based interventions including fortification and genetic improvement of foods, supplementary feeding. Malnutrition and Health economics - Its impact on productivity and national development. Cost management.

UNIT-V [9]

Information Education Communication approaches to improve health and nutrition: Concepts – Scope- Elements- Models of communication - Communication Process - Approaches and Barriers to communication, Communication for Extension Education and Development - Introduction to IEC Aims and Objectives, Importance

of IEC, relevance to programmes - Nutrition education for behaviour change – Rationale, Planning Execution and evaluation of Department of Food Science and Technology.

Text books

1. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.

Reference

2. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
3. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Bamji, M.S., Rao, P.N., Reddy, V (Eds) (2003): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

FN 621 INSTITUTIONAL FOOD ADMINISTRATION 3-1-0-4

UNIT-I [3]

Review of different types of institutional food service operations, canteens, hotels, restaurants and hospitals.

UNIT-II [7]

Meal planning, Food preparation and Service: Basic factors in successful institutional meal planning, considerations with regard to religion, region, availability of food and season, food habits, personnel, equipment, physical plant and financial resources. Procedures involved in constructions of recipes in large scale cooking. Processes of food preparation in large quantities. Type of food service in different institutions: Formal and informal food service.

UNIT-III [4]

Management: Definition, functions, tools of management-organization chart, job description, job specification, work sheet. Work improvement and work simplification.

UNIT-IV [8]

Personnel Management: Personnel and leadership qualifications for food service administrator, responsibilities and importance of good human relationship in organization. Criteria for selection of staff personnel, employment conditions, employee-training, role of employee unions, welfare provisions for labour.

UNIT-V [9]

Management of Resources: Budget, records and book keeping. Food cost control and Labour cost control: Factors affecting cost-menu, types of service, methods of purchasing, serving and pricing, maintenance of standard portions, waste, and meals for employee, wages. Physical plant: Its location, floor plans, space allowances for food preparation activities, storage units, service units and washing units.

UNIT-VI [8]

Importance of food standards, criteria for good quality products, hazards of adulteration and poor quality, quality control, specifications for quality in food products, food laws regarding quality and adulteration.

Labour laws regarding health and safety of employees, health examination, sanitary working conditions, labour regulations, welfare policies.

Text Book

1. West BB, Wood, L. Harger, V.F. and Shugert, G.S. 1977, Food Service in Institutions. John Wiley and Sons, NewYork
2. Sethi, M and Malhan, S. 1993. Catering Management – An integral approach, Wiliey Eastern Limited, New Delhi.

Reference

3. R. Kinton und V. Ceserani 2000. The theory of catering. Aufl., Seiten, Abb., Tab. Verlag Edward Arnold Ltd, London 1
4. Weiss H. and Edith. 2000. Catering Handbook /9780471284277; Publisher: Wiley
5. Mizer and Porter, 2010. Food Preparation for the professionals. Eich Drummond. New York: John Wiley & Sons, Inc
6. Crusius, V.C. 2001: Quantity Food Management. Minneapolis, Minn. Burgess, (c)1981

FN 631 CLINICAL AND THERAPEUTIC NUTRITION **3-1-0-4**

UNIT-I [6]

Nutritional screening and assessment of nutritional satus of hospitalized and outdoor patients.identification of high risk patiets. Assessment of patient needs based interpretation of patient data-clinical, biochmecial, biophysical, personal etc. Newer trends in delivery of nutritional care and dietary counselling

UNIT-I [10]

Diet nutrient and drug interaction. Effect of drugs on ingestion, digestion, absorption and metabolism of nutrients, effect of foods, nutrients and nutritional status on drug dosage and efficacy.

Nutritional support-recent advances in techniques and feeding substrates

UNIT-I [18]

Etiopathophysiology, metabolic and clinical aberrations, complications, prevention and recent advances in the medical nutritional management of:

Weight imbalances

Cardio vascular disorders

Diabetes mellitus and other metabolic disorders

GI tract disorders

Liver and gall bladder, pancreatic disorders

Renal disorder

Stress and trauma

Cancer

Neurological disorders

Musculo-skeletal disorders

Immuno-deficiency disorder
Genetic disorders
Infection and AIDS
Respiratory problems

UNIT-I [5]

Childhood problems/disorders including inborn errors of metabolism and their nutritional management.

Text Book

1. Mahan, L.K. and Escott-Stump, S. (2000): Krause's Food Nutrition and DietTherapy, 10th Edition, W-13 Saunders Ltd.
2. Shills, M.E., Olson, J.A, Shike, M and Ross, A.C. (2003): Modern Nutrition in Health and Disease, 9th Edition, A. Vaiiiams and Willdns.

Reference

3. Williams, S.R. (2003): Nutrition and Diet Therapy, 7th Edition, Times Mirror/Mosby Collage Publishing.
4. Chandra, R.K. (eds) (2002): Nutrition and Immunology, ARTS Biomedical. St. John's Newfoundland.
5. Sareen, S, James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition, Thomson Wordsworth Publication, USA.

MB 641 INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY 3-0-0-3

UNIT-I

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feedback repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

UNIT-I

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

UNIT-I

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

UNIT-I

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (β-lactam, aminoglycosides). [12]

UNIT-I [5]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids.

Text Book

1. Crueger and Crueger (2003): Biotechnology: a textbook of industrial microbiology, 2nd Edition. Panima publications.
2. Stanbury, P.F. and Whitaker, A. (2016): Principles of fermentation technology. Pergamon press.

Reference

3. Taylor and Francis (2007): Fermentation microbiology and biotechnology. El-mansi. 2nd Edition.
4. Scragg (1991) :Bioreactors in Biotechnology: A Practical approach. Latest Ed.
5. Mansi, E. T., Bryce, C. A, Demain, A. L. and Allman A. R. (2011):Fermentation Microbiology& Biotechnology. 3rd Edition.

FN 651 Food and Nutrition Laboratory-II 0-0-4-2

Practical exercises related to FN 611, FN 621 and FN 631

Mody University of Science & Technology

M.Sc. Physics

Session 2018-2019

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc. Physics

Academic Curriculum (2015 – 16 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 511	Mathematical Physics-I	3	1	0	4	3	25	25	50
	PH 521	Classical Mechanics	3	0	0	3	3	25	25	50
	PH 531	Classical Electrodynamics and Plasma Physics	3	1	0	4	3	25	25	50
	PH 541	Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 551	Statistical Physics and Thermodynamics	3	1	0	4	3	25	25	50
	PH 561	General Physics and Optics Laboratory	0	0	4	2	4	100		
	PH 571	Programming Language Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**4**	**8**	**23**	**-**	**-**		
		Foreign Language-I (Non-Credit)‡	3	0	0	3	3	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 512	Mathematical Physics -II	3	1	0	4	3	25	25	50
	PH 522	Atomic & Molecular Physics and Lasers	3	1	0	4	3	25	25	50
	PH 532	Condensed Matter Physics	3	0	0	3	3	25	25	50
	PH 542	Computational Physics	3	0	0	3	3	25	25	50
	PH 552	Elements of Nuclear and Particle Physics	3	0	0	3	3	25	25	50
	PH 562	Computational Physics Laboratory	0	0	4	2	4	100		
	PH 572	Advance Physics Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**2**	**8**	**21**	**-**	**-**		
		Foreign Language-II (Non-Credit)‡	3	0	0	3	3	25	25	50

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 611	Semiconductor Physics and Devices	3	1	0	4	3	25	25	50
	PH 621	Digital Electronics	3	1	0	4	3	25	25	50
	PH 631	Physics of Nano-Materials	3	0	0	3	3	25	25	50
	PH 641	Ancient Indian Science	2	0	0	2	3	25	25	50
	PH 651	Electronics Laboratory	0	0	4	2	4	100		
		Specialized Paper –I	3	1	0	4	3	25	25	50
		Specialized Paper –II	3	1	0	4	3	25	25	50
	Sub Total		**17**	**4**	**4**	**23**	**-**	**-**		

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 612	Advance Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 622	Instrumentation and Characterization Techniques	3	0	0	3	3	25	25	50
		Specialized Paper –III	3	1	0	4	3	25	25	50
		Specialized Paper –IV	3	1	0	4	3	25	25	50
	PH 682	Project	0	0	0	8	-	100		
	Sub Total		**12**	**3**	**0**	**23**	**-**	**-**		

Total Credits = 90

Specializations:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE**	ETE
A	**Nanoscience**								
PH 661	Elements of Nanoscience	3	1	0	4	3	25	25	50
PH 671	Nano-Fabrication Techniques	3	1	0	4	3	25	25	50
PH 632	CNT and Sensor Applications	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
B	**Photonics**								
PH 681	Advance Opto-Electronics	3	1	0	4	3	25	25	50
PH 691	Fiber and Non-linear Optics	3	1	0	4	3	25	25	50
PH 652	Quantum Optics	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
C	**Condensed Matter Physics**								
PH 613	Advance Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 623	Soft Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 662	Material Science	3	1	0	4	3	25	25	50
PH 672	Smart Materials	3	1	0	4	3	25	25	50

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

[#]*Student will perform* ***project work*** *for a period of 2 months and submit two copies of Dissertation report to the Ddepartment. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

Detailed Syllabus (M.Sc. Physics):

PH 511 **Mathematical Physics-I** **3 - 1 - 0 - 4**

1. **Vector Analysis:** Gradient, divergence, Curl and their representations in Orthogonal curvilinear coordinates. [11]

   Linear algebra: Linear vector spaces, linear operators, dual space, ket and bra notation, Hilbert space, Metric space, Function spaces.

   Matrices: The algebra of matrices, Special matrices, Rank of a matrix. Elementary transformations, Elementary matrices, Equivalent matrices, Solution of linear equations. Linear transformations, Change of Basis, Eigenvalues and eigenvectors of matrices, The Cayley-Hamilton theorem, Diagonalisation of matrices.

2. **Tensor Analysis:** Tensor analysis, Coordinate transformations, scalars, Covariant and Contravariant tensors, Addition, Subtraction, Outer product, Inner product and Contraction, Symmetric and antisymmetric tensors, Quotient law, Metric tensor, Conjugate tensor. [8]

3. Partial Order Differential Equations and Special Functions: Separation of variables-ordinary differential equations, singular points, Bessel, Leguerre, Legendre, Hermite equations. Recurrence relations, generating functions and Rodrigues formulae for the Bessel, Leguerre, Legendre and Hermite functions [11]

4. **Greens Functions:** Sturm-Lioville operators and eigen values and eigen functions. Dirac delta functions-properties and representations, Definitions and physical significance of Greens functions, Eigen function expansion of Greens function, Greens function for ordinary differential operators [9]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990.
3. M.D. Greenberg:Advanced Engineering Mathematics, 2nd Edition, PHI, New Jersey, 1998.
4. B.D. Gupta: Mathematical Physics, 3rdedition, Vikas Publishing House, New Delhi. , 2006.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, 8th ed., Wiley, New York, 1999.
2. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
3. Satyaprakash, Mathematical Physics, Sultan Chand & sons, 6th edition, New Delhi, 2004.

PH 521 **Classical Mechanics** **3 - 0 - 0 - 3**

1. **Fundamental Principles and Lagrangian Formulation and Applications:** Newtonian Mechanics: Mechanics of a particle and system of particles, Conservation laws, Constraints, Generalized coordinates, D' Alembert's principle and Lagrange's equation, Hamilton's Variational principle, **Lagrangian Problems:** Double Pendulum, Spherical pendulum, Cylinder rolling down an inclined plane. [8]

2. **Hamiltonian Formulation and Application:** Hamilton's equations, cyclic variables, Principle of least action, **Hamiltonian Problems:** motion of a particle in a central force field, charged particle moving in an electromagnetic field, Equations of motion and first integrals, Kepler's laws, Scattering by central potential, Transformation from center of mass to laboratory frame. [10]

3. **Rigid Body Dynamics and Canonical Transformations:** Rigid body motion – Kinematics - Euler's angles - Angular momentum and kinetic Energy – Moment of inertia tensor - Euler's equations of motion –Canonical transformation and their generators – simple examples, Poisson brackets. [8]

4. **Jacobi Theory and Theory of Small Oscillations :** Hamilton-Jacobi equations – application to Linear Harmonic Oscillator problem - Action Angle variables - Application to Kepler's problem - Oscillatory motion - Theory of small oscillation –Two coupled pendulums, Vibrations of a triatomic molecule. [8]

5. **Relativity:** Reviews of basic ideas of special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence [5]

Text Books:

1. H. Goldstein, C.Poole and J.Safko; Classical Mechanics, Pearson, New Delhi, 3rd ed 2002.
2. N.C.Rana and P.S.Joag; Classical Mechanics, Tata Mc: Graw Hill, New Delhi, 1991.

Reference Books:

1. L. D. Landau E.M. Lifshitz; Mechanics: Volume 1 (Course of Theoretical Physics), Pergamon Press Ltd, 2nd ed. 1969.

PH 531 Classical Electrodynamics and Plasma Physics 3 - 1 - 0 - 4

1. **Electrostatics:** Electric potential, Poisson and Laplace‟sequations.Boundary value problems, Uniqueness theorems, Green‟stheorem.Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion. [6]

2. **Electromagnetic Waves:** Maxwell‟s equations, Boundary conditions, Wave equation and its complex notation, Electromagnetic waves in vacuum, Electromagnetic waves in non-conducting and linear media, Electromagnetic waves in linear conducting media. Poynting theorem, Reflection, refraction and polarization of electromagnetic waves, [6]

3. **Waveguides and Cavities:** Metallic boundary conditions, Electromagnetic waves confined to hallow metallic pipe,TE, TM and TEM modes, TE and TM modes in rectangular waveguides, Bessel‟s function, TE and TM modes in cylindrical waveguides, Dielectric waveguides, TE and TM modes in rectangular and cylindrical Resonant cavities. [6]

4. **Potential, Fields and Radiations:**

   Scalar and vector potentials, Gauge transformation, Coulomb and Lorentz gauge, Retarded potential, Lienard-Wiechert potentials, Fields due to moving charge, Power radiated by an accelerated charge and angular distribution, Bremstrahlung Cerenkov and Synchrotron radiations. [6]

5. **Relativistic Electrodynamics:** Four vectors, Lorentz transformation in terms of Four vectors, Lorentz transformation matrix, Transformation of electromagnetic fields, Field Tensor, Dual field strength tensor, Maxwell's equations in terms of strength tensors, [6]

6. **Plasma Physics:** Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, Motion of charged particles in electric and magnetic fields, Adiabatic Invariants Wave in Plasma: Polarisation, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and Perpendicular to the Magnetic Field Propagation at Finite Angle. [9]

Text Books:

1. David J. Griffith; Introduction to Electrodynamics, PHI Private Limited, 1999
2. John D. Jackson; Classical Electrodynamics, Wiley Eastern Limited, 1998
3. F.F. Chen; Plasma Physics and Controlled Fusion,Springer,2006

Reference Books:

1. Edward C. Jordan and Heith G. Balmain; Electromagnetic Waves and Radiating Systems, PHI, 1991
2. W.K.H. Panofsky and M. Phillips; Classical Electricity and Magnetism, Dover Publications; 2nd Ed., 2005
3. J A Bittencourt; Fundamentals of Plasma Physics, 3rd Ed, Springer, 2004

PH 541 **Quantum Mechanics** **3 - 1 - 0 - 4**

1. Limitations of classical mechanics, development of Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states. Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest‟s theorem, momentum Eigen functions in the coordinate representation, box normalization and Dirac delta function. Coordinate and momentum representations, Schrodinger equation in momentum representation [10]

2. Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, Eigen values and Eigen vectors, Hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations. Matrix representation of operators, change of basis, unitary transformations, quantum dynamics, Schrodinger, Heisenberg and interaction picture. [10]

3. Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method. Angular momentum operator, commutation relations, expression for L2 operator in spherical polar coordinates, Role of L2 operators in central force problem, eigen value problem for L2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator. [10]

4. Generalized angular momentum, raising and lowering operators, matrices for J2, Jx, Jy, Jz operators, Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions. [9]

Text Books:

1. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
2. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

Reference Books:

1. L.I.Schiff; Quantum Mechanics, TMH, 2010.
2. Mathews and Venkatesan; A Textbook of Quantum Mechanics, TMH 1976,
3. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
4. J.J.Sakurai; Modern quantum Mechanics, Addison Wesley; 2 ed., 2010

PH 551 Statistical Physics and Thermodynamics 3 - 1 - 0 - 4

1. **Review: (Elementary Probability Theory & Thermodynamics):** Preliminary concepts, Random walk problem, Binomial distribution, mean values, standard deviation, various moments, Gaussian distribution, Poisson distribution, mean values. Extensive and intensive variables, laws of thermodynamics, thermodynamic potentials, Maxwell relations, applications of thermodynamics to (a) ideal gas, (b) magnetic material, and (c) dielectric material. Laws of thermodynamics [4]

2. **Statistical Description of System of Particles and Statistical Thermodynamics:** State of a system, microstates, ensemble, basic postulates, behavior of density of states, density of state for ideal gas in classical limit. Thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of density of states on external parameters, Statistical calculation of thermodynamic variables [10]

3. **Classical Statistical Mechanics :** Microcanonical ensembles and their Equivalence, Canonical and grand canonical ensembles, partition function, thermodynamic variables in terms of partition function and grand partition function, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem. Maxwell-Boltzmann gas velocity and speed distribution. Chemical potential, Free energy and connection with thermodynamic variables, First and Second order phase transition; phase equilibrium. [10]

4. **Quantum Statistical Mechanics :** Formulation of quantum statistics, Density Matrix, ensembles in quantum statistical mechanics, simple applications of density matrix. The theory of simple gases : Maxwell-Boltzmann, Bose-Einstein, Fermi Dirac gases. Statistics of occupation numbers, Evaluation of partition functions, Ideal gases in the classical limit. [10]

5. **Ideal Bose System :** Thermodynamic behavior of an Ideal Bose gas, Bose-Einstein condensation. Thermodynamics of Black body radiation, Stefan-Boltzmann law, Wien's displacement law. [5]

Text Books:

1. B. B. Laud; Fundamentals of Statistical Mechanics, New Age International, 2007.
2. F. Reif; Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965
3. S. Loknathan&Gambhir; Statistical and Thermal Physics: An Introduction, PHI Learning, 1991.

Reference Books:

1. K. Huang; Statistical Mechanics, 2nded, John Wiley & Sons, 1987.
2. R. K.Pathria, Paul D. Beale, Statistical Mechanics;Butterworth-Heinemann Press, 2011.
3. L. D. Landau and E. M. Lifshitz; Statistical Physics: Volume 5 (Course of Theoretical Physics), 3rded Butterworth-Heinemann Press, 1980.

PH 561 General Physics and Optics Laboratory 0-0-4-2

Experiments based on Mechanics, Optics, Basic Electronics, PH 531.

PH 571 Programming Language Laboratory 0-0-4-2

Programming based on C^{++} related to Physics.

PH 512 Mathematical Physics -II 3 - 1 - 0 - 4

1. **Complex Analysis :**Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula, Taylor's series and Laurent's series expansion, Zeros and singular points, Multivalued functions, Branch Points and Cuts, Riemann Sheets and surfaces, Residues, Cauchy's Residue theorem, Evaluation of definite integrals. [11]

2. **Group Theory:** Definition of groups e.g. matrix groups- transformation groups , Representation of groups: matrix, faithful, Unitary, reducible and irreducible representations' Lie groups and algebras: Definition of Lie groups with examples- O(3), SO(3), SU (2) groups- representation of SU(2), SO(3). [9]

3. **Fourier Series & Transforms**: Integral transforms, Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives [9]

4. **Laplace Transforms:** Convolution Theorems, Momentum representation, Laplace transform, Properties and examples of Laplace Transform, Laplace transforms of derivatives, Use for solving differential equations [10]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. M. R. Spiegel: Theory and Problems of Complex Variables, Schaum's outline series, 6thed., 2008
3. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990,
4. B.D. Gupta: Mathematical Physics, 3rd edition, Vikas Publishing House , New Delhi. , 2006,

Reference Books:

1. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
2. E. Kreyszig: Advanced Engineering Mathematics, 8thed., Wiley, New York, 1999.
3. M.D. Greenberg: Advanced Engineering Mathematics, 2nded., PHI, New Jerrsey, 1998,

PH 522 **Atomic & Molecular Physics and Lasers** **3 - 1 - 0 - 4**

1. Time independent perturbation theory, First order perturbation theory applied to nondegenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic [11]

2. **Pauli's Principle and Shell Structure:** Systems with several electrons and spin functions. [2]

3. **Complex Spectra:** LS-Coupling scheme, normal triplets, basic assumptions of the theory, identification of terms, selection rules, jj- coupling (Qualitative). [2]

4. **Infrared and Raman Spectra:** Rigid rotator, energy levels, spectrum (no derivation of selection rules), Harmonic oscillator: energy levels, eigenfunctions, spectrum, comparison with observed spectrum, Raman effect, Quantum theory of Raman effect, Rotational and Vibrational Raman spectrum. Anharmonic oscillator: energy levels, Infrared and Raman Spectrum, Vibrational frequency and force constants. Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of Dunham coefficients), Symmetry properties of rotational levels, influence of nuclear spin. [12]

5. **Electronic Spectra:** Electronic energy and potential curves, resolution of total energy,Vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronicbands: General relations, branches of a band, band-head formation, Intensity distribution in avibrational band system. [6]

6. **Lasers:** Basic concept and principle of laser, Component of lasers, Einstein's and Gain coefficient, Types of lasers and pumping, Gas laser, YAG laser and chemical laser, Erbium lasers, Fibre lasers, Erbium-doped fibre lasers. Q-Switching:Laser Spiking and relaxation oscillations, Rate equations, TW and PW laser systems, Application of lasers. [6]

Text Books:

1. Kuhn H., Atomic Spectra, Academic Press, 1962
2. Herzberg I G., Molecular Spectra and Molecular Structure Van-Nostrand Rein-hold, 1950

Reference Books:

1. White H.E., Atomic Spectra, Mc-Graw Hill, 1934.
2. C N Banwell and E M McCash, Fundamentals of Molecular Spectroscopy: Tata Mc-Graw Hill, 2008
3. Chandra S., Molecular Spectroscopy, Narosa, 2009.
4. Vishwakarma H. L., Applied Physics, Wiley India Pvt. Ltd., 1st Edition, 2013.

PH 532 **Condensed Matter Physics** **3 - 0 - 0 - 3**

1. **Elastic Constants:** Binding in solids; Stress components, stiffness constant, elastic constants, elastic waves in crystals. [5]

2. **Lattice Dynamics and Thermal Properties:** Rigorous treatment of lattice vibrations, normal modes; Density of states, thermodynamic properties of crystal, anharmonic effects, thermal expansion. [5]

3. **Energy Band Theory**: Electrons in a periodic potential: Bloch theorem, Nearly free electron model; tight binding method; Semiconductor Crystals, Band theory of pure and doped semiconductors; elementary idea of semiconductor superlattices. [8]

4. **Transport Theory:** Electronic transport from classical kinetic theory; Introduction to Boltzmann transport equation; electrical and thermal conductivity of metals; thermoelectric effects; Hall effect and magnetoresistance. [7]

5. **Dielectric Properties of Materials:** Polarization mechanisms, Dielectric function from oscillator strength, Clausius-Mosotti relation; piezo, pyro- and ferro-electricity. [6]

6. **Liquid Crystals:** Thermotropic liquid crystals, Lyotropic liquid crystals, long range order and order parameter, Various phases of liquid crystals, Effects of electric and magnetic field and applications, Physics of liquid crystal devices. [8]

Text Books:

1. Kittel C., Introduction to Solid State Physics, Wiley, New York, 2005.
2. Kittel C., Quantum Theory of Solids, Wiley, New York, 1987.
3. Ziman J., Principles of the Theory of Solids, Cambridge University Press, 1972.

Reference Books:

1. Ibach H. and Luth H., Solid State Physics, Springer Berlin, 3rd ed. 2002.
2. Walter A. Harrison Solid State Theory, Tata McGraw-Hill, New Delhi, 1970.
3. Chandrasekhar S. Liquid Crystals, Cambridge University, 2nd ed. 1992.
4. Sluckin T.J., The Liquid Crystal Phases, Physics & Technology, Contemporary Physics Taylor & Francis, 2000.

PH 542 **Computational Physics** **3 - 0 - 0 - 3**

1. **Errors analysis and curve fittings:** General formula for errors – Errors of observation and measurement, Empirical formula, Graphical method, Method of averages, Least square fitting, curve fitting, parabola, exponential. Least square curve fittings methods for linear and polynomial functions. [7]

2. **Numerical solution of algebraic and transcendental equations:**

   The bisection method, the iteration method, The method of false position, Newton – Raphson method. [7]

   Linear systems of equations: Direct methods, Gauss elimination method, Gauss–Seidel method.

3. **Interpolation:** Finite differences (Forward, backward and central difference), Newton Interpolation formula, Central difference Interpolation formula, Cubic spline interpolation formula, Newton's interpolation formula for unequal intervals. [8]

4. **Numerical Differentiation and Integration:** Newton's forward and backward difference formula for numerical derivatives, Numerical Integration: the trapezoidal rule and Simpson's rule. [7]

5. **Numerical Solutions of Ordinary and Partial Differential Equations:** Taylor's method, modified Euler's method, second and fourth order Runge-Kutta methods, Predictor-Corrector methods. Finite-difference approximation to derivatives, S.O.R. and Jacobi methods for solving Laplace equations, Parabolic equations and Hyperbolic equations. [10]

Text Books:

1. S.S. Sastry; Introductory Methods of Numerical analysis, PHI New Delhi, 3rd Ed, 2003.
2. E. Balagurusamy; Numerical methods, Tata Mc Graw Hill, New Delhi, 2008.

Reference Books:

1. Erwin Kreyszig; Advanced Engineering Mathematics, 10thed, John Wiley and Sons, 2011.
2. W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling ; Numerical Recipes in C, , Cambridge University, 1996.

PH 552 **Elements of Nuclear and Particle Physics** **3 - 0 - 0 - 3**

1. **Nuclear Properties and Models:** General properties of Nuclei: nuclear size, Rutherford scattering, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magnetic dipole moment and electric quadrupole moment. Liquid drop model, Bethe-Weizs¨acker binding energy/mass formula, Fermi model, Shell model. [6]

2. **Nuclear Two-body Problem:** Properties of deuteron, Schr¨odinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces. Experimental n-p scattering data, Partial wave analysis and phase shifts, scattering length, magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Scattering from molecular hydrogen and determination of singlet and triplet scattering lengths, effective range theory, low energy p-p scattering, Nature of nuclear forces: charge independence, charge symmetry and iso-spin invariance of nuclear forces. [10]

3. **α, β and γ Decay:** α-decay, Gamow theory, Barrier penetration, fine structure of α spectrum. alpha decay, neutrino hypothesis β emission and electron capture, Fermi's theory of allowed β decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment, Gamma decay- Multiple transitions in nuclei- Angular momentum and parity selection rules [8]

4. **Nuclear Reactions and Fission:** Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions — Breit Wigner dispersion relation; Compound nucleus formation and break-up, Statistical theory of nuclear reactions and evaporation probability, Optical model; Principle of detailed balance, Transfer reactions, Nuclear fission and fusion. [8]

5. **Elementary Particle Physics:** Elementary particles: Photons, quarks, baryons, mesons, leptons, hadrons, Elementary idea of quark model. Conservation laws in particle reactions, Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula, C, P, T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic Kinematics. [7]

Text Books:

1. B L Cohen; Concepts of Nuclear Physics, Tata-McGraw Hill, 2008
2. Kenneth S. Krane; Introductory Nuclear Physics, Wiley India Pvt., 1988.
3. I.Kaplan;Nuclear Physics; Addison-Wesley, 1955

Reference Books:

1. S S M Wong; Introductory Nuclear Physics, Wiley, 1998.
2. S.B.Patel; Introductory Nuclear Physics, New Age International, 1991.
3. D.C.Tayal; Nuclear Physics, Himalayan Publishing House, 5th Edition, 2014.
4. R. R. Roy and B. P. Nigam; Nuclear Physics: Theory and Experiments, John Wiley & Sons, 1967.

PH 562 Computational Physics Laboratory **0-0-4-2**

Practical exercises based on 542, 512 and computational methods in Physics

PH 572 Advance Physics Laboratory **0-0-4-2**

Practical exercises based on 522, 532, 552 and related experiments.

PH 611 Semiconductor Physics and Devices 3 - 1 - 0 - 4

1. **Network Theorems:** Thevenin's, Norton's theorem and analysis of equivalent Circuits of networks. [9]

   Power Supplies: Half-Wave, Full-Wave and Bridge rectifiers with Capacitive input, Inductance input and PI filters, Shunt regulated power supplies using Zener diodes, Series regulated power supply. I. C. Voltage regulators.

2. **Transistor Amplifiers:** The CE, CB and CC configurations. Class A, Class B and Class C amplifiers. Low-frequency amplifiers. The transistor hybrid model and the h-parameters for a transistor. Conversion formulae for the h-parameters of the different transistor configurations. Analysis of a transistor CE amplifier at low frequencies using h-parameters. The CE amplifier with un-bypassed emitter resistor. The emitter follower at low frequencies. The emitter-coupled differential amplifier and its characteristics. Low frequency power amplifiers. The push-pull and the complementary - symmetry power amplifiers. Transistor biasing, Self-bias and thermal stability. [10]

3. **BJT and FET:** The BJT at high frequencies – the hybrid – model. Analysis of CE amplifier at high frequencies. Single stage CE amplifier and the gain-bandwidth product. Cascaded amplifiers. The emitter follower at high frequencies. The field effect transistor and its small signal model. The CS and CD amplifiers at low frequencies. Biasing the FET. The CS and CD amplifiers at high frequencies. [7]

4. **Feedback:** The Gain of an amplifier with feedback. General characteristics of negative feedback amplifiers. Stability of feedback amplifiers, The Barkhaussen Criteria. Grain and Phase margins. Compensation. Sinusoidal oscillators: RC oscillators – The Phase shift and the Wien's bridge oscillators. LC oscillators. Frequency stability and the crystal oscillators. [7]

5. **Operational Amplifiers:** Characteristics of an ideal operational amplifier. Applications of operational amplifiers – Inverting and Non-inverting amplifiers. Summing circuits, integration and Differentiation. Waveform generators. [6]

Text Books:

1. Maillman and Halkias, Integrated Electronics, Tata McGraw-Hill 1972.
2. V K Mehta; Principal of Electronics S. Chand and Sons 2008.
3. Donald Neamen; Semiconductor Physics and Devices, McGraw-Hill; 4th ed. 2011.

Reference Books:

1. M K Achuthan and K N Bhat; Fundamental of Semiconductor Devices, TMH 2006.
2. Rolf Enderlein, Norman J. M. Horing; Fundamentals of semiconductor physics and devices, World Scientific Pub, 1997.
3. John D. Ryder & Charles M. Thomson; Electronic Circuits & Systems, PHI Publication, 1976.

PH 621 **Digital Electronics** **3 - 1 - 0 - 4**

1. **Binary Number System:** Binary number system and other codes, binary arithmetic series and parallel processing of bites, logic of the addition operation, logic fundamentals, Boolean theorems, synthesis of Boolean functions, Karnaugh diagram. [8]

2. **Basics of Digital Electronics**: Basics and derived gates: OR gate, AND gate, NOT gate, NAND gate, NOR gate, XOR gate, Boolean identities and logic circuits using gates, Boolean algebra- DeMorgans Theorems, Sum of products and product of sums expressions, Minterm, Maxterm, SOP and POS from truth tables. [10]

3. **Combinational and Sequential Circuits:** Parity checker and generator, Half adders, full adders, Binary adders, decoders, multiplexer, demultiplexer, encoders, ROM and applications, Digital comparator, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and applications, A/D and D/A converters; Microprocessor and microcontroller basics. [12]

4. **Digital Circuits with MOS:** MOSFET, MOS invertors- static inverter, dynamic inverter, two phase inverter, MOS NAND gates, NOR gates, complementary MOSFET technology, CMOS inverter, CMOS NOR gates and NAND gates, MOS shift register and RAM. [9]

Text Books:

1. Malvino & Brown:Principle Of Digital Computer Electronics, 3rd Ed., McGraw-Hill, 1992.
2. Morris Mono: Digital logic Design, 4th edition, PHI, 2006.
3. J. Millman and C.C. Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi, 1991.

Reference Books:

1. Mottershed: Electronics fundamentals and application, 8th edition, PHI, 2009.
2. A.P. Malvino and D.P. Leach, Digital Principles and. Applications, 6thed., TMH, 2003.

PH 631 **Physics of Nano-Materials** **3 - 0 - 0 - 3**

1. **Introduction**: An overview of quantum mechanical concepts related to low dimensional systems. [12]

   Concepts related to Electronic Structure: direct lattice, Reciprocal lattice, Brilloujn zones, Diffraction from 2D structures, Free —electron approximation, periodic boundary Conditions, allowed k values, Fermi energy, density of electronic states for electron gas, Energy bands, Electron statistics, carrier concentration and Fermi level, Direct- and Indirect- gap semiconductors, Lattice matching, Effective mass, Variation of energy bands with alloy compositoin and its exploitation for devices.

2. **Hetrostructures and Electron States**: Hetero junctions, Type I and Type II hetero structures, Classification of Quantum confined systems, Electrons and holes in Quantum wells. Surface to volume ratio in quantum confined systems, Electronic wave functions, energy sub bands and density of electronic states in Quantum wells, Quantum wires, and Quantum dots, Effective mass mismatch in hetero structures. Coupling between Quantum wells, Super lattices, Wave functions and Density of States for super lattices, Unit cell for quantum well, for quantum wire and for quantum dot. [12]

   EXCITONS: Excitons in bulk, in Quantum structures and in hetero structures.

3. **Nanoclusters and Nanoparticles**: Introduction, Particle shape and the surface, Collective surface area, Porosity, Spherical cluster approximation, Metal nanoclusters – Magic numbers, Geometric structures, Electronic structure, Bulk to nanotrasition, Magnetic clusters; Semiconducting nanoparticles; Rare-gas and molecular Clusters. [6]

4. **Carbon nanotubes**: Chiral vector, Chiral angle and the Unit cell for the Carbon nanotubes. [5]

5. Bulk Nanostructurs Materials: Solid disordered nanostructures, Nanostructured crystals, photonic crystals. [4]

Text Books:

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio; Quantum Heterostructures: Microelectronics and Optoelectronics, Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens; Introduction to Nanotechnology, Wiley India, 2003.
3. T. Pradeep; Nano: The essentials, Tata McGraw-Hill, New Delhi, 2007.
4. P. Harrison; Quantum Wells, Wires, and Dots: Theoretical and Computational Physics of Semiconductor Nanostructures, Wiley, 2009.

Reference Books:

1. G. Streetman and S. Banerjee; Solid State Electronic Devices, Prentice Hall of India, 6th Edition, 2005.
2. A. Y. Shik ; Quantum Wells: Physics and Electronics of two-dimensional systems, World Scientific, 1997.
3. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao; Introduction to Nanoscience, CRC Press, 2009.

PH 651 Electronics Laboratory 0-0-4-2

Practical exercises based on 611, 621 related to analog and digital electronics.

PH 641 Ancient Indian Science 2 - 0 - 0 - 2

1. **Reference of Science in Vedas** [3]

2. **SAGE Scientists and Their Achievements:** Baudhayan, Aryabhatta,Brahmgupta, Bhaskaracharya , varahamihira, Mahaviracharya, Acharya Kanad, Varahamihira, Nagarjuna, Acharya Bhardwaj, SusrutaAtreya, Acharya Charak, Patanjali. [8]

   Scientists of modern era: C. V. Raman (1888-1970), S. Ramanujan (1887-1920), J. C. Bose (1858-1937), H. J. Bhabha (1909-1966), V. A. Sarabhai (1919-1970), H. G. Khorana (1922-2011), Harish Chandra (1923 - 1983), S. N. Bose (1894 - 1974)), S. S. Bhatnagar (1894 – 1955), Visvesvaraya (1860 –1962)[, MeghnadSaha (1893–1956) etc.

3. **Discoveries in Astronomy and Physics of Ancient India:** Earth's rotation, Gravity, Speed of light, Lunar Eclipse, Planetary motion, Mechanics, Matter, Magnetism and Optics [5]

4. **Vedic Mathematics**: Algebra & Arithmetic, Geometry, Trigonometry [5]

5. **Chemical and Biological advancement of Ancient India**: Chemistry (Distillation, Caustic Alkali, Cell and Explosives), Metallurgy (Crucible, Furnaces, Air Blowers, Metal Powder, Binder), Botany, Medicine and Pharmacology. [5]

Text Books:

1. Pride of India- A Glimpse into India's Scientific Heritage. SamskritaBharati, New Delhi, 2006.
2. Science in Samskrit, SamskritaBharati, New Delhi, 2007.
3. N. K. Jain; Science and Scientists in India. Kalyani India, Delhi, 2001.
4. Awakening Indians to India, All India ChinmayaYuvaVendra, Central Chinmaya Mission Trust, Mumbai, 2003.

Reference Books:

1. N.K. Jain; History of Science and Scientific Methods. Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi, 1990.
2. S. Soni; India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd., New Delhi, 2006.

PH 612 **Advance Quantum Mechanics** **3 - 1 - 0 - 4**

1. Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission,atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein‟s A and b coefficients and their calculations.Approximation methods: W. K. B. method and its application to barrier penetration.Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential. [10]

2. System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule. [11]

3. Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential , Partial wave method, phase shifts and their importance, scattering by a square well; potential and a perfectly rigid sphere, resonance scattering. [6]

4. Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac‟s relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac‟s theory, negative energy states and their qualitative explanations. [12]

Text Books:

1. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
2. L.I.Schiff; Quantum Mechanics, TMH, 2010.

Reference Books:

1. E. Merzbacher, Quantum Mechanics, Wiley and Sons, 1998
2. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
3. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

4. Pauling, Introduction to Quantum Mechanics, Dover Publication 2008.

PH 622 **Instrumentation and Characterization Techniques** **3 - 0 - 0 - 3**

1. **Imaging Techniques:**

Optical microscopy: Use of polarized light microscopy, Phase contrast microcopy, Interference Microscopy, hot stage microscopy - surface morphology. [2]

Scanning electron microscopy: Basic design of the scanning electron microscopy , Modes of operation, Backscattered electrons, secondary electrons, X-rays – typical forms of contrast, Resolution and contrast, Specimen Preparation, application of SEM. [5]

Transmission electron microscopy: Basic principles, Modes of operation, Specimen preparation, Diffraction in imperfect crystals, Dislocations, precipitates, Structure of Grain boundaries and interface. [4]

Force microscopy: Basic concepts-Interaction force, AFM and the optical lever, force curves, measurements and manipulation, feedback control, different modes of operation, contact non-contact and tapping mode, Imaging and manipulation of samples in air or liquid environments-Imaging soft samples, Applications . [6]

Scanning tunneling microscopy: Principle, Instrumentation, importance of STM for nanostructures, surface and molecular manipulation using STM. [4]

2. **Qualitative and Quantitative analysis**

X-Rays powder diffraction: Single crystal diffraction techniques, Determination of accurate lattice parameters, structure analysis , profile analysis, particle size analysis using Scherer formula. [3]

Thermal analysis methods: Principle and Instrumentation of Thermogravimetry, Differential Thermal Analysis and Differential scanning calorimetry. Electron Energy Loss Spectroscopy; Atom probe field ion microscopy-X-Ray Photoelectron Spectroscopy, X-Ray Characterization, EDAX and WDA analysis, EPMA, ZAP corrections. [7]

Spectroscopic techniques: Introduction to Molecular Spectroscopy and Differences-With Atomic Spectroscopy-Infrared (IR) Spectroscopy and Applications- Microwave Spectroscopy-Raman Spectroscopy and CARS Applications-Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique. [8]

Text Books:

1. Cullity, B. D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
2. Loretto, M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.

Reference Books:

3. Rose, R.M., Shepard, L.A. and Wulff, J., The Structure and Properties of Materials, 2nd Ed., Wiley Eastern Ltd, 2005.

PH 661 **Elements of Nanoscience** **3 - 1 - 0 - 4**

1. **History , Scope and Classes of Nanomaterials:** Pre-nanotechnology, origins of concepts of Nano, Basics and basis of Nanotechnology, Generations and Development, Molecular aspects, Top down and Bottom up approaches, fullerenes: properties of fullerenes [8]

2. **Nanomagnetics**: Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics. [12]

   Quasicrystals: Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

3. **Optical and Vibrational Spectroscopy**: spectroscopy of semiconductor; infrared surface spectroscopy, Raman spectroscopy, Brillouin spectroscopy, luminescence (photoluminescence, thermoluminescence), [7]

4. **Biological Materials**: biological buildings blocks, nucleic acids, biological nanostructures. [6]

5. **Nanomachines and Nanodevices**: MEMS, MEMSs, molecular and super molecular switches. [6]

Text Books:

1. S. Shanmugam; Nanotechnology, MJP Publishers, Chennai, 2010.
2. Guozhong Cao; Nanostructures and Nanomaterials, Imperial College Press, London, 2004.
3. Charles P. Poole, Frank J Owens; Introduction to Nanotechnology, Wiley, 2003.
4. T. Pradeep; Nano: The Essentials, TMGH, New Delhi, 2009.

Reference Books:

1. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

PH 671 **Nano-Fabrication Techniques** **3 - 1 - 0 - 4**

1. **Physical and Chemical Methods:** Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE), Sol-Gel Process — Self-assembly – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Photochemical Synthesis - Sonochemical Routes – Reverse Micelles and Micro emulsions - Combustion Method – Template Process - Chemical Vapor Deposition (CVD) – Metal Oxide Chemical Vapor Deposition (MOCVD) [12]

2. **Optical Lithography:** Introduction - Necessity for a clean room- different types of clean rooms-construction and maintenance of a clean room- Lithography -Optical lithography- Optical projection lithography- Multistage scanners resolution- Photomask- Binary mask- Phase shift mask - Attenuated phase shift masks - alternating phase shift masks - Off axis illumination- Optical proximity correction - Sub resolution assist feature enhancement-Optical immersion lithography- Optical interferometric lithography- Holographic lithography. [9]

   Maskless optical projection lithography - Zone plate array lithography-Extreme ultraviolet lithography.

3. **Electron Beam and Ion Beam Lithography:** Scanning electron-beam lithography- maskless EBL- parallel direct-write e-beam systems-electron beam projection lithography - Scattering with angular limitation projection e-beam lithography- Projection reduction exposure with variable axis immersion lenses. [8]

   Focusing ion beam lithography - Ion projection lithography - Projection focused ion multi-beam - Masked ion beam lithography- Masked ion beam direct structuring- atom lithography.

4. **Nanoimprint Lithography and Soft Lithography**: Nanoimprint lithography (NIL)- NIL- hot embossing- UV-NIL- Soft Lithography- Moulding/Replica moulding: Printing with soft stamps- Edge lithography -Dip-Pen Lithography-set up and working principle. [5]

5. **Etching Techniques**: Reactive Ion etching- RIE reactive ion etching- Magnetically enhanced RIE- IBE Ion beam etching- Other etching techniques. [5]

Text Books:

1. Zheng Cui; Nanofabrication-Principles, Capabilities and Limits, Springer, 2008
2. Guozhong Gao; Nanostructures & Nanomaterials: Synthesis, Properties & Applications, , Imperial College Press, 2004.

Reference Books:

1. K. Suzuki and B W Smith, Microlithography: Science and Technology, 2nd Ed., CRC Press, 2007.
2. M.Ratner, D Ratner. Nanotechnology - A Gentle Introduction to the Next Big Idea, Pearson, 2003.
3. Bhushan, B., Handbook of nanotechnology, 2nd Ed., Springer, 2007.

PH 632 CNT and Sensor Applications 3-1-0-4

1. Structure of CNTs

Allotropes of carbon, Buckminsterfullerene, Fullerene-related carbon nanotubes, Single- and double-walled nanotubes, Catalytically produced carbon nanotubes, Bonding in carbon materials, Vector notation for carbon nanotubes, Unit cells of nanotubes, Symmetry classification of nanotubes, Defects in the hexagonal lattice, The layer structure of multiwalled nanotubes, Theory of nanotube capping, multiwalled nanotubes produced by arc-evaporation, multiwalled nanotubes produced by catalysis, experimental studies: single-walled nanotubes General features Electron diffraction of SWNTs, HRTEM of SWNTs, Scanning tunnelling microscope of SWNTs, Neutron diffraction.

[9]

2. Physical properties of CNTs

Electronic properties of graphite, Electronic properties of nanotubes, Band structure of single-walled tubes, Effect of curvature and of tube–tube interactions, Electron transport in nanotubes, Effect of a magnetic field, Correlation between electronic properties and structure of single-walled nanotubes, Quantum conductance, Electronic properties of nanotubes in a magnetic field, Superconductivity, Mechanical properties of carbon nanotubes, Optical properties of nanotubes, Thermal properties of nanotubes.

[8]

3. Chemistry and biology of CNTs

Covalent functionalization, Functionalization of nanotube ends and defects, Functionalization of sidewalls, Non-covalent functionalization, Characterizing chemically functionalized nanotubes, Biological functionalization, Proteins, Nucleic acids, Toxicity of carbon nanotubes.

[6]

4. Synthesis, Purification and processing of CNTs

Production of multiwalled nanotubes by arc-evaporation, Growth mechanisms of multiwalled nanotubes in the arc, Production of multiwalled nanotubes by high-temperature heat treatments, Production of single-walled nanotubes by arc-evaporation, Production of single-walled nanotubes by laser vaporization, Growth mechanisms of SWNTs in the arc and laser methods, Purification of single-walled and multiwalled tubes, Processing of single-walled and multiwalled nanotubes.

[10]

5. Probes and sensors Applications

Nanotube tips for atomic force microscopy, Preparing nanotube tips: mechanical assembly, Preparing nanotube tips: chemical vapour deposition, Imaging using nanotube AFM tips, Gas sensors, Biosensors, Physical sensors.

[6]

Text Books

1. Applied Physics of Carbon Nanotubes: Fundamentals of Theory, Optics and Transport Devices, Rotkin Slava V. , Subramoney Shekhar, Springer (2005)
2. Aligned Carbon Nanotubes: Physics, Concepts, Fabrication and Devices, Zhifeng Ren, Yucheng Lan, Yang Wang, Springer-Verlag Berlin Heidelberg (2013)

3. Carbon Nanotube and Graphene Device Physics, H.-S. Philip Wong, Deji Akinwande , Cambridge University Press (2011)

Reference Books

1. Carbon Nanotubes – Growth and Applications Edited by Mohammad Naraghi Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia (2011)
2. Carbon nanotubes : properties and applications Edited by Michael J O'Connell, CRC Press (2006)
3. Carbon Meta-Nanotubes: Synthesis, Properties and Applications, Edited by Mark Monthioux, Willey (2011)

PH 642 Nanophotonics 3 - 1 - 0 - 4

1. **Photons and electrons:** Isomorphism of Schrodinger and Helmholtz equations, free space propagation. Confinement of photons and electrons. Bloch waves, reciprocal space, and Brrilouin zones Propagation through well and barriers, Cooperative effects for photons and electrons. [8]

2. **Quantum Confinement Effect:** Quantum confinement effects in solids, nanoscale interaction dynamics, quantum wells, quantum wired, quantum dots, quantum rings. Manifestation of quantum confinement: linear and nonlinear optical properties. [10]

3. **Photonic Crystals**: Basics Concepts, Light in periodic nanostructures, Features of Photonic Crystals, photonic bandgaps, Band gap and band structures in 1-D, 2-D and 3-D photonic lattices. Photonic Crystal Sensors, Microstructure Fibers: Photonic crystal fiber, photonic band gap fibers (PBG), band gap guiding, single mode and multi mode, dispersion and nonlinear effect of Photonic crystal devices using crystal fibers. [12]

4. **Plasmonics:** Optical response of metals, plasmons, shell nanoparticles, metal-dielectric shell nanoparticles, Nonlinear optics with surface plasmons, Plasmon waveguides, Applications of Metallic Nanostructures: nanolasers, nanowire lasers, resonant cavity LED, Metamaterials. [9]

Text Books:

1. Paras N Prasad: Nanophotonics, John Wiley & Sons, 1st edition, NJ, 2004.
2. S V. Gaponenko, Introduction to Nanophotonics, 1st ed., Cambridge University Press, NY, 2010.
3. J D Joannopoulos, R.D. Meade and J.N.Winn: Photonic Crystals: Modelling Flow of Light; 2nd ed. , Princeton University Press, NJ, 2008.

Reference Books:

1. Lukas Novotny and Bert Hecht: Principles of Nano Optic,2nd ed., Cambridge Univ. Press, 2012.
2. J MLourtioz, H Benisty; V Berger, Jean-Michel Gerard: Photonic Crystals: Towards Nanoscale Photonic Devices, 2nd ed., Springer, Berlin 2008.

PH 681 **Advance Opto-Electronics** **3 - 1 - 0 - 4**

1. **Optical Properties of Semiconductors:** Basic of semi-conductors, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, External quantum efficiency, double hetero-junction, fabrication of hetero-junction, Solar cells, photo-resistors quantum wells and super lattices. [6]

2. **Optical Sources:** Current Densities and Injection Efficiency, Injection Luminescence and the Light-Emitting Diode, Spectrum of Injection Luminescence, Selection of Materials for LEDs, Internal/External Quantum Efficiency The Hetero-junction, Surface-Emitting LEDs, Edge-Emitting LEDs, Super-luminescent Diodes, LASER as an amplifier of light and necessary conditions for amplification, special properties of LASER- monochromatic, coherent and light power nature, directionality, divergence and attenuation of LASER beam. Study of three level Laser (Ruby LASER), Study of four level laser (He-Ne laser), semiconductor laser and applications of high power, low power continuous wave and pulse lasers [14]

3. **Light Detectors:** Idea of light detectors and their basic types, Optical Absorption Coefficient and Photocurrent, Quantum Efficiency, Responsivity, Long-Wavelength Cut-off, p-i-n-Photodiode, Avalanche photodiodes (APDs) [4]

4. **Opto-electronic Modulator and Display Devices:** Optical polarization, Electro-optic effect, Longitudinal and Transverse Electro-optic modulator, Acousto-optic effect, Raman-Nath Modulator, Bragg Modulator. Display devices, Photoluminescence, cathodo luminescence, EL display, LED display, drive circuitary, plasma panel display, liquid crystals, properties, LCD displays, numeric displays. [9]

5. **Organic Optoelectronic Devices:** Organic Light-Emitting Diodes (OLEDs), Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs Organic photovoltaic diodes (OPVDs), Exciton absorption, Exciton dissociation ,Charge collection Characterization of OPVDs [6]

Text Books:

1. A. YarivOptical Electronics,4thed, Saunders Collage Press, 1991.
2. A. Ghatak&K.Thyagarajan; Optical Electronics, Cambridge University Press, 1989.
3. R. P. Khare; Fiber Optics and Optoelectronics, Oxford University Press, 2004.
4. Wolfgang Brutting;Physics of Organic Semiconductors, Wiley, 2006.

Reference Books:

1. Pallabh Bhattacharya, Semiconductor Optoelectronics Devices, Prentice Hall; 2nd ed. 1996.
2. A. Roger, Essentials of Optoelectronics, Chapman Hall, 1997.
3. Jasprit Singh, Electronic & Optoelectronic properties of Semiconductor, Cambridge University Press, 2007.

PH 691 **Fiber and Non-linear Optics** **3 - 1 - 0 - 4**

1. **Basic Optics :** Basic optical laws, reflection at plane interface, Brewster angel and total internal reflection, Linear and nonlinear medium, Maxwell's equations, Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides, polarization, dielectric susceptibility, first and higher order susceptibilities. [6]

2. **Optical Fiber Waveguides and Sources:** Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays, evanescent field and Goos-Haechen shift, step index and graded index fibers, single and multi-mode fibers. [5]

3. **Transmission Characteristics of Optical Fibers:** Attenuation , material absorption losses in silica fibers, linear and nonlinear scattering losses, fiber bend loss, mid-infrared and far-infrared transmission, intra-modal and inter-modal dispersion, overall fiber dispersion in multimode and single-mode fibers, modal birefringence. [8]

4. **Fabrication Techniques and Connection of Optical Fibers:** Glass fibers, Preparation of optical fibers, Liquid-phase (melting) and Vapour-phase deposition techniques, characteristics of single-mode, multimode, plastic-clad and all-plastic fibers, Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen absorption, fiber alignment and joint loss, fiber splices, Fiber connectors, Fiber couplers, Sources to Fiber Power launching. [8]

5. **Nonlinear Optical Effects in Fiber and Solitons in Optical Fiber Communication:** Refractive index, frequency and intensity dependent refractive index, group velocity dispersion, self-phase modulation, Kerr effect, chirping, stimulated Raman scattering , stimulated Brillouin scattering, self-steepening, self-focusing, self-defocusing, concept of solitons, formation of solitons, Nonlinear Schrödinger equation for solitons, soliton switching, soliton laser, advantages of soliton based communication. [12]

Text Books:

1. AGhatak and K. Thyagarajan; Introduction to fiber optics, Cambridge University press, 6th ed., 2006.
2. K. Thyagarajan and A Ghatak; Fiber Optic Essentials, , Wiley-IEEE Press, 2007.
3. G. Keiser, Optical Fiber Communications, Mc Graw-Hill, 5th ed., 2013.
4. Govind P. Agrawal, Nonlinear Fiber Optics, Academic Press, 2001

Reference Books:

1. John M. Senior; Optical fiber communications: Principles and practice, PHI, 3rded, 2009.
2. B.B. Laud; Lasers and Non-Linear optics, John Wiley & Sons, 1985.
3. Robert W Boyd; Nonlinear fiber optics, Elsevier, 2nd ed., 2006.

PH 652 **Quantum Optics** **3 - 1 - 0 - 4**

1. **Quantized States of Radiation**: Quantization of the radiation field, quantum harmonic oscillator, the zero-point energy. the connection between the positive and negative frequency parts of the electric field operator; states of the quantized radiation field - single mode number states, thermal states, phase states, the minimal uncertainty states; the coherent and squeezed coherent states. [6]

2. **Semi-classical and Quantum Descriptions of a Radiation Field**: Various definitions of a coherent state: the minimal uncertainty states, the states with classical motion, the displacement operator eigen states etc; the Glauber-Sudarshan P-function, the Q-function and other quasi-probability distribution functions and their use in the semi-classical description of a radiation field; Nonclassical aspects like squeeezing and antibunching and examples of nonclassical states and experimental status. Important experiments in Quantum Optics: Photon counting experiments, Intentsity-intensity correlation - Hanbury-Brown and Twiss experiment. [8]

3. **Classical and Quantum Theories of Optical Coherence**: The concept of an analytic signal, elementary description of stochastic processes, correlation functions and coherence functions; Stationary and ergodic processes, Wiener-Khinchin relations etc. Young's double slit experiment to discuss the conditions on the classical coherence functions and quantum coherence functions for various orders of coherence; higher-order correlations functions etc. [8]

4. **Interaction Between Light and a Two-level Atom**: The Jaynes-Cummings model interaction and the corresponding Hamiltonian - its solution and the expression for the population inversion; the experimental developments; the classical and quantum signatures -collapses and revivals. [6]

5. **Quantum Theory of Laser**: Photon rate equations, threshold conditions, laser photon distribution, fluctuations in laser light and laser phase diffusion. [12]

   Special topics: Spontaneous emission, laser cooling, collective and cooperative effects in the light-atom(s) interaction, quantum beats, the role of quantum optics in the problem of quantum entanglement and quantum information.

Text Books:

1. L. Mandel and E. Wolf; Optical coherence and quantum optics, Cambridge, 1995.
2. M Fox; Quantum Optics, An Introduction, Oxford University Press, 2006.

Reference Books:

1. P. Meystre and M. Sargent; Elements Of Quantum Optics 3Ed, Springer (India) Pvt. Ltd., 2006.

PH 613 Advance Condensed Matter Physics 3 - 1 - 0 - 4

1. **Plasmons, Polaritons and Polarons:** Dielectric function of the electron gas, Plasma optics, Dispersion relation for electromagnetic waves, Transverse optical modes in plasma, Longitudinal plasma oscillations, Plasmons, electrostatic screening, Mott metal-insulator transition, Screening and phonons in metals; Polaritons and LST relation, Electron-electron interaction; Electron –phonon interaction (Polarons). [9]

2. **Optical Properties and Raman Effect in Crystals:** Optical reflectance, Kramers-Kronig relations, Excitons, Frenkelexcitons, weakly bound excitons, Raman Effect in crystals, Electron spectroscopy with X-rays, Energy loss of particles in a solid. [8]

3. **Superconductivity:** Superconductors, Meissner effect, heat capacity, energy gap, isotope effect, London penetration depth, coherence length, BCS theory, Flux quantization in a superconducting ring, Josephson tunnelling. [5]

4. **Magnetic Properties of Solids and Magnetic Resonance:** Langevin diamagnetism, quantum theory of paramagnetism, paramagnetic susceptibility of conduction electrons, ferromagnetic, Curie point, temperature dependence and saturation magnetization at absolute zero, Magnons, Curie temperature and susceptibility of Ferrimagnets, Antiferromagnetics and susceptibility below Neel temperature, Ferromagnetic domains, Nuclear magnetic resonance, line width, hyperfine splitting, electron paramagnetic resonance [12]

5. **Imperfections in crystals and diffusion in solids:** Point, line and surface imperfections, Dislocations; Fick's law of diffusion, Fick's second law, Kirkendall effect, Temperature dependence of diffusion coefficient, determination of diffusion coefficient and activation energy [5]

Text Books:

1. Kittel C, Introduction to Solid State Physics, Willey 7th ed. 2005
2. Hayden W., Moffatt W. G. And Wulff J., Structure and properties of materials, Willey Vol. 3rd.
3. Dekker A., Solid State Physics, Prentice-Hall, 1967

Reference Books:

1. Azaroff L. V., Introduction to Solids, Mc-Graw Hills, 2010
2. Vijaya M. S. And Rangrajan G., Material Science, Tata McGraw Hills, 2006
3. J. R. Hook, H. E. Hall., Solid State Physics, Wiley; 2 edition, 1995.
4. Narula and Gupta, Material Science, Tata McGraw Hills, 2007

PH 623 **Soft Condensed Matter Physics** **3 - 1 - 0 - 4**

1. **Introduction and Review of Statistical Mechanics:** Examples of soft materials in industry and biology, Foams as a lead-off example of macro properties derived from micro, Atomic- and molecular-scale forces and bonds, Repulsion, entropy, hydrophobicity. Probabilities; Boltzmann distribution, Helmholtz energy, Equipartition theorem, Example of pulling RNA and measuring stiffness of a network (experiments). [8]

2. **Van der Waals Forces and Fluctuation-induced forces:** Keesom, Debye, and London contributions, Mean-field models of media, Measurements; list of Hamaker constants, relationship to surface tension, Derjaguin approximation; interaction between spherical particles. Osmotic pressure, Depletion attraction, Repulsion between membranes, Tension in a polymer. [7]

3. **Polymer :** Part A: Survey of types of polymers. Ideal-chain and Freely-jointed chain models.

   Part B: Worm-like chain (Kratky-Porod) model. The spectrum of fluctuations and the stiffness of a single polymer. [4]

4. **Friction in Fluids and The Diffusion Equation:** The Langevin Equation of motion of a particle in fluid. Viscosity and a simple model for its value; terminal velocity; sedimentation. The mean-square displacement, Fluctuation-dissipation theorem. A free particle; an ink spot; diffusion to capture, etc. Particle-hopping model; Fick's law; diffusion with drift. Experimental methods: Dynamic light scattering and the correlation function. Measuring interactions: terminal velocity; g(r); Boltzmann method. [10]

5. **Fluid Interfaces**, **Fluid Dynamics and Electrostatics in Solution (3D):** Surface tension, surfactants and Pickering emulsions. Consequences of a surface tension: LaPlace pressure, Jurin's Law, the Rayleigh instability, the Young-Dupre law and wetting, the shape of a meniscus: the equation of capillarity. Forces among interfacial inclusions (the 'Cheerios Effect'). Assembly of particles at liquid interfaces. [10]

   The Navier-Stokes equation for an isotropic fluid. Reynolds Number, laminar flow, Poiseuille flow, lubrication. Poisson-Boltzmann theory and Debye length Inter-particle forces,

Text Books:

1. Richard A.L Jones., Soft Condensed Matter, Oxford University Press, 1st Edition, 2002.
2. Chaikin P. M. and Lubensky T.C. , Principles of Condensed Matter Physics, Cambridge University Press, 1st Edition 2000

Reference Books:

1. Poon W.C.K. , David Andelman, Soft Condensed Matter Physics in Molecular and Cell Biology, CRC Press, Taylor and Francis Group, 2006

PH 662 **Material Science**

3-1-0-4

1. **Introduction**

   Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern Materials.

   [2]

2. **Phase Diagrams and Phase Transition in materials**

   Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system.

   Solid solutions, Phases, Thermodynamics of solutions, Phase rule, Binary phase diagrams, Binary isomorphous systems, Binary eutectic systems, ternary phase diagrams, kinetics of solid reactions. Order disorder phenomenon in binary alloys, long range order, super lattice, short range order.

   [14]

3. **Elastic,Anelastic and viscoelastic behaviour**: Atomic model of elastic behavior- Rubber like elasticity- Anelastic behavior- Viscoelastic behavior, Spring-Dashpot model.

   [5]

4. **Plastic deformation, Creep and Fracture**

   Plastic deformation - Slip - twinning - Critical resolved shear stress - theoretical shear strength of perfect crystal - role of dislocation in plastic deformation - methods of strengthening crystalline materials - strain hardening - grain size - solid solution strengthening - precipitation strengthening - fibre reinforced materials - whiskers - creep - creep curves - mechanism of creep - creep resistant materials, Ductile, Brittle fracture, Fracture toughness, Ductile-Brittle transition, fatigue fracture, Method of protection against fracture.

   [14]

5. **Oxidation and Corrosion**

   Mechanisms of oxidation, Oxidation resistant materials, Principles of corrosion, Protection against corrosion

   [4]

Text Books:

1. Dekker A J, "Solid State Physics", Macmillan and Co., (2000).
2. Raghavan V, “Materials Science and Engineering: A First Course", 5th Edition, Prentice Hall of India Pvt. Ltd., (2004).
3. Narula G K,Narula K S and Gupta V K,”Material Science”4th Ed.Tata McGraw Hill,(1993).

Reference Books:

1. Callister W D, "Materials Science and Engineering: An Introduction", 7th Edition, John Wiley & Sons, Inc., (2007).
2. James F Shackelford, "Introduction to Materials Science for Engineers", 7th Edition,Pearson Prentice Hall, (2009).
3. Van Vlack L H, "Elements of Materials Science and Engineering", 5th Edition, Addison Wesley, New York, (1989).

PH 672 Smart Materials 3 - 1 - 0 - 4

1. **Smart Materials: An Introduction:** States of matter, atomic structure, chemical bond, oxidation and reduction, aldehydesand ketones, amines and amino acids, lipids, carbohydrates, proteins and Enzymes, Biological Cell structure, Bacteria, Viruses, DNA and heredity , chromosomes, Genes, Study of Smart Materials and their integration into novel designs. Classifies according to their Response and Stimuli ability. Describes the effect of crystalline structures in the properties of piezoelectric materials, magnetostrictive materials, shape memory alloys. [10]

2. **Sensing Elements And Transducers:** Mechanical spring devices, Cantilever, Helical spring, Torsion bars or Shaft; Pressure Sensitive Devices, Bourdon tubes, bellows; Passive and active transducers, Theory of strain gauges, measurement of temperature, Thermocouples, RTDs, Thermistors, LVDT, Capacitive transducers, Hall effect transducers. [12]

3. **Chemical, Gas and optical Sensors:** pH, pH electrode, pH measurement, Humidity, Absolute and relative humidity, measurement of humidity, P-i-n and APD photodetectors, Fiber optic sensor, sensors using CNTs [6]

4. **MEMS and NEMS:** An elementary idea of MEMS, NEMSs, molecular and super molecular switches. [7]

5. **Biosensors:** Insulin therapy, Enzyme electrode, bio receptor molusles, Transduction mechanisms in biosensors. [4]

Text Books:

1. Jasprit Singh, Smart Electronic Materials, Cambridge University Press,2005.
2. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
3. Vinod Kumar Khanna, Nano Sensors, CRC Press, 2012.
4. Helmut Budzier, Gerald Gerlach; Thermal Infrared Sensors, John Wiley & Sons, Ltd, 2011.

Reference Books:

1. Jon S. Wilson, Sensor Technology Handbook, Elsevier, 2005.

2. Pavel Ripka, AloisTipek,Modern Sensors, ISTE, 2007.

Mody University of Science & Technology

Ph.D.

(Effective from Academic Year 2018-19)

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

RM20.711 **Research Methodology** **3-0-2-4**

Course Objectives:

1. To equip students with knowledge, abilities and insight in research methodology and related interdisciplinary fields.
2. To plan and design research using scientific and statistical methods.

1. Introduction to Research: Meaning, nature, purpose and motivation; Types of research – exploratory, descriptive, causal, and analytical; Research process; Definition of construct and variables and types of variables; Bases for choosing a topic; Problem definition; Literature review, Identification of research gap; Formulation of objectives; Signification and relevance of research objectives. **[06]**

2. Research Design and Sampling: Research Design - Meaning, need, features, types, important concepts, developing a research plan. **[06]**
Sampling: Census and Sample Survey, implications and types of sampling, process of sample selection, criteria and characteristics of selecting a good sample.

3. Scaling and Methods of Data Collection: Definition and types of scales, construction of measurement scale, errors, test of sound measurement scale. **[06]**
Methods of data collection: Types, sources and methods (Qualitative and Quantitative).

4. Statistical Tools for Data Analysis*: Measures of central tendency – Mean, Median, Mode, Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness, Correlation – Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests – Chi-Square test. **[09]**

5. Application of Computer in Research*: MS office and its application in Research, Use of Internet in Research – Websites, Search Engines, E-journal and E-Library – INFLIBNET. **MS-Excel:** Data representation, application of inbuilt formulas, formulation of equation using BODMAS rule in MS-Excel. **[06]**

6. Foundation of Research and Report Writing*: Significance and technique of interpretation, importance of report writing, types of reports, structure and components, writing research proposal and synopsis, planning phase of report writing (cauterization), Bibliography, Appendices, referencing, Style Manuals – APA style, MLA style, ASA style, Harvard/IEEE etc), plagiarism, journals, citations and indexing, funding agencies, ethics in research, characteristics of a good research report. **[06]**

Remark: 39 Hours for Lecture and 26 Hours for Practical*.

Course Outcome:

1. Develop the ability to understand and analyse the problems and able to connect the problem with practical and present scenario.
2. Develop the ability to think independently as well as scientifically towards for continuous lifelong learning process.
3. Analyse the situation, convert into problem and find its solution.

Suggested Readings

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill.India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics.Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House(Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami, O. R., Ranganatham M. (2011). Methodology of Research in SocialSciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New AgeInternational (P) Publisher. New Delhi
8. Lambert, Joan , Frye, Curtis D. (2016). Microsoft Office 2016 Step By Step. PHI
9. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd. India
10. Sekaran Uma (2003). Research Methods for Business. Wiley India.
11. Zikmund, Babin, Carr, Griffin (2003). Business Research Methods. Cengage Learning,India.

https://www.proschoolonline.com/blog/top-10-data-analytics-tools

BT 761	Forensic Biotechnology	3-0-0-3
Forensic Serology: General Introduction, Collection, preservation and packing of Biological fluids. Forensic applications of Isozymes and Polymorphic proteins. Introduction to Human Leucocyte Antigen, classification and typing		**[6]**
DNA profiling: Nuclear DNA and Mitochondrial DNA Techniques involved: PCR, Sequencing, RFLP analysis, analysis of STR, SNP Significance of DNA profiling DNA extraction/isolation from different samples, FTA cards, Ethical issues		**[7]**
Forensic Toxicology: Brief Idea of Toxins and Drugs, Extraction, separation and Identification		**[4]**
Wild Life Forensics: Collection, Processing and Examination of forensic artefacts: Pug marks, Horn, Skin, Fur, Hair, Nail and Teeth. Extraction of species specific antigens. Introduction to forensic entomology and forensic microbiology, Wild Life Protection Act		**[9]**
Analytical techniques for forensic applications: Spectroscopy: UV-Visible, NMR and Mass Chromatography: Normal and Reverse Phase, Paper and Column (Gel filteration, Ion exchange and Affinity) Electrophoresis: Agarose, PAGE-1D and 2D, IEF Antigens- Antibody reactions. ELISA, Immuno-electrophoresis, RIA, single diffusion, double diffusion, and rocket electrophoresis Microscopy: Simple and Compound microscope, Phase contrast Microscope, Fluorescent Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM) Centrifugation: Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges		**[13]**
Suggested Readings **Text Book** 1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986). 2. Wilson K and Walker J; Principle and Techniques of Biochemistry and Molecular Biology and Practical Biochemistry, Cambridge University Press **Reference Book** 1. Clark, E.G.C. Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986 2. Brown TA; Gene cloning; Willey-Liss Publications, Singapore. 3. Old & Primrose; Principle of Gene Manipulation; Panima Publications, New Delhi 4. Goldsby et al; Kuby Immunology; Freeman and Company, New York.		

Evaluation Pattern

Course Code	Course Title	Contact Hours per Week	Credits	ETE Duration	Weightage (%)

		L	T	P		Hours	CW	MTE	ETE
BT 761	**Forensic Biotechnology**	3	-	-	3	3	100		

Annexure-VIII

Ph.D. Syllabus

BT 711	**Animal Toxicology**	**3-0-0-3**
	Introduction to the subject, History, Terminology, Disciplines. Basic Principles, Dose, Dose Response, Toxic Effects and Testing methods, Risk Assessment, Exposure Standards and Guidelines. Toxicokinetics: Absorption, Distribution, Biotransformation and elimination of toxic agents Environmental Toxicology, Classification of toxicants, Routes of Exposure, Duration and frequency, category of toxic effects, bio-magnification Cellular Toxicology, Introduction, Effects of toxicant on cell structures, DNA damage Cellular Toxicology, Biochemical disturbance, cellular response and repair Mechanism of Toxicity: Introduction, Dose-response Relationship, Receptor Concept Natural Protection Mechanism: Role of cell organelles, Glutathione Metabolism, Antioxidants Antidotal Therapy: Types and Procedures, free radicals Nanotoxicology: Introduction and Interdisciplinary aspects **Suggested Readings:** 1. Landis WG, Sofield RM, Yu MH. Introduction to Environmental Toxicology, Molecular Substructures to Ecological Landscapes, CRC Press 2. Reviews of Environmental Contamination and Toxicology Springer 3. Worth DJH, Howard G J. Fundamental Toxicology Springer	
Course instructor : Dr. R.S.Chundawat		
Evaluation pattern: End Term Examination of 100 marks		

BT 721	**Plant Microbe Interaction**	**3-0-0-3**
	Introduction: Plant and microbe interaction, Plants as a host environment, The effects of microbes on plant physiology such as effects on photosynthesis, respiration, and the translocation of water and nutrients. Plants defense including structural defenses, biochemical defenses, and the hypersensitive response, Biotechnological perspectives of plant-microbe interaction Plant-Bacteria Interaction: Introduction, Abundance and distribution of bacteria in plants, Epiphytic/Endophytic bacteria, Rhizobacteria, Plant growth-	

	promoting rhizobacteria/bacteria (PGPR/PGPB), Pseudomonads *Bacillus* and as PGPR, Bacteria and plant health, Root nodule formation on legumes by *Rhizobium*spp for nitrogen fixation; other nitrogen fixing systems such as in alder/ *Frankia* and *Azolla*/*Anabaena*, Molecular mechanism of plant growth-promotion and biocontrol by bacteria, Microbial response to plants under habitat-imposed stresses (abiotic and biotic), Pathogenic interactions of bacteria with plants Plant-fungal Interaction: Introduction to fungal biology, Abundance and distribution of fungus in plants (Epiphytic/Endophytic), Mycorrhiza: Ecto, endo and VAM, Survey of fungal diseases important in plant pathology, Diagnostics and preventive measures Plant-virus Interaction: Diversity of plant viruses, Plant diseases caused by virus, Life cycles of plant viruses, Diagnostics and preventive measures Plant-nematode Interaction: Root-knot nematode, role of *Meloidogyne*, Plant health and nematode, Diagnostics and preventive measures **Suggested Readings:** 1. Burns and Slater. Experimental Microbial Ecology, Blackwell Scientific Publications, Oxford 2. Alexander M. Microbial Ecology, John Wiley and Sons 3. Atlas RM and Bartha R. Microbial Ecology: Fundamentals and Principles, Benjamin Cummins, USA	
Course instructor : Dr. D.K.Choudhary		
Evaluation pattern: End Term Examination of 100 marks		

BT 731	**Plant Transgenic Biology**	**3-0-0-3**
	Agrobiology: *Agrobacterium*-plant interaction, T-DNA transfer mechanism, *Agrobacterium* based vectors, Binary and shuttle vectors. Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co -integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Gene silencing, Chloroplast transformation Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance, Plants as Bio-factories, Metabolic engineering of plant secondary metabolites pathways of metabolism Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection.	

	Transgenic animal production, Methods of transgene delivery, Integration of foreign genes and their validation, Gene targeting methods and strategies, Expression of mammalian genes into prokaryotic and eukaryotic cell **Suggested Readings:** 1. Henry RJ. Practical Application of Plant Molecular Biology, Chapman and Hall Publishers 2. Glick and Pasternak.Molecular Biotechnology: Principles and application of Recombinant DNA, ASM Press 3. P.K.Gupta: Elements of Biotechnology, Rastogi and Co. Publishers 4. Freshney I. Culture of Animal Cells, Wiley-Liss. 5. Hafez B, Hafez ESE. Reproduction in Farm Animals, Wiley-Blackwell. 6. Houdebine LM. Transgenic Animals: Generation and Use, CRC Press. 7. Decker J and Reischl U. Molecular Diagnosis of infectious diseases, 2nd Edition, Humana Press	
Course instructor: R.K. Gaur		
Evaluation pattern : End Term Examination of 100 marks		
BT 741	**Biocatalysis and Biotransformation**	**3-0-0-3**
	Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc. Stresses related defense enzymes in plants and animals Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc. **Suggested Readings:** 1. Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press 2. Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press 3. Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford	

	4. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.	
Course instructor: Dr. K.P.Sharma		
Evaluation pattern: End Term Examination of 100 marks		

BT 751	**Environmental Biotechnology**	**3-0-0-3**
	Sources, generation, classification & composition of pollutants;effect on living organism;Persistence and biomagnification of xenobiotic molecules. Biological and Chemical methods for detection ofWastes; Need for management of resources. Biodegradation. Acclimation, detoxification activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Methods in determining biodegradability; Contaminant availability for biodegradation. Microbial degradation of aliphatic and aromatic compounds; Microbial degradation of halogenated and sulfonated compounds; Biodegradation of pesticides. Bioremediation, Constraints, advantages and applications; Types of bioremediation, Bioaugmentation and biostimulation; factors affecting	

	bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol. Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, bioreactors; Phytoremediation. Sources of heavy metal pollution; Microbial interactions with inorganic pollutants - Microbial metal resistance; Microbial transformation; Accumulation and concentration of metals; Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills. **Suggested Readings:** 1. Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition,McGraw-Hill, 2000. 2. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999. 3. K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999. 4. Martin Alexander, Biodegradation and Bioremediation, 2nd edition, Academic Press, 1999. 5. M.N.V. Prasad, Kazimierz Strzalka, Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, Kluwer Academic Publishers, Dordrecht Hardbound, 2002. 6. Baker, K.H and Herson, D.S.BioremediationMcGraw Hill, Inc. New York, 1994. 7. M.V.Levin&Gealt, M.A., Biotreatment of Industrial & Hazardous Waste McGraw Hill. Inc. 1993. 8. Martin Alexander, Biodegradation and Bioremediation (2nd editon). Elsevier Science & Technology. 1999. 9. Raina M. Maier, Ian L. Pepper, Environmental Microbiology. Academic Press. 2001.	
Course instructor: Dr. Pankaj Kumar Jain		
Evaluation pattern: End Term Examination of 100 marks		

MS 711 Advanced Computational Methods and MATLAB 3-1-0-4

Algebraic and Transcendental Equations: General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graeffe's root squaring method, Muller's method, Bairstow iterative method. **[7]**

System of Linear Equations and Boundary Value Problems: Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. Finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method **[8]**

Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations. **[8]**

Elements of MATLAB-I: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. **[8]**

Elements of MATLAB-II: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[8]**

Text Books:

1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd.
2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
3. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.
4. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW	MTE	ETE

MS 711	Advanced Computational Methods and MATLAB	3	1	-	4	3	---	---	100

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
1.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
2.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
3.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
4.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**
5.	**Elements of MATLAB:** Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 3. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 4. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.		
Reference Books: 1. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 2. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.		

3. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education.
4. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
6.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
7.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
8.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
9.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**

10. Elements of MATLAB: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 5. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 6. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 7. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 8. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.	
Reference Books: 5. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 6. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited. 7. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education. 8. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.	

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

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Session 2019-2020

Mody University of Science and Technology

School of Liberal Arts and Sciences

BSc CBZ

2019-20

Department of Science

B.Sc. Chemistry, Zoology and Botany
Three years Programme
(Batch 2018-19 Onwards)
FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE COMPULSORY (CC)**									
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BO 121	Botany Laboratory-I	-	-	2	1	3	100		
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	100		
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Lab	-	-	2	1	3	100		
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	3	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab-I	-	-	2	1	3	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	BT 181	Bioethics and IPR	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	80
		Sub Total				**26.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	**CORE COMPULSORY (CC)**									
	BO 142	Gymnosperms and Taxonomy of Angiosperms	3	-	-	3	3	25	25	50
	BO 122	Botany-Lab II	-	-	2	1	3	25	25	50
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 142	Animal diversity lab-II	-	-	2	1	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	3	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 152	Genetics	3	1	-	4	3	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total				**24.5**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. Chemistry, Zoology and Botany
Three years Programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE COMPULSORY (CC)**									
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	3	25	25	50
	BO 231	Plant Physiology and Metabolism	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-I‡	3	-	-	3	2	25	25	50
		Sub Total				**22.5**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**CORE COMPULSORY (CC)**									
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	3	25	25	50
	BO 232	Plant Anatomy and Embryology	3	-	-	3	3	25	25	50
	BO 242	Plant Morphology and Breeding	3	-	-	3	3	25	25	50
	BO 252	Botany Laboratory -IV	-	-	4	2	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total				**26.5**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. Chemistry, Zoology and Botany
Three years Programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE COMPULSORY (CC)**									
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	3	25	25	50
	BO 311	Plant Ecology and Economic Biology	3	-	-	3	3	25	25	50
	ZO 321	Immunology	3	1	-	4	3	25	25	50
	ZO 331	Immunology Laboratory	-	-	2	1	3	25	25	50
	BO 321	Ecology Laboratory	-	-	2	1	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)									
	CH 325	Reagents and Reactions	2	-	-	2	3	25	25	50
		Sub Total				**18.5**				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**CORE COMPULSORY (CC)**									
	CH 392	Physical Chemistry-IV	2		-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2		-	2	3	25	25	50
	CH 324	Organic Chemistry–IV	2		-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-		3	1.5	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 332	Animal Biotechnology	3	-	-	3	3	25	25	50
	BO 312	Plant Biotechnology	3	-	-	3	3	25	25	50
		Sub Total				**18.5**				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

BO 111 Botany-I 3-0-0-3

Algae: General characteristics, Thallus organization and classification, economic importance. [2]

Type Study of Algal Classes: General characteristics, morphology and reproduction in Chlorophyta (Volvox), Charophyta (Chara), Xanthophyta (Vaucheria), Phaeophyta (Ectocarpus), Rhodophyta (Polysiphonia), Cyanophyta (Nostoc). [6]

Fungi: Characteristics and broad classification of fungi (Alexopolus and Mims, 1972), Economic importance of fungi. Structure and life history of Diplomastigomycotina (Sclerospora), Ascomycotina (Saccharomyces and Aspergillus), Basidiomycetes (Puccinia and Ustilago), Deuteromycotina (Cercospora, Alterneria, Colletotrichum). [8]

Parasexual Cycle in Fungi: Introduction and its importance in genetic improvement. [3]

A brief account of mycorhizza and lichens. [3]

Plant Pathology: Elementary knowledge, Plant pathogens, Common plant diseases and their symptoms, control measures. [5]

Bryophyta: General characters, classification and evolutionary trends in organization of thallus and sporogonium. A brief introduction to morphology and life cycle of Riccia, Anthoceros and Funaria. [5]

Pteridophyta: General characters, classification, stellar system, a brief study of morphology and life history of Selaginella, Equisetum, Marselia and Rhynia. [6]

Heterospory and Seed habit: Origin and evolution of heterospory and seed habit in Selaginella. [1]

Suggested Reading

Text Book

1. Vasistha P.C; Pteredophyta; S.Chand Publications, New Delhi.
2. Vasistha B.R.; Bryophyta; S.Chand Publications, New Delhi

Reference Book:

3. Morrish; Algae; Hutchinson and Company, USA
4. Sharma O.P.; Fungi; Tata McGraw Hill, New Delhi
5. Sharma O.P.; Algae; Tata McGraw Hill, New Delhi
6. Mehrotra & Aneja; An Introduction to Mycology; New Age International Publisher
7. Dubey & Maheshwari; Fungi; S.Chand Publication, New Delhi

BO 121 Botany Laboratory-I 0-0-2-1

Assignments are based on the course BO 111 Botany-I containing exercises on type studies of algae and fungi and study of plant morphology.

BO 142 Gymnosperms and Taxonomy of Angiosperms 3-0-0-3

Seed Habit in Plants: Origin and evolution of seed habit and seed plants, primitive seed plants. [5]

Gymnosperm: General characteristics and classification. Morphology, reproduction and life cycle of Cycas, Pinus and Ephedra. [8]

Angiosperm: Taxonomy, α and ω taxonomy, Taxonomic literature and plant nomenclature. [6]

Angiosperm Classification: Salient features of the system proposed by Bentham-Hooker and Engler-Prantile. [3]

Brief study of some of the Important Flowering Families:, Rannunculaceae, Brasicasseae, Malvaceae, Solanaceae, Leguminaceae, Gramineae, Rutaceae, Apiaceae, , Apocynaceae, Asclepediaceae, Euphobiaceae and Lilliaceae. [9]

Paleobotany: Fossilization, Types of fossils and their importance, Fossil Gymnosperm – William sonia and Glossopteris. [4]

Characters: Variations, OTUs characters weighting and coding: cluster analysis, phenograms, cladograms (definitions and differences) [4]

Suggested Reading

Text Book

1. Bhojwani and Bhatnagar; A Text book of Plant Embryology; Vikas Publication

Reference Book

2. Maheswari P; Plant Embryology; Tata Mc Graw Hill
3. Chamberlain C.J; Gymnosperm; CBS, New Delhi
4. Chowdhary H.K.; Elementary Principles of Plant Breeding. Oxford and IBH Publishing.

BO 122 Botany Laboratory-II 0-0-2-1

Assignments are based on the course BO 142 containing exercises on plant breeding and study of angiosperms.

BO 231 Plant Physiology and Metabolism 3-0-0-3

Water potential: Water potential and its components, Ascent of sap, Transpiration and its significance,
Root pressure and Guttation, Mechanism of opening and closing of stomata, anti-transpirants. (8)

Essential elements: Absorption of minerals role of macro and microelements, active and passive transport, carriers, channels and pumps.Translocation of organic and solutes-source sink relationship, phloem loading and unloading. (8)

Photosynthesis: Photosynthetic pigments, light reaction, CO_2 fixation by C_3 and C_4 cycle and CAM pathway. ,Photorespiration. (8)

Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.Enzyme structure and properties, Mechanism of catalysis and enzyme inhibition (6)

Plant growth and plant growth regulators: Auxin, Cytokinin, Gibberellin, ABA, Ethylene. An introduction to secondary metabolites. (5)

Biological Rhythm: Photoperiodism (SDP, LDP, Day neutral plants), (4)

Phytochrome, Vernalisation and Senescence, Plant movement, Stress physiology: antioxidant, water stress, salt stress

Suggested Reading

Text Book

1. Pandey and Sinha; Plant Physiology; Vikas Publishing House. New Delhi.
2. Malik C.P; Plant Physiology; Kalyani Publications.

Reference Book

3. Taiz, L. Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A.5thed.
4. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition
5. Srivastava H.S; Plant Physiology; Rastogi publication

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BO 221 **Botany Laboratory-III** **0-0-2-1**

Assignments are based on the course BO 231 Plant Physiology and Metabolism.

BO 232 **Plant Anatomy and Embryology** **3-0-0-3**

Plant Tissue &Tissue system: Root and shoot apical meristems. Simple and complex tissues. Structure of dicot and monocot root stem and leaf. [10]

Secondary Growth: Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).Epidermis, stomata, General account of adaptations in xerophytes and hydrophytes. [10]

Embryology: Structure of anther and pollen. Tapetum- types & functions. Microspore types. Structure and types of ovules.Types of embryo sacs, organization and structure of mature embryo sac. [7]

Pollination: Type, mechanisms and adaptations. Double fertilization & its significances. [5]

Endosperm: Types, structure and functions of endosperm. Dicot and monocot embryo. Apomixis and polyembryony, definition, types and practical applications. [7]

Suggested Readings

Text Book

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. P.C.Trivedi, Aparna Pareek, (2018-19). Plant Morphology & Anatomy, R.B.D. Publication House Jaipur, New Delhi.

Reference Book

3. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/ Cummings Publisher, USA.
4. Eames Mcdaniels: An Introduction to Plant Anatomy. Tata

McGraw Hill Publication
5. Maheswari P. Plant Embryology; Tata McGraw H

BO 252 Botany Laboratory-IV **0-0-4-2**

Assignments are based on the course BO 232 Plant Anatomy and Embryology & BO 242 Plant Morphology and Breeding containing exercises on morphology, reproductive cycle and embryonic development.

BO 321 Plant Ecology Laboratory **0-0-2-1**

Assignments are based on the course BO 311 Plant Ecology and Economic Biology containing exercises on different environmental factors, eco-toxicology affecting the biological systems.

BO 311 Plant Ecology & Economic Biology **3-0-0-3**

Introduction to Ecology: Ecological factors. Soil-origin, formation, composition, profile. Water- precipitation types. Light and Temperature. Shelford, law of tolerance. Adaptation of hydrophytes and xerophytes. (6)

Plant communities: Characteristics feature, Ecotone, Succession. Ecosystem -structure; energy flow, trophic organisation, food chains and food webs, ecological pyramid. Biogeochemical cycling- carbon, nitrogen and phosphorous cycle. An introduction to phytogeography. Endemism.

An introduction to biodiversity & its conservation. [9]

An introduction to the "origin of cultivated Plants": Vavilov's work. Origin, morphology, uses of some economically important crop plants

(1) Cereals-Wheat &Rice
(2) Legumes with special reference to Gram and Soybean
(3) Spices-botanical name, family, part used, morphology and uses
(4) Beverages -Tea (morphology, processing, uses)
(5) Oils and Fats-Mustard & Groundnut
(6) Fibre yielding plants with special reference to Cotton (botanical name, family, part used, morphology and uses)
(7) Scope and importance of medicinal plants with special reference to Rajasthan (botanical name, family, part used, morphology and uses). [10]

Ethnobotany : As an interdisciplinary science. Major and minor ethnic groups or tribals of India. Plants used by the tribals: a) food plants b) intoxicants and beverages c)resins and oils and miscellaneous uses. [6]

Role of ethnobotany in modern medicine: Significance, habitat and morphology of the following plants in ethnobotany a) neem (b) tulsi (c) Gloriosa superba (g) Cassia auriculata h) Indigofera tinctoria [6]

Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. Ethnobotany and legal aspects. [2]

Suggested Readings

1. Odum. E P & Barrett. G W. Fundamentals of Ecology

2. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
3. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi.
4. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons –
5.Manjula K Saksena & Anuja Tyagi. Plant Ecology & Economic Botany.
College Book House, Jaipur.
6. Singh, Pande & Jain. 2018.A text book of Botany-ANGIOSPERMS. Rastogi Publication,
Meerut.

CH 325 **Reagents & Reactions** **2-0-0-2**

Reagents: Introduction, Fenton's Reagent, Gilman's reagent, Wilkinson's catalyst, Lindlar catalyst, Adams' catalyst**,** Lithium aluminium hydride, Sodium borohydride, Anhydrous aluminium chloride, Dicyclohexyl carbodiimide, N-Bromosuccinimide, Lead tetra acetate, Osmium tetroxide, Perbenzoic acid, Raney nickel, selenium dioxide, 1,3-Dithiane (Umpolung reagent), Liquid ammonia. [10]

Reactions: Introduction, A detailed study of the following reactions: Reimer-Tiemann, Arndt-Eistert, Witting, Friedal craft, Aldol condensation, Cannizzaro, Diel's Alder, Mannich, Reformatsky, Favorskii, Hofmann, Curtius, Schmidt, Michael, Knoevenagel, Perkin , Shapiro reaction, Simmons-Smith reaction, Darzens reaction, McMurry reaction, Baeyer-Villeger, Heck reaction. [12]

Rearrangement: Introduction, nature of migration, migratory aptitude. A detailed study of the following rearrangements: Benzil – Benzillic, Beckmann, Claisen, Fries, Wagner-Meerwein, Pinacol-pinacolone, Demjanov. [04]

Suggested Books:

Text Books:

1. Reactions, rearrangements and reagents, S.N Sanyal, Bharti Bhawa
2. Name reactions and Reagents in organic synthesis, 2nd Edition, B.F WILEY, 2005.

Reference Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Camb
3. Advanced Organic Chemistry, Reactions Mechanisms and Structur
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, E
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg

BO 312 **Plant Biotechnology** **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory. [7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture. [8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement. [8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. [8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods. [8]

ZO 332 Animal Biotechnology 3-0-0-3

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.
6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

BT 324 Entrepreneurship Development 2-0-0-2

UNIT I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing

entrepreneurship, Features of a successful Entrepreneurship

UNIT II [8]

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital

UNIT III [8]

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship

MD003	Environmental Studies	3-0-0-4

Environmental Science: Definition, scope and importance, Multidisciplinary nature.	**[2]**
Ecology and Life Sustaining Process: Origin, evolution and diversification of life; natural selection; levels of selection. Ecosystem structure, functions; nutrient cycles; biomes; habitat ecology; primary and secondary productivity; Population ecology; metapopulation dynamics; growth rates; density growth; niche concept; Species interactions:. Biodiversity and bio conservation; genetic drift; biogeography and evolutionary ecology (indian context only); gene-environment interaction; Endangered and endemic species of India.	**[7]**
Present civilization and its engine:. Empowerment through Science and Technology: Its power and its consequences. The strongest contemporary ideas of science and their consequences on society. Industrial Civilization and its engine. Economics and its limitations: meta economics Psychology: The Anatomy of Greed, Envy and vanity (Freud's Psychoanalytic perspective, Hans Selye Stress Model; Self-regulation techniques) Unsustainable development. Traditional methods of protecting nature Suggested Case studies: i) Cultural Basics of our Environmental Crisis: ii) Ecofeminism	**[7]**
Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources Suggested Case Studies: i) What has posterity ever done for me? ii) Energy policy and further future: The identity problem	**[6]**
The story of Commons: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. Suggested Case Studies i) The tragedy of commons: ii) We all live in Bhopal iii) The Silent Spring;	**[7]**
Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. **Human Population and the Environment:** Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. Role of Information Technology in environment	**[7]**

and human health. Suggested Case Studies: i) Earth the Crowded Planet ii) Famine Affluence and morality iii) The world food supply	
Sustainable Development (Objective and Application): **Dysfunctional civilization, Vision of sustainable world, Satyagraha for Conservation, Buddhist Attitude towards nature , Buddhists Economics** **Suggested case studies** a. **Management Sciences**: Carbon credits and trading , green marketing and cause related marketing b. **Science and Engineering Issues: Organic farming, Renewable** energy. **c. Built Environments: Sustainable site planning, management of waste and its reduction, Low energy building materials and its implications, embodied energy, different case studies** d. **Sustainable fashion:** Online study of eco-fashion brands (how India can lead), NGO's working with local crafts; Community involvement Sampling and designing garments from recycled waste. Sampling /designing garments, comparative studies, handmade constructed from natural fiber/fabric and dyes Class room project to ; create public awareness (saying NO to garments made from non-environmentally friendly fabrics (exhibition & publicity); sustainable lifestyle challenge of starting with 'self & environment' **e. Judicial intervention**: Principle of absolute liability, inter-generational equality, environmental protection, use and conservation of natural resources, the precautionary principle, polluter pay principle, public trust doctrine and poverty eradication.	[**12]**
Field Trip & Report writing: (Any one of the following) **i)** Visit to renewable energy site **ii)** Visit to biodiversity park **iii)** Workshop on sustainable fashion **iv)** Shekhawati and its environment **v)** Morarka Foundation (organic farms) Nawalgarh/ Piplantri village rajsamand district	**[4]**
Suggested Books: **Text Book** i) Environmental Science: A Global Concern, Cunningham William P. Saigo B Woodworth, McGraw-Hill Higher Education; Sixth Edition (2001) ii) Odum E. P..Barret G.W Fundamental of Ecology, 5th Edition Cengage Learning, (2004) iii) Morgan, C.T., King, R.A., Weisz, J. R., & Schopler, J. Introduction to Psychology, International Student edition, Tata McGraw Hill, New Delhi (1986) **Reference Book** i) Environmental Law, S.C Shastri,5th Ed EBC Explorer, India, (2015) ii) Small is Beautiful: Economics as if People Mattered E.F.Schumacher, Blond and Briggs, London (1973) iii) Heywood V.H. & Watson R.T. 1995. Global biodiversity assessment, Camb ridge Univ. Press iv) Our Common Future, Report on World Commission on Environment and Development United Nations Document(1987) v) Al Gore, Dysfunctional Civilization: The Earth in Balance, Houghton, Mifflin, (1992) vi) Lester Brown, Christofer Favin, Sandra Postel, Vision of a Sustainable	

World, The Worldwatch Reader, Ed Lester R. Brown New York (1991)

vii)

Mongraphs for suggested Case Studies :

i) Cultural Basics of our Environmental Crisis: **Lweis W. Moncrief, Science Vol 170,508-12 (1970)**

ii) Ecofeminism: **Karen J Warren** Environmental Ethics, Vol 12 (1990)

iii) Satyagraha for Conservation : Awakening the spirit of Hinduism: **O. P. Dwivedi** Ethics of Environment and Development, Edited by Engel and Engel, Bellhaven Press, UK (1990)

iv) Buddhist Attitude towards nature: **Lily De Silva,** The Buddhist Attitude towards Nature, Ed: K.Sandell, Buddhist Publication Society, Sri Lanka (1987)

v) What has posterity ever done for me?: **Robert Heilbroner, Times Magazine, New York (1975)**

vi) Energy policy and further future: The identity problem: Derek Parfit, Energy and the future , Eds MacLean and Brown, (1983)

vii) The tragedy of commons: **Grrettn Hardin,** Science, 162 (1968)

viii) We all live in Bhopal: **George Bradford ,** Questing Technology, Freedom Press, US (1988)

ix) The Silent Spring: **Rachel Carson,** Houghton Mifflin Co, US (1962)

x) Earth the Crowded Planet: **Tristram Coffin, The Washington Spectator, Vol 17.15 (1991)**

xi) Famine Affluence and Morality: **Peter Singer,** World Hunger and Moral Obligation Ed William Aiken, Hugh, Lafollette, (1977)

xii) The world food supply: **Tristram Coffin, Washington Spectator, Vol 19.2, 1993**

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 ***Plant and Animal Biotechnology*** **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. *Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization* **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 Tissue Culture Laboratory 0-0-2-1

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage **[4]**

pathways; catabolism.

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,

2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.

4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
   (a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**

   (b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**
   Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical

correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial **[5]**

photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation.

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New

Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press

Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]

3. Natural Resources: Renewable and Nonrenewable resources. [**2**]

4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect.
   Visit to a local area to document environmental assets [**3**]

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION

B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101	**Foundation Course in English**	**2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from

ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.

5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 Cell Biology Laboratory 0-0-2-1

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 Animal Diversity Laboratory-I 0-0-2-1

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton [11]

and Digestive system and Brain.

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter,

Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211	**Bio-Instrumentation**	**3-1-0-4**
	Principle of pH meter.	[1]
	Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow.	[6]
	Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications.	[8]
	Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.	[8]
	Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE.	[8]
	Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography.	[8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.

2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson
and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith
G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 Animal Physiology 3-0-0-3

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology 2-1-0-3

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I 2-0-0-2

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.

2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III 2-0-0-2

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base

catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III 3-0-0-1.5

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory 0-0-2-1

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory 0-0-2-1

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology 3-1-0-4

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic [5]

fertilization, significance of fertilization.

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, [5]

Antigenic determinants of antibody molecules.

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis

on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand

& Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk and hazard associated with their use; Potential uses and applications of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc. [12]

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory.

[7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture.

[8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in

crop improvement. [8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement. [8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods. [8]

MB 331 General Microbiology **3-0-0-3**

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters. [12]

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al*.; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New Delhi.
4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation. [4]

Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium). [5]

Biofuels: Bioethanol, Biodiesel, Methanogenesis. [4]

Biopesticides: Bacterial, Fungal and Viral pesticides. [4]

Biofertilizers: Nitrogen fixing microbes and their application in crop productions. [5]

Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and

pesticide biodegradation, Biobleaching of industrial effluents.

[6]

Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling.

[6]

Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process.

[5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells. [8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..

2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.

3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.

4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.

5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.

6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 Environmental Biotechnology Laboratory **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 Tissue Culture Laboratory

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 Internship **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 Genetic Engineering **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase.

[6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors.

[6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for selection of recombinant DNA molecules.

[6]

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing.

[7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen.

[6]

BT 352 Bioinformatics **3-0-0-3**

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP)

[5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized databanks).

[7]

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X-ray crystallography), Algorithm for modeling protein folding. [5]

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 Bioprocess Engineering 3-0-0-3

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation. [10]

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration [10]

and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics.

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.,), Bioprocess Engineering, Prentice Hall PTR, New Jersey.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.*
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York.

***latest edition**

BT 334 Enzyme Technology 3-0-0-3

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes. [12]

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular [8]

emphasis on change in pH and hydrophobicty

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of Biochemistry , MacMillian Worth Publishers, US.
2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.
3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.
4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.
5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.
6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory 0-0-2-1

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory 0-0-2-1

Assignments are based on the course BT 334 Enzyme Technology containing exercises on enzymes kinetics.

Mody University of Science & Technology

B.Sc. (Hons) Biotechnology

Session 2019-2020

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

BACHELOR OF SCIENCE (HONOURS)-BIOTECHNOLOGY (B.Sc.)

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)
No. of Seats: 30

Input Qualification:
Candidate should have passed 10+2 in Science stream from a recognized Board with proficiency in English.

Evaluation Procedure:
All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of Mody University shall be followed. Further, the Faculty proposes to adopt the following:

1. **Grading System:** Absolute Grading System irrespective of the number of students.
2. **Minimum Credits* required for continuation of Registration:**

S. No.	Year	B.Sc. (Hons.)-Biotech.
1.	First	20
2.	Second	40
3.	Third	60
4.	Fourth	80
5.	Fifth	Must Complete

* Excluding Proficiency credits.

B.Sc. (H)-Biotechnology
Three years programme
(Batch 18-19 onwards)
FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CORE (Compulsory)**									
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	CH 113	Chemistry I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Laboratory I	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 171	Biotechnology and Human Welfare	2	-	-	2	3	25	25	50
	BT 181	Bioethics and IPR	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	80
		Sub Total	**15**	**1**	**6**	**19**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	**CORE (Compulsory)**									
	BT 152	Genetics	3	1	-	4	3	25	25	50
	MB 331	General Microbiology	3	-	-	3	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	4	25	25	50
	CH 114	Chemistry II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Laboratory II	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (Compulsory)									
	BT 172	Basics of Drug Designing	2	-	-	2	3	25	25	50
	BT 182	Basics of Forensic Sciences	2	-	-	2	3	25	25	50
	AECC: ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	**16**	**1**		**20**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H)-Biotechnology
Three years programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Compulsory (CC)**									
	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Bio-Instrumentation Lab	-	-	2	1	4	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Laboratory	-	-	2	1	4	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BO 231	Plant Physiology and Metabolism	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 291	Introductory Biomedical Science	2	-	-	2	3	25	25	80
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-I‡	3	-	-	3	2	25	25	50
		Sub Total				**21**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Compulsory (CC)**									
	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
	BO 232	Plant Anatomy and Embryology	3	-	-	3	3	25	25	50
	BO 222	Plant Developmental Biology Laboratory	-	-	2	1	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 381	Modern Biology	3	-	-	3	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)									
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total				**19**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology
Three years programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Compulsory (CC)**									
	BT 311	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 341	Genetic Engineering Lab	-	-	2	1	4	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocess Engineering Laboratory	-	-	2	1	4	25	25	50
	ZO 321	Immunology	3	1	-	4	3	25	25	50
	ZO 331	Immunology Laboratory	-	-	2	1	4	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 333	Introduction to Research Methodology	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
		Sub Total				**22/25**				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc (H)-Biotechnology
Three years programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Compulsory (CC)**									
	BT 352	Bioinformatics	3	-	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	ZO 332	Animal Biotechnology	3	-	-	3	3	25	25	50
	BO 312	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 323	Tissue Culture Laboratory	-	-	2	1	4	25	25	50
	BT 342	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 392	Environmental Biotechnology Laboratory	-	-	2	1	4	25	25	50
	GENERAL ELECTIVES (GE, Compulsory)									
	BT 334	Enzyme Technology	3	-	-	3	3	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	50
	DISCIPLINE CENTRIC SUBJECTS(DCS)*									
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 312	Ethology and Evolution	3	-	-	3	3	25	25	50
	BO 142	Gymnosperms and Taxonomy of Angiosperms	3	-	-	3	3	25	25	50
		Sub Total				**23/26**				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

***The student has to take maximum two courses in each semester of Third year from the DCS. The minimum strength of student should be five (5) in the particular DCS course.**

Total Credit: 125/131

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Course Description

BT 171 Biotechnology and Human Welfare **2-0-0-2**

[8]

UNIT I

Industry Application: protein engineering; enzyme and polysaccharide synthesis, Metabolites: Alcohol and antibiotic production.

UNIT II [8]

Agriculture Application: N_2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III [10]

Human Health: Diagnostics and Treatment: development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, Human genome project.

Text Book

1. Concepts in Biotechnology by Balasubrahmanian et. al.,University press, 2010

Reference Book

2. Recombinant DNA technology by Watson et. al., Scientific American Books, 2012.
3. Principles of Gene Manipulation by Old and Primrose. Blackwell, 2010
4. Biotechnology: Applications In Human Healthcare Hardcover, Sampat Nehra, Pointer Publishers (2009)

BT 181 Bioethics and IPR **2-0-0-2**

UNIT I [11]

Bioethics – Meaning and Necessity of Bioethics, different paradigms of Bioethics – National & International, Ethical issues against the molecular technologies

UNIT II [8]

IPR- Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions.

UNIT III [7]

Intellectual/Industrial property and its legal protection in research, design and development. Patenting in Biotechnology, economic, ethical and depository considerations.

Text Book:

1. Patterns of Entrepreneurship 2005: Jack M. Kaplan. Wiley,
2. Sateesh MK. 2010 Bioethics and Biosafety, I. K. International Pvt Ltd.

References:

3. Entrepreneurship: New Venture Creation: David H. Holt Tata McGraw – Hill 2002
4. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
5. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BT 172 Basics of Drug Designing 2-0-0-2

UNIT I [5]
Drug designing-Meaning and Introduction, Disease and drug target identification

UNIT II [5]
Identification of Lead compound, SAR, optimising target interactions

UNIT III [8]
Toxicology and safety issues, Development and Production, Clinical trials, Patenting issues

UNIT IV [8]
Newer drugs, Drug discovery in cancer research/new target based drugs in clinical trials. Microbial genomics for new antibiotics, immunotoxin drug

Text Book

1. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
2. J.M. Haile , Molecular Dynamics Simulation Elementary methods, , John Wiley and Sons ,1997

References:

3. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
4. Remington's Pharmaceutical Science, Mark Publishing and Co.
5. The Organic Chemistry of Drug Design and Drug Action, by R. B. Silverman
6. An Introduction to Medicinal Chemistry by G. L. Patrick

BT 182 Basics of Forensic Science 2-0-0-2

UNIT I [8]
Introduction and principles of forensic science, tools and techniques in forensic science, Classification of injuries and their medico-legal aspects, method of assessing various types of deaths

UNIT II [6]
Fire arms and explosives, Handwriting analysis, Significance of toxicological findings

UNIT III [6]
Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification

UNIT IV [6]
Principle of DNA fingerprinting, application of DNA profiling in forensic medicine, Introduction to Cyber security.

Text Book:

1. Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First Century, Select Publishers, New Delhi (2001).

References:

3. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
4. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
5. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (ED.), CRC Press, Boca Raton (1997).
6. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
7. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

BT 291 Introductory Biomedical Science 2-0-0-2

UNIT I [8]

Introduction to human biology, Clinical biochemistry of human diseases, microbiology, epidemiology, and biomedical engineering

UNIT II [6]

Screening for disease, Application of biochemical techniques to inborn errors of metabolism, tumor markers, liver function, iron and porphyrins

UNIT III [7]

Enzymes and their use in laboratory medicine, clinical applications of protein biochemistry, nutrition in health and disease, lipids and atherosclerosis

UNIT IV [5]

Electronic devices used as sensors

Text Book

1. Raven, P.H et al (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi

Reference

2. Campbell, N.A. and Reece, J.B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Griffiths, A.J.F et al (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY

BO 212 Plant Developmental Biology 2-0-0-2

UNIT I

Development and morphology of gametophyte – formation of vegetative and generative cells, microsporogenesis, organization of mature pollen grain, types of ovules, integument, nucellus, megasporogenesis, types of embryo sacs. [6]

UNIT II [4]
Pollination and fertilization – Pollen transfer, artificial pollination, pollen germination, double fertilization, self-incompatibility.

UNIT III [5]
Endosperm – development, cytology and functions of endosperm
Endosperm types - nuclear, cellular - helobial - Ruminate endosperms, function of endosperms.

UNIT IV [5]
Embryo – Development of embryo in Dicot (Capsella) and Monocot (Najas). A brief account on Polyembryony, parthenocarpy.

UNIT V [6]
Seed – Development, classification, dispersal and dormancy

Text Book

1. Plant Physiology by Taiz and Zeiger, Sinauer Associate Inc. Publishers

Reference

2. The Arabidopsis Book, ASPB publication (available freely at www.aspb.org)
3. Biochemistry and Molecular Biology of plants Ed. Buchanan, Grussem and Jones, ASPB publication.
4. Bhojwani. S.S. and Bhatnagar. S.P. 1978. The embryology of Angiosperms. Vikes Publishing Pvt. Ltd., Delhi.
5. Maheswari P.1971. An introduction to embryology of Angiosperms Tata Mc Graw Hill, Delhi.
6. Swamy B.G.L. and Krishnamurthy K.V. 1950. From flower to fruit. Tata Mc Graw Hill, Hew Delhi.

BO 222 Plant Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course BO 212 Plant Developmental Biology containing exercises on plant developmental studies using permanent slides and embryo development related experiments.

BT 333 Introduction to Research Methodology **2-0-0-2**

UNIT I [5]
Introduction to Research Methodology: Objectives and motivation in research

UNIT II
Defining the Research Problem, Selecting and defining a research problem, Reviewing and conducting literature search, developing a research plan [7]

UNIT III
Designing of Experiment, Number of Different experimental designs – single and multifactorial design [6]

UNIT IV

Making measurements and sources of error in measurements, Methods of data collection and record keeping. Report writing, Writing a research paper - abstract, introduction, methodology, results and discussion. [8]

Text Book

1. Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi)

Reference

2. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
3. Montgomary, Douglas C. &Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
4. Krishnswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT II [8]

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital

UNIT III [8]

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

BT 271 Food Technology 2-0-0-2

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 Plant and Animal Biotechnology **2-0-0-2**

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 **Tissue Culture Laboratory** **0-0-2-1**

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 **Medical Biotechnology** **2-0-0-2**

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry 3-0-0-3

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and Beer. **[10]**

5. **Microbes and Environment**: Microbes in mineral recovery-Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each **[5]**

pathway.

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, Biosynthesis of unsaturated fatty acids. **[5]**

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,

2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.

4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
(a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical **[7]**

biochemistry; internal and external quality assurance producers

(b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**

Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics. **[7]**

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; **[5]**

Indices of food sanitary quality and sanitizers.

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission and spread of infection. **[6]**

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance [**2**]

2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem [**2**]

3. Natural Resources: Renewable and Nonrenewable resources. [**2**]

4. Human Population and Environment: Population Growth, World and Indian scenario. [**2**]

5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. [**2**]

6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. [**3**]
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION

B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101	**Foundation Course in English**	**2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and

Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.

2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I 2-0-0-2

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation.

Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed.

2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and [6]

Landslides.

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects

and applications. [8]

Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 Animal Physiology 3-0-0-3

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 **Physical Chemistry-I** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation.

Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S.

Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005,

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature,

Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint

2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M.

Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 232 Molecular Biology Laboratory **0-0-2-1**

Assignments are based on the course BT 212 Molecular Biology containing exercises on techniques involved in study of Nucleic acids.

ZO 242 Developmental Biology Laboratory **0-0-2-1**

Assignments are based on the course ZO 232 Developmental Biology containing exercises on reproductive cycle and embryonic development.

MB 321 Immunology Laboratory **0-0-2-1**

Assignments are based on the course MB 311 Immunology containing exercises on antigen-antibody interaction techniques.

BT 381 Modern Biology **3-0-0-3**

Nanoscience and Nanotechnology: Overview of different nanomaterials available, Brief idea of their synthetic methods; Risk [12]

and hazard associated with their use; Potential uses and applications of Nanotechnology in Agriculture, Energy and Environment, Food Science, Medical science etc.

Biosensors: Introduction; Generation of an electronic signal; Amperometirc, Potentiometric, Conductimetric, Optical, Thernal and Microbial Biosensors. [9]

Intellectual Property Rights: Types of protection: Patent, Copyright, Trade secrets and Breeders right for variety protection; Moral issues in patenting Biotechnological inventions; Significance of IPR in the protection of Biodiversity, Traditional knowledge and geographical indications; Brief idea of IPR protection for Bio-informatics' components. [9]

Scientific communication: Scientific literature: Structure of Research article, Review article, Short communication, Book review etc. Literature database- NCBI, EMBL; Use of library and internet for scientific literature search; Abstracting methodology; Scientific Literature Standardization; Concept of Impact factor; Citation Index; Preparation of a scientific article [9]

Suggested Books:

1. Poole Jr., C.P., Owens, F.J. Introduction to Nanotechnology, Wiley, New York.
2. Bhushan, Bharat. Handbook of Nanotechnology. Springer, US.
3. CNR Rao et. al., Chemistry of nanomaterials : Synthesis, properties and applications. Springer, US.
4. Donnell et al., Intellectual Property in Food Technology Industry. Springer, US.
5. Satarkar S V, Intellectual Property Rights and Copyrights. Ess Ess Publications. India.
6. Ganguly P., Intellectual Property Rights. Tata McGraw Hill. New Delhi, India.
7. Barker RDJ et al., Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford, UK.

BT 322 Plant Biotechnology **3-0-0-3**

General Principles: Terms and Definition, Historical aspects and scope Classical vs. modern approach, totipotency and cell theory, Principles underlying in vitro culture, Growth and differentiation, Culture media and its constituents, Media preparation, Sterilization and Organization of plant tissue culture laboratory.

[7]

Micropropagation: Basic technique, Automation in the area scope as a commercial venture, Production of disease free plants, shoot tip culture, anther culture and ovule culture.

[8]

Genetic Variability in Tissue Culture: Somaclonal and gametoclonal variation, Selection, Sources and causes of variation, Application in crop improvement.

[8]

Protoplast Related Techniques: Protoplast isolation, Protoplast culture and fusion, Selection of hybrid cells, regeneration of hybrid plants, somatic hybridization and cybridization, Applications in crop improvement.

[8]

Gene Transfer in Plants: Agrobactrium tumefaciens and Agrobacterium rhizogenes, structure of T-DNA, virulence and other gene organization, application in genetic transformation, Gene transfer methods in plants – Direct and Indirect methods.

[8]

MB 331 General Microbiology **3-0-0-3**

Definition and scope of Microbiology: History and recent developments – Spontaneous generation versus biogenesis, Germ theory of diseases, pure-culture concept.-contributions of Louis Pasteur – Leuwenhoek, Lazaro Spallanzani, John Tyndall, Joseph Lister, Robert Koch. Microscopy: simple, compound light microscopy – Dark Field, Bright Field, Phase contrast, Fluorescence and Electron Microscopy. Classification of Microbes – Systems of classification, General properties, principles and types of classification of

[12]

microorganisms, Bergey's manual, Nutritional types, Classification on the basis of physical parameters.

General characteristics and functions of Bacteria: structure and function of cell wall, cilia, flagella, slime layer, capsule, pilli, Cytoplasmic membrane and Cytoplasmic inclusions, sporulation. Kingdom prokaryotes - classical techniques of microbial identification - morphological, physiological and biochemical properties. [8]

Kinetics of Bacterial growth: Different types of bacterial culture (Batch, Synchronous, Arithmetic) – Definition and brief description. Growth Phases, Growth Kinetcs, Calculation of duration of Phases and generation time, Growth yields, Methods of growth determination, Environmental factors affecting growth - temperature, pH, osmotic pressure, partial pressure of oxygen and nutrient concentration. Concept of Sterilization - Definition of sterilization, Physical and Chemical methods of sterilization. [7]

Basic concepts of Virology: General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses on the basis of capsid symmetry - enveloped (Herpes virus), helical (TMV) and icosahedral (Polyoma viruses), Complex (Bacteriophage), Bacteriophages: Stages in the Lytic and Lysogenic Life Cycle of a typical phage, Properties of a phage infected bacterial culture. Viroids and prions. [6]

Brief description of Algae, Fungi and protozoa: General characteristics of Algae, Fungi and Protozoa. [6]

Suggested Books:

1. Pelczar *et. al.*; Microbiology; Tata McGraw Hill; New Delhi.
2. Powar & Daginawala; General Microbiology I & II; Himalaya Publishing House, Mumbai.
3. Stanier *et al.;* General Microbiology; Prentice Hall of India, New Delhi.
4. Prescott, Harley, Klein; Microbiology; Mc Graw Hill Publication, New York.

BT 342 Environmental Biotechnology **3-0-0-3**

Introduction to Biodiversity: Applications of biotechnology in biodiversity conservation.	[4]
Bioleaching: Use of microbial source for enhanced oil recovery, metal leaching (Copper and Uranium).	[5]
Biofuels: Bioethanol, Biodiesel, Methanogenesis.	[4]
Biopesticides: Bacterial, Fungal and Viral pesticides.	[4]
Biofertilizers: Nitrogen fixing microbes and their application in crop productions.	[5]
Biodegradation: General characteristics of xenobiotics, Technology development of bioremediation, Case study of hydrocarbon and pesticide biodegradation, Biobleaching of industrial effluents.	[6]
Biogeochemical Cycling: Sulphur, Nitrogen and Phosphorus cycles, Role of microbes in biogeochemical cycling.	[6]
Waste Treatment and Disposal: Waste water treatment, industrial and municipal waste, BOD removal, activated sludge process, trickling filters, lagoons, land farming, contact stabilization and anaerobic digestion, nitrification and denitrification in the activated sludge process.	[5]

BT 313 Animal Tissue Culture **3-0-0-3**

Introduction to animal cell sciences: Structure, organization and biology of animal cell. General concepts of animal cell culture. General concept of differentiation and dedifferentiation. Expression of proteins in animal cells.	[8]

Growth requirements and kinetics: Media -Development of simple growth media, BSS. Chemical, physical and metabolic functions of different constituents of culture medium. Role of CO2 and serum. Serum and protein free defined media and their applications. Growth kinetics of cultured cells. [8]

Animal cell culture and its types: Primary and established cell line cultures, Cell lines: A general concept. Disaggregation of tissue and primary culture. Cell separation, Organ and histotypic cultures. [8]

Techniques used in Animal Cell Culture : Cell cloning and micromanipulation, Transfection techniques, Cell transformation, Scaling-up of animal cells [8]

Application of animal cell culture: Cell culture based vaccines, Stem cell culture, Embryonic stem cells and their applications, Cell hybridization, Hybridomas and their selection, application of cell hybridization. [7]

Suggested Readings:

1. R. Ian Freshney, (3rd ed., 2007), Culture of Animal Cells, Wiley,New York..
2. John R.W., (2nd ed., 2004), Animal Cell Culture-Practical Approach Masters, Oxford Press, UK.
3. J.M. Davis, (2nd ed., 2007), Basic Cell Culture, Oxford, UK.
4. Jennie P. Mather and David Barnes, (2nd ed., 2008), Animal Cell Culture Methods, Academic Press,US.
5. S.J. Higgins and B.D. Hames, (3rd ed., 2008), Protein Expression: A Practical Approach, Oxford University Press, UK.
6. S.B. Primrose, R.M. Twyman and R.W. Old, (3rd ed., 2007), Principles of Gene Manipulation, Blackwell Science, US.

MB 341 General Microbiology Laboratory **0-0-2-1**

Assignments are based on the course MB 331 General Microbiology containing exercises on microscopic and cultural study of microorganisms and their isolation from natural sources.

BT 392 **Environmental Biotechnology Laboratory** **0-0-2-1**

Assignments are based on the course BT 342 Environmental Biotechnology containing exercises on analysis of environmental samples.

BT 323 **Tissue Culture Laboratory**

Assignments are based on the courses BT 322 Plant Biotechnology and BT 313 Animal Tissue Culture containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 371 **Internship** **0-0-0-6**

Each student shall undergo project work of six to eight weeks during the Summer after Spring Semester of second year in an approved Organization and submit a Project Report.

BT 311 **Genetic Engineering** **3-1-0-4**

Introduction: Nucleic acid structure, properties and isolation. [5]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA in vitro with their activities and major applications – Restriction endonucleases, Nucleases, DNA ligases, Topoisomerase. [6]

Cloning and Expression Vectors: Brief outline of plasmids, phagemids, bacteriophage lambda vectors, cosmids, and high capacity cloning vectors like BACs, PACs and YACs. Binary and shuttle vectors, brief outline of expression vectors. [6]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, methods of gene transfer to bacterial cells, cDNA and genomic library, and screening methods for selection of recombinant DNA molecules.

[6]

Tools of Recombinant DNA Technology: Fragmentation and separation of DNA fragments, PCR, Northern, Southern and Western hybridization, sequencing.

[7]

Applications of Recombinant DNA Technology: Role of genetic fingerprinting in diagnostics, novel drug and therapies for genetic diseases, combating infectious diseases, protein engineering, medicinal and plant breeding applications, production of commercially important proteins like insulin, growth hormone and tissue plasminogen.

[6]

BT 352 Bioinformatics **3-0-0-3**

Introduction to Networking: Definition and scope of networking, Basic network topology, Concept of LAN, MAN and WAN, Introduction to Internet and data transfer protocol (TCPI/P, FTP)

[5]

Biological Information Resources: Introduction to biological data and database management, Biological databases – Protein databanks (Primary and Secondary databank; Sequence and structure databank), Genomic databanks (Sequence and specialized databanks). [7]

Sequence Alignment: Introduction to biological sequence alignment, Database searching, Algorithm for sequence alignment, Pairwise alignment (Needleman and Wunsch algorithm, Smith-Waterman algorithm), Multiple Sequence Alignment, Concept of Gaps, Gap penalties and scoring matrices. [7]

Tools for Sequence Alignment: FASTA, BLAST, Variations of BLAST, Alignment scores and statistical significance of database searches. [5]

Genomics: Genome, Gene structure of prokayotes and eukaryotes, Concept of ORFs, GC-content, Codon Usage, cDNAs and ESTs, Serial analysis of gene expression (Microarrays). [5]

Proteomics: Introduction to proteome and proteome analysis (2D electrophoresis, Mass spectrophotometry, Protein microarray and X- [5]

ray crystallography), Algorithm for modeling protein folding.

Phylogenetics: Introduction to phylogenetics, Parsimony, Molecular phylogenetics, Methods of phylogenetic tree construction [5]

Suggested Books:

1. Peruski and Peruski: The Internet and the new Biology: tools for Genomic and Molecular Research, ASM Publishing House, India.
2. Higgins and Taylor, Bioinformatics, Oxford University Press, US.

BT 324 Bioprocess Engineering 3-0-0-3

Introduction: History and role of bioprocess engineering in biotechnology industries, Concept of unit operation unit processes. Introduction to Engineering calculation: Variables, their dimensions and units, dimensionally homogeneous and non- homogeneous equations, standard conditions and ideal gases, physical and chemical property data, basics of materials and energy balances in a macroscopic view point. [10]

Fluid Mechanics: Principle of microbial nutrition, formulation of culture media, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents, importance of pH, fluid vs. solids, fluid static's mass and energy balance in fluid flow, Bernoulli's equation, flow past immersed bodies and drag coefficient. Sterilization of process fluids, recovering and purifying products, integration of reaction and separation. [10]

Heat Transfer: Principles and design of processes involving biochemical reactions, including aerobic and anaerobic respiration and fermentation (involving pure and mixed cultures). Shake flask, batch and continuous operations. Solid state fermentations. Primary and secondary metabolites Energy balances and biochemical kinetics. [10]

Diffusion and Mass Transfer: Biological production consideration, large scale production, Enzyme kinetics, cell growth, energetics and mass transfer. Production of Penicillin, Streptomycin, Tetracycline and other Antibiotics. [9]

Suggested Readings:

1. Shuler ML; Kargi F (2nd ed.,), Bioprocess Engineering, Prentice Hall PTR, New Jersey. 1.
2. Ward, O.P. Bioprocessing, John Wiley and Sons, New York.* 2.
3. Reinhold Van Nostrand, Belter P.A, Cussler E.L, Hu W.S. (2nd ed.), Bioseparations- Downstream processing for biotechnology. New York. 3.

***latest edition**

BT 334 Enzyme Technology 3-0-0-3

Introduction: General properties of enzyme; Classification; Nomenclature; Cofactor & Coenzyme; Activation Energy; Fisher's Lock and Key hypothesis; Khosland Induced-Fit Model; Entropy reduction; Factors affecting the enzyme activity: Reversible and irreversible covalent modifications; Uni substrate and bi substrate reactions. [5]

Enzyme Kinetics: Mechanism of enzyme substrate reaction; Michaelis- Menten Knetics; Double reciprocal plot ; Enzyme inhibition & regulation. [6]

Enzymes in metabolic regulation: Structure and properties; Allosteric behavior; Deviation from Michaelis-Menten Kinetics; Role of allostric enzymes in metabolic pathway; Sigmoidal kinetics and their physiological significance. [8]

Methods in Enzymology: Isolations and activity measurements; Extraction and purification; Structure determination; Investigation of active sites and catalytic mechanism; enzyme engineering, ribozyme and abzymes. [12]

Enzymes in Industry: Immobilization methods; Effect of partition on kinetics and performance of enzyme system with particular emphasis on change in pH and hydrophobicty [8]

Suggested Readings:

1. Nelson D L and Cox M M, (3rd ed.), Lehninger Principles of

Biochemistry , MacMillian Worth Publishers, US.

2. Palmer T and Bonner P, (5th Ed.), Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, East West Press Pvt. Ltd. New Delhi.

3. Wilson, (5th Ed.), Bimolecular Interactions: I Enzymes in Wilson K and Walker J Practical Biochemistry: Principles and techniques Cambridge University Press UK.

4. Barker RDJ et al., (2005), Technological applications of Biocatalysts. Butterworth-Heinemann Ltd. Oxford,US.

5. Voet D, Voet J D and Pratt C W, (2007), Fundamentals of Biochemistry, John Wiley and Sons, Inc.US.

6. Berg J M, Tymoczko J L and Stryer L , (2003), Biochemistry, W H Freeman and Company New York.

BT 341 Genetic Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 311 Genetic Engineering containing exercises on nucleic acid isolation from different biological sources and amplification techniques.

BT 314 Bio-informatics Laboratory 0-0-2-1

Assignments are based on the course BT 352 Bioinformatics containing excercises on internetworking, sequence homology search (BLAST) and phylogenetic tree construction and analysis

BT 344 Bioprocess Engineering Laboratory 0-0-2-1

Assignments are based on the course BT 324 Bioprocess Engineering containing exercises on fermentation, primary and secondary metabolites.

BT 354 Enzyme Technology Laboratory 0-0-2-1

Assignments are based on the course BT 334 Enzyme Technology

containing exercises on enzymes kinetics.

Mody University of Science & Technology

B.Sc. (Hons) Maths
Session 2019-2020

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc (Honours) in Mathematics
(Mathematics, Physics and Computer Science*/Chemistry)**
Three-Year Programme
Academic Curriculum
First Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
						5				
	Mathematics									
	MS 111	Calculus	3	-	-	3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 111	Mechanics, Properties of Matter and Relativity	3	-	-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 121	Programming concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 181	Physical and Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 23*/23.5**									
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 23
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

First Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
						6				
	Mathematics									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
						6				
	Physics									
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2	-	-	2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
						7				
	Computer Science*									
	CA 122	Data Structure Through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
						8				
	Chemistry*									
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
						5.5				
	Total Credits: 27*/24.5**									
	GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

*Mathematics, Physics and Computer Science 27

**Mathematics, Physics and Chemistry 24.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language I ‡	3	-	-	**3**	3	25	25	50
	Mathematics									
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
						7				
	Physics									
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
						8				
	Computer Science*									
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
						8				
	Chemistry**									
	CH 291	Physical Chemistry- I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry- I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry -III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry -III	-	-	3	**1.5**	4	25	25	50
						7.5				
	Total Credits: 26*/25.5**									
	GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Autumn Semester

*Mathematics, Physics and Computer Science 26

**Mathematics, Physics and Chemistry 25.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Second Year-Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Compulsory Courses									
		Foreign language II ‡	3	-	-	3	3	25	25	50
	Mathematics									
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3	3	25	25	50
						7				
	Physics									
Spring Semester	PH 212	Mathematical Physics and Special theory of Relativity	3	1	-	4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
						6				
	Computer Science*									
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
						5				
	Chemistry**									
	CH 272	Physical Chemistry- II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry- II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry -IV	-	-	3	1.5	4	25	25	50
						7.5				
	Total Credits: 21*/23.5**									
	GE 202	Proficiency (Non-Credit) #	-	-	-	1	-	-		

‡ *Refer to the Foreign Languages Section*

*Mathematics, Physics and Computer Science 21
**Mathematics, Physics and Chemistry 23.5

$ CW (Course work): It would include attendance, assignments, class /quiz test.

Third Year -Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester	***Compulsory Courses***									
	Mathematics									
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
	MS 331	Combinatorics	3	-	-	3	3	25	25	50
	MS 341	Vector Calculus	3	-	-	3	3	25	25	50
	MS 351	Probability and Statistics	3	1	-	4	3	25	25	50
	MS 361	Analytical Solid Geometry	3	1	-	4	3	25	25	50
	Total Credits:21									
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Third Year - Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	***Compulsory Courses***									
	Mathematics									
	MS 312	Special Functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
	MS 332	Advanced Calculus	3	-	-	3	3	25	25	50
	MS 342	Graph Theory	3	-	-	3	3	25	25	50
	MS 352	Basic Differential Geometry	3	-	-	3	3	25	25	50
	MS 362	Dissertation	-	-	-	5	-	100		
	Total Credits:21									
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Total Credits (all Semester)- 139/139

$ CW (Course work): It would include attendance, assignments, class /quiz test.

MS 331 **Combinatorics** **3-0-0-3**

1. Relation: Definition, different forms, properties and operations on sets, principle of inclusion and exclusion, partition of a set, definition of relation, types of relation, composition, properties and graphical representation of relation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice and different forms. **[10]**

2. Function: Properties, definition of function and different forms, composition and properties of functions, recursively defined functions, applications of functions. **[10]**

3. Induction: Mathematical induction, strong induction and well-ordering, definition of recursive, structural induction. **[10]**

4. Counting: Basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.

Reference Books:

1. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd edt., Mc Graw Hill Education, New Delhi.
2. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International

MS 341 **Vector Calculus** **3-0-0-3**

1. Vector Differentiation I: Vector algebra, operations with vectors, scalar and vector product of three vectors, product of four vectors, reciprocal vectors, scalar-valued functions over the plane and the space, vector function of a scalar variable, curves and paths, vector differentiation. **[10]**

2. Vector Differentiation II: Directional derivative, gradient of a scalar function, conservative field, divergence, curl, related properties of gradient, divergence and curl of sums, second order differential operator, cylindrical and spherical coordinates. **[10]**

3. Vector Integration I: Integration of a vector function of a scalar argument, line integral, work done , potential, conservative field and area, surface integrals, surface area and flux, volume integrals. **[10]**

4. Vector Integration II: Green's theorem in plane, transformation between line integral and double integral, area in Cartesian and polar coordinate, Stoke's theorem, Gauss divergence theorem. **[09]**

Text Books:

1. Shanti Narayna, A Text Book of Vector Calculus by, S. Chand & Co., New Delhi.
2. R.Murrary, Theory and Problems of Advanced Calculus by Spiegal, Schaum's Publishing Company, New York.

Reference Books:

1. N. Saran and S.N. Nigam, Introduction to Vector Analysis by Pothishala Pvt. Ltd., Allahabad.
2. Thomas, Calculus by Thomas, 11 Editions, Pearson.
3. G. Paria, A Text Book on Vector Calculus by Scholar's Publishing House, Indore.
4. B.V. Ramana(2006), Higher Engineering Mathematics by TMH.

MS 351 **Probability and Statistics Theory** **3-1-0-4**

1. Basic Statistics: Mean, mode, median for grouped and ungrouped data, variance, standard deviation, dispersion and measures of dispersion, skewness and measures of skewness, moments. **[10]**

2. Probability Theory: Recapitulation of basic probability theory, law of addition and law of multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[10]**

3. Random Variables and Distribution: Discrete and continuous random variables, types of distribution, probability mass and density functions, mean variance and standard deviation of distribution, discrete distributions (binomial and Poisson), continuous distributions (normal and uniform). **[10]**

4. Hypothesis and Correlation-Regression: Simple and composite hypothesis, type I and type II errors, tests of significance, simple correlations, linear regression. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics, 3rd ed., SCS Publisher.

MS 361 **Analytical Solid Geometry** **3-1-0-4**

1. Plane and Straight Line: Different form of plane, angle between two planes, perpendicular distance of a point from a plane, plane through intersection of two planes, bisectors of two intersecting planes, locus of a plane, different form of straight line, angle between two lines, distance of a point from a straight line, coplanarity of straight lines, shortest distance between two lines, intersection of three planes. **[10]**

2. Sphere: Different form of sphere, plane section of a sphere, intersection of two spheres, sphere through a given circle, intersection of a straight line and sphere, tangent planes and normal, touching spheres and condition of orthogonality. **[10]**

3. Conicoids I: Different form of cone, equation of the cone with given vertex and a given conic for its base, angle between the lines in which a plane cuts a con, tangent lines and tangent plane, reciprocal con, right circular con, different form of cylinder, equation of tangent plane, enveloping cylinder, right circular cylinder. **[10]**

4. Conicoids II: Ellipsoid, hyperboloid of one and two sheets, elliptic paraboloid , hyperbolic paraboloid, tangent plane , equation of normal, director sphere, polar plane and pole of the plane. **[09]**

Text Books:

1. R.J.T. Bell (1994), Elementary Treatise on Co-Ordinate Geometry of Three Dimensions by, Macmillan India Ltd.
2. Shanti Narayan, Analytical Solid Geometry by S. Chand & Company, New Delhi.

Reference Books:

1. Deepak Chatterjee, Analytic Solid Geometry by PHI Learning Private Ltd., New Delhi.
2. H.M. Vasavada (1992), Analytical Geometry of Two and Three Dimensions.

MS 332 **Advanced Calculus** **3-0-0-3**

1. Preliminary: Functions, continuity, the derivative, composite functions Rolle's theorem, theorem of the mean, Taylors's series with remainder indeterminate forms, fundamental theorems on infinitesimals. **[10]**

2. Power Series: Definition, tests for convergence, region of convergence, uniform convergence, integral and derivative of power series, operations with two power series, exponential, trigonometric, hyperbolic and dominant functions, conditionally convergent series. **[10]**

3. Partial Differentiation: Functions of two variables, partial derivatives of composite function, Euler's theorem on homogeneous functions, directional derivative, higher differential, implicit functions, one equation of two or more variables, two equations of four variables, four equations of six variables, Jacobians. **[10]**

4. Definite Integral: Definition and properties, existence proof, Simpson's rule, change of variables, differentiation of a definite integral, differentiation under the integral sign, differentiation and integration of integral with infinite limit, infinite integrand, multiple integrals, beta and gamma functions, Dirichlet's integral. **[09]**

Text Books:

1. Frederick S Woods (1934), Advanced Calculus by Ginn and Company.
2. George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Thomas Calculus by Pearson.

Reference Books:

1. R.C Buck , Advanced Calculus by Waveland Press, Inc.
2. Walter Rudin, Principles of Mathematical Analysis by McGraw-Hill.
3. Gerald B. Folland, Advanced Calculus by Pearson.

MA 342 **Graph Theory** **3-0-0-3**

1. Graphs: Introduction, definition and applications of graphs, finite and infinite graphs, null graph, sub graphs, incidence and degree, isolated vertex, pendant vertex, walk, path and circuits, connected graphs, disconnected graphs and components, isomorphism, Euler graphs, operations on graphs, Hamiltonian paths and circuits, the travelling sales man problem, matrix representation of graphs, properties and some standard theorems on graphs. **[10]**

2. Directed Graphs: Definition, in-degree, out-degree, isomorphic digraphs, types of digraphs, digraph and binary relations, relation matrices, directed paths and connectedness, Euler digraphs, fundamental circuits in digraphs, properties and some standard theorems on digraphs. **[10]**

3. Trees: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's algorithm and Prim's algorithm. **[10]**

4. Cut-Sets and Cut-Vertices: Cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism, some standard theorems. **[09]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science, PHI.
2. Chartland G., Zhang P. (2006) Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.

MS 352 **Basic Differential Geometry** **3-0-0-3**

1. Preliminaries: Graphs and level sets, vector fields, the tangent space, surfaces, vector fields on surfaces orientation, the gauss map. **[10]**

2. Tensors: Definition of tensors and basic properties, Christoffel symbols, uses of tensors in differential geometry. **[10]**

3. Geodesics I: Parallel transport, Weingarten map, curvature of plane curves, arc length and the line integrals, curvature of surfaces. **[10]**

4. Geodesics II: Envelops and evolutes, first fundamental form, metric potentials, direction coefficient and angle between two curves on a surface. **[09]**

Text Books:

1. Chuan-Chih Hsiung (1997), A First Course in Differential Geometry by International Press, Cambridge.
2. T.J. Willmore(1964), An Introduction to Differential Geometry by Oxford University Press.

Reference Books:

1. M. Abate and F. Tovena, Curves and Surfaces by Springer.
2. A. K. Peters (2010), Differential Geometry of Curves and Surfaces by Ltd., Natick.
3. D.J. Struik(1988) , Lectures on Classical Differential Geometry by 2nd Edition, Addison-Wesley.

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 *Physics Laboratory-I* 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. [7]

Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission [10]

grating and its resolving power.

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.

3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10] [8]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and [8]

grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments.

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of [6]

cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon-nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and [6]

Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:**Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]
Applications of Matrices: Applications of matrices to a system of linear	[9]

(both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.

2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd.,

Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 *C Language Laboratory* 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi
4. Achyut S Godbole, "Operating Systems", TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and [8]

Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes.

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, "Let Us C++", BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, "Mastering C++" , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, "C++ The Complete Refernce", TMH, New Delhi.
2. Lafore R, "Object Oriented Programming Using C++", GalgotiaPulications, New Delhi
3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 *Computational Numerical Analysis Laboratory* **0-0-4-2**

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular

velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's **[5]**

equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey,

reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child [5]

Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and

pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand

& Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing [8]

mechanism

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology 3-0-0-3

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons, Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal

system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.

4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 Laboratory Course in Chemistry-IV **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

B.Sc. (Hons) Psychology
Session 2019-2020

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H)-Psychology
Three years programme
(Batch 18-19 onwards)
FIRST YEAR

	Course	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab. -I	-	-	2	1	4	25	25	50
	PL 111	Basic Psychological Processes-I	3	-	-	3	3	25	25	50
	PL 121	Experimental Methodology & Elementary Statistics-I	3	-	-	3	3	25	25	50
	PL 131	Psychology - I	-	-	2	1	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course	Course Title	Contact Hours per			Credits	ETE Duration	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	ZO 132	Animal Diversity - II	3	-	-	3	3	25	25	50
	BT 152	Genetics	3	1	-	4	3	25	25	50
	BT 182	Basic of Forensic Sciences	2	-	-	2	3	25	25	50
	ZO 142	Animal Diversity Lab. -II	-	-	2	1	4	25	25	50
	PL 112	Basic Psychological Processes-II	3	-	-	3	3	25	25	50
	PL 122	Experimental Methodology & Elementary Statistics-II	3	-	-	3	3	25	25	50
	PL 132	Psychology - II	-	-	2	1	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Sub Total	**20**	**2**	**4**	**24**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (Hons.) Psychology
Three-Year Programme
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Lab	-	-	2	1	3	25	25	50
	BC 221	Bio-Instrumentation Laboratory	-	-	2	1	4	25	25	50
	PL 213	Positive Psychology	3	-	-	3	3	25	25	50
	PL 221	Psychology of Human Development - I	3	-	-	3	3	25	25	50
	PL 231	Applied Psychology - I	3	-	-	3	3	25	25	50
	PL 241	Psychology Lab - III	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 212	Molecular Biology	3	1	-	4	3	25	25	50
	BT 232	Molecular Biology Laboratory	-	-	2	1	4	25	25	50
	BT 262	Sensitive Sciences	2	1	-	3	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Lab.	-	-	2	1	4	25	25	50
	PL 212	Psychology of Human Development - II	3	-	-	3	3	25	25	50
	PL 222	Applied Psychology - II	3	-	-	3	3	25	25	50
	PL 232	Psychology Lab - IV	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Sub Total	**17**	**1**	**8**	**22**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

B.Sc. (Hons.) Psychology
Three-Year Programme
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW	MTE	ETE
Autumn Semester	PL 311	Social Psychology-I	3	-	-	3	3	25	25	25
	PL 321	Biological Basis of Behaviour	3	-	-	3	3	25	25	50
	PL 331	Systems of Psychology	3	-	-	3	3	25	25	50
	PL 341	Psychopathology-I	3	-	-	3	3	25	25	50
	PL 351	Industrial and Organizational Psychology-I	3	-	-	3	3	25	25	50
	PL 361	Psychological Testing-I	3	-	-	3	3	25	25	50
	PL 371	Psychology Lab.-V	-	-	4	2	3	25	25	50
		Sub Total	**18**		**4**	**20**				
	GE 301	Proficiency (Non-Credit) #								

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW	MTE	ETE
Spring Semester	PL 312	Social Psychology-II	3	-	-	3	3	25	25	50
	PL 322	Guidance and Counseling	3	-	-	3	3	25	25	50
	PL 332	Experimental Psychology	3	-	-	3	3	25	25	50
	PL 342	Psychopathology-II	3	-	-	3	3	25	25	50
	PL 352	Industrial and Organizational Psychology-II	3	-	-	3	3	25	25	50
	PL 362	Psychological Testing-II	3	-	-	3	3	25	25	50
	PL 372	Psychology Lab.-VI			4	2	3	25	25	50
		Sub Total	**18**	-	**4**	**20**				
	GE 302	Proficiency (Non-Credit) #				1				

Total credits 130

PL 213 Positive Psychology 3-0-0-3

Introduction to Positive Psychology: An Introduction, Perspectives on Positive Psychology: Western and Eastern, Classification and Measures of Strengths and Positive Outcomes, Identifying your Personal Strengths [10]

Positive Emotional States and Processes: Understanding Positive Affect, Positive Emotions, Happiness and Wellbeing: Definitions and distinguishing between the Positive and Negative: Emotional Intelligence: Definition, Working with Emotions to Bring About a Positive Change. [11]

Positive Cognitive States and Processes: Self-efficacy, Learned Optimism, Hope, Wisdom, Flow, Mindfulness: Definition, Historical Basis, Neurobiology and Scales [10]

Towards building Positive Environment: Positive Schooling, Gainful Employment, Building better Communities, Successful Aging. [8]

Text Books:

1. Snyder, C.R., & Lopez, S.J.(2007). *Positive Psychology: The scientific and practi explorations of human strengths.* Thousand Oaks, CA: Sage.

2. Baumgardner, S.R. Crothers M.K. (2010). *Positive Psychology*. Upper Saddle River, N.J.: Prentice Hall.

3. Carr, A. (2004). *Positive Psychology: The science of happiness and human strength*.UK: Routledge.

References:

1. Peterson, C. (2006). *A Primer in Positive Psychology*. New York: Oxford University Press.

2. Seligman, M.E.P. (2002). *Authentic Happiness: Using the New Positive Psychology to Realize Your Potential for Lasting Fulfillment*. New York: Free Press/Simon and Schuster.

3. Snyder, C. R., & Lopez, S. (Eds.). (2002). *Handbook of positive psychology*. New York: Oxford University Press.

BT 262 Sensitive Sciences 3-0-0-3

History and Introduction: Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation [6]

Class and Individual Characteristics: Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints. [10]

Classification of Fingerprints: Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC [10]

Fingerprint Developmental techniques: Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra- oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court. [7]

AFIS & Biometrics : AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications [6]

Text Books:

1. Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.

References:

1. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahabad, 2000.
2. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
3. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
4. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
5. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

PL 111 Basic Psychological Processes-I 3-0-0-3

UNIT-I
Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

UNIT-II
Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

UNIT-III [6]
Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance.

UNIT-IV [9]
Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.

UNIT-V [8]
Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

UNIT-I
Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

[5]

UNIT-II
Problems and Hypothesis: Nature, Type and Sources.

[7]

UNIT-III
Variables: Nature and Types; Control of Variables.

UNIT-IV [5]
Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement.

UNIT-V
Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

UNIT-VI
Measures of Central Tendency: Mean, Median and Mode. [8]

UNIT-VII
Reliability of Statistics: Significance of Difference Between Two Means [3]

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., &Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 131 Psychology Lab.-I 0-0-2-1

Assignments are based on the course PL 111 Basic Psychological Processes-I containing exercises on learning and personality.

PL 112 Basic Psychological Processes-II 3-0-0-3

UNIT-I
Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

UNIT-II
Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

[6]

UNIT-III
Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.

[9]

UNIT-IV
Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation.

[9]

UNIT-V
Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests.

Text Book

1. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference:

2. Atkinson, R. L., Atkinson, R. C., &Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. Psychology: The Essential Science. Allyn & Bacon, New York.
4. Zimbardo, P. G., & Weber, A. L. Psychology.Harper Collins College Publisher, New York.

PL 122 Experimental Methodology & Elementary Statistics-II 3-0-0-3

UNIT-I [4]
The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales.

UNIT-II [7]
Sampling Methods: Probability and Non-Probability Sampling Methods.

UNIT-III [8]
Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs.

UNIT-IV [5]
Measures of Variability: Range, Quartile Deviation and Standard Deviation.

UNIT-V [4]
Normal Probability Curve: Properties and Applications. Skewness and Kurtosis.

UNIT-VI [6]
Reliability of Statistics: Chi-Square.

UNIT-VII [5]
Correlations: Product-Moment and Rank Order.

Text Book

1. McGuigan, F. J. Experimental Psychology. Prentice-Hall of India, New Delhi.

Reference Book:

2. Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
3. Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.
4. Guilford, J. P., & Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

PL 132 Psychology Lab.-II 0-0-2-1

Assignments are based on the course PL 112 Basic Psychological Processes-II containing exercises on memory and intelligence.

PL 221 Psychology of Human Development-I 3-0-0-3

UNIT-I [8]
Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.

UNIT-II [6]
Determinants of Development: Biological and Socio- Cultural.

UNIT-III [9]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.

UNIT-IV [8]
Prenatal Development: Stages and Factors Affecting Prenatal Development.

UNIT-V [8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.

Text Books:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 231 Applied Psychology-I 3-0-0-3

UNIT-I [8]
Introduction: Nature and Fields of Applied Psychology.

UNIT-II [7]
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services.

UNIT-III [6]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up,

Modern Trends in Counseling, Ethical Issues in Counseling.

UNIT-IV [9]

Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.

UNIT-V [9]

Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. Rao, S. N. Counselling and Guidance. Tata McGraw-Hill, New Delhi.
4. Charles, J. G., & Bruce, R. F. Counseling Psychology: Practices, Issues and Intervention. CENGAGE Learning, New Delhi.
5. Sue, R., Sue, D., & Sue, S. Understanding Abnormal Behaviour. Houghton Mifflin.

PL 241 Psychology Lab.-III 0-0-2-1

Assignments are based on the courses PL 221 Psychology of Human Development-I and PL 231 Applied Psychology-I containing exercises on the study of the characteristics of the neonate and guidance and counseling.

PL 212 Psychology of Human Development-II 3-0-0-3

UNIT-I

Development during Infancy: PhysicalGrowth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

UNIT-II

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

UNIT-III [9]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity.

UNIT-IV [8]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family.

UNIT-V [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues.

Text Book:

1. Hurlock, E. Child Development. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

Reference Book:

3. Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis.
4. Santrock, J. W. Life-Span Development. McGraw-Hill, New York.
5. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 222 Applied Psychology-II 3-0-0-3

UNIT-I

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

UNIT-II

Psychology and Health: Mental Health and General Health, Dimensions of Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

UNIT-III

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

UNIT-IV

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

UNIT-V

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

Text Book:

1. Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.

Reference Book:

2. Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. Industrial Psychology. Prentice Hall, Englewood Cliffs.
4. Misra, G. Psychological Perspective on Stress and Health. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. Social Psychology. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. Psychology in Sports: A Contemporary Perspective. Friends, New Delhi.

PL 232 Psychology Lab.-IV 0-0-2-1

Assignments are based on the courses PL 212 Psychology of Human Development-II and PL 222 Applied Psychology-II containing exercises on the study of developmental pattern of various stages of human life and stress management.

PL 311 Social Psychology - I **3-0-0-3**

UNIT-I [3]
Social Psychology: Nature and Subject Matter; Relationship with other social sciences.

UNIT-II [5]
Methods: Experimental, Observation, and Sociometry.

UNIT-III
Socialization: Nature, Process and Agents of Socialization. [4]

UNIT-IV [8]
Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.

UNIT-V [5]
Social Norms: Meaning, Characteristics and Formation

UNIT-VI [6]
Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants

UNIT-VII [8]
Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional

Text Book:

1. Baron, R.A., Byrne, D. Social Psychology (10th Edn)-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E.The Handbook of Social Psychology (2nd Edn.), Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S. Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M.Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. Social Psychology (8th Edn.)-Tata McGraw Hill International Editions.
7. Penrod, S. Social Psychology (2nd Edn.) New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K.Samaj Manovigyan Ki Rooprekha (6th Edn), NewDelhi: MotiLal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O.Social Psychology (12th Edn) - Pearson Education

PL 321 Biological Basis of Behaviour 3-0-0-3

UNIT-I
Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical. [6]

UNIT-II
Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters. [7]

UNIT-III
Nervous System: Central nervous system and Peripheral nervous system – Structure and Functions. Endocrine system and its behavioral implications. [9]

UNIT-IV
Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention. [6]

UNIT-V
Motivation: Neural mechanism of Hunger, Thirst and Sex [5]

UNIT-VI
Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory. [6]

Text Book:

1. Carlson, N.Biology of Behavior. Boston : Allyn and Bacon.
2. Graham, R.B.Physiological Psychology. California :Wadsworth.

Reference Book

3. Grossman, S.P. A Text book of Physiological Psychology. New York :Siley.
4. Hoyenga, K.B. and Hoyenga, K.T.Psychobiology : The neuron and Behavior. California :Broks/Cole.
5. Kalat, J.N.Biological Psychology. California :Wadsworth.
6. Levinthal, C.R.Introduction of Physiological Psychology. New Jersey : Prentice Hall.
7. Pinel, Johan, P.J.Biopsychology.Boston : Allyn and Bacon.
8. Rosenzweig, M.R. and Liemen, A.L.Physiological Psychology. New York : Random House.

PL 331 Systems of Psychology 3-0-0-3

UNIT-I
Nature and scope of Psychology: Psychology as science; Historical Origins: Pre-experimental period- Science Among Greeks, British Empiricism, German Nativism. [4]

UNIT-II
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status [5]

UNIT-III [7]
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner.

UNIT-IV [6]
Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.

UNIT-V [6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).

UNIT-VI [5]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.

UNIT-VII [6]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.

Text Book

1. Chaplin, T. Kraweic, T.S. Systems and Theories of psychology. Holt Rinehart and Winston.
2. Schiffman, H.R. Sensation and Perception. New York: John Wiley and Sons.

Reference Book

3. Hilgard, E.H., and Bower, G.H. Theories of Learning. Englewood Cliffs : Prentice Hall.
4. Matlin, M.W. Cognition. Bangalore : Prism.
5. Mazur, J.E.Learning and Behaviour. Englewood Cliff's : Prentice Hall.
6. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology. London : Methuen and Co.
7. Marks, M.H. and William, A. Cronan – Hillix, Systems and Theories in psychology. McGraw Hill International Editions, Psychology Series.
8. Vygotsky, L.S. Thought and Language, Cambridge, mass. MIT Press.
9. Hall C.S. :Lindzey, G. Theories of Personlaity. New York : Wiley Eastern Limited.

PL 341 Psychopathology-I **3-0-0-3**

UNIT-I [3]
Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.

UNIT-II [7]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.

UNIT-III [3]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.

UNIT-IV [5]
Diagnostic Assessment: Case History, Interview, Projective Techniques

UNIT-V [12]
Anxiety Based Disorders: Nature, Symptoms and Etiology- Generalized Anxiety Disorders, Phobia, O.C.D, Conversion Hysteria and Dissociative Disorders

UNIT-VI [5]
Psycho physiological Disorders: Nature, Symptoms and Etiology – Asthma, Peptic Ulcer, CHD, Hypertension

UNIT-VII [4]
Mental Retardation: Nature, Types, Causes and its Management

Text Book:

1. Carson, R.C.; Butcher, J.N., et al. Abnormal Psychology ; New Delhi: Pearson Education.

Reference Book

2. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior ;New Delhi: PearsonEducation Inc.
3. Davison, G.C. & Neale, J.M. Abnormal Psychology ;New York: Willy.

PL 351 Industrial and Organizational Psychology-I 3-0-0-3

UNIT-I
Industrial/Organizational Psychology: Nature, historical development and scope. [5]

UNIT-II
Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing. [9]

UNIT-III [9]
Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme

UNIT-IV [10]
Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal

UNIT-V [6]
Work environment: Noise, atmospheric conditions. Illumination and performance

Text Book

1. Blumm M.L. abdNylor, J.C.Industrial Psychology. N.Y : Harper & Row.
2. Davis. K.Human Behaviour at Work. New Delhi : Tata McGraw Hill.
3. Dunnet, M.D.Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.

Reference Book

4. Ganguli, H.C.The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.

6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour,New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A.Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
9. Mohanty G.Industrial and Organizational Psychology New Delhi: Oxford and IBH.

PL 361 Psychological Testing-I 3-0-0-3

UNIT-I [9]
Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.

UNIT-II [9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.

UNIT-III [9]
Validity: meaning, validation procedures, and special problems.

UNIT-IV [12]
Construction and Standardization of Psychological Tests
General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S.Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L. Psychological Testing : Design, Analysis and UseBoston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods. New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B.Clinical methods in psychology. New York : Wiley inter science publication.

PL 371 Psychology Lab.-V 0-0-4-2
Assignments to be based on the course PL 311 (Social Psychology), PL 341 (Psychopathology) AND PL 351 (Industrial and Organizational Psychology).

PL 312 Social Psychology-II 3-0-0-3

UNIT-I [6]
Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.

UNIT-II [6]

Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects.

UNIT-III [6]

Attribution process Nature and theories: Kelly and Weiner.

UNIT-IV [5]

Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies

UNIT-V [5]

Propaganda: Nature, Tools and Techniques

UNIT-VI [5]

Aggression and Violence: Nature, Determinants and Management.

UNIT-V [6]

Social Change: Nature, Factors and Theories.

Text Book

1. Baron, R.A., Byrne, D. Social Psychology-Prentice-Hall.
2. Daniel, P, Cozby, P.C.Social Psychology, New York: CBS College Publishing Holt, Rinehart and Winston.

Reference Book

3. Lindzey, L., and Aronson, E..The Handbook of Social Psychology, Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S .Social Psychology, Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. Handbook of Psychology (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. .Social Psychology-Tata McGraw Hill International Editions.
7. Penrod, S.Social Psychology ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Taylor, S.E. Peplau, L.A. Sears, D.O. Social Psychology -Pearson Education.

PL 322 Guidance and Counseling **3-0-0-3**

UNIT-I

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational. [5]

UNIT-II [5]

Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.

[9]

UNIT-III

Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.

[9]

UNIT-IV

Counseling process: External conditions and preparation;

Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.

UNIT-V [7]
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling.

UNIT-VI [4]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.

Text Book

1. Bernard, H.W. and Fullmer, D.W.Principles of Guidance. New York : Crowell.
2. Burnard, Philips; Counseling skills for Health Professional. Madras: Chapman and Hall.

Reference Book

3. Crow, L.D. and Crow, A.; Introduction to Guidance. New Delhi: Imersia Pub.
4. Gelso, G. J. and Fretz B.R. ; Counseling psychology, Banglore : Prism.
5. Jones, J.F. ;Principles of Guidance. NY : McGraw Hill.
6. Lynn, S.J. and Garske, J.P. Contemporary Psychotherapies, and methods. Ohio, Bell and Howell.
7. Rao, S.N. Counselling and Guidance, New Delhi : Tata MC Grw Hill.

PL 332 Experimental Psychology 3-0-0-3

UNIT-I
Experimental Psychology: Nature and History, Experimental Method

[4]

UNIT-II
Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. Perception: Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.

[9]

UNIT-III
Psychophysics: Problems and Methods of Classical Psychophysics.

[8]

UNIT-IV
Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.

[6]

UNIT-V
Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning

[5]

UNIT-VI
Verbal Learning: Methods, Materials, Organizational Processes.

[3]

UNIT-VII [4]
Discrimination Learning: Phenomena, Procedures and paradigms

Text Book

1. Bourne, L.E. Jr., Dominowski, R.L., & Loftus, E.F.Cognitive Processes. New Jersey. Prentice Hall.
2. D' Amato, M.R. Experimental Psychology. New Delhi: Tata McGraw Hill.

Reference Book

3. Flaherty, C.F. et. Al. Learning and Memory. Chicago: Rn McNally Pub.Co.
4. Gordon, W.C. Learning and Memory. California: Brooks / Cole.
5. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's Experimental Psychology.London: Methuen & Co.
6. Mazur. Learning and Behavour, New Delhi: Prentice Hall of India.
7. Snodgrass, J.G., Berger, G.L., & Haydon, M. Human Experimental Psychology, New York: Oxford.
8. Solso, R.L.Cognitive Psychology Allyn& Bacon.

PL 342 Psychopathology-II 3-0-0-3

UNIT-I
Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation. [6]

UNIT-II [10]
Mood Disorders: Unipolar and Bipolar Symptoms and Etiology

UNIT-III [11]
Schizophrenia: Nature , Symptoms , Types and Etiology

UNIT-IV
Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT [12]

Text Book

1. Carson, R.C.; Butcher, J.N., et al.. Abnormal Psychology NewDelhi: Pearson Education.

Reference Book

2. Davison, G.C. & Neale, J.M. Abnormal Psychology New York: Willy
3. Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior New Delhi: Pearson Education Inc.

PL 352 Industrial and Organizational Psychology-II 3-0-0-3

UNIT-I
Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory. [7]

UNIT-II
Job Satisfaction: Concept, determinants and measurement. [5]

[6]

UNIT-III
Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.

UNIT-IV
Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents. [6]

UNIT-V [6]
Human engineering: Man-machine system. Designs, displays, controls and action.

UNIT-VI
Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions. [9]

Text Book

1. Blumm M.L. and Nylor, J.C. Industrial Psychology. N.Y. : Harper & Row.
2. Davis. K. Human Behaviour at Work. New Delhi : Tata McGraw Hill.

Reference Book

3. Dunnet, M.D. (Ed.).Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.
4. Ganguli, H.C. The Industrial worker Psychological Studies. Delhi :Siddharth.
5. Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.
6. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour, New Delhi : Prentice Hall
7. Saal, F.E. and Knight P.A. Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
8. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
9. Mohanty G. Industrial and Organizational psychology New Delhi: Oxford and IBH.

PL 362 Psychological Testing-II **3-0-0-3**

UNIT-I [9]
Personality Tests: Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors.

UNIT-II [9]
Projective- Rorschach and TAT.

UNIT-III [8]
Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.

UNIT-IV [6]
Measurement of aptitude and Interest

UNIT-V [7]
Measurement of Creativity- Torrance Test
Anxiety and Depression,

Text Book:

1. Aiken, L.R. Psychological Testing and Assessment. Boston : Allyn and Bacon.
2. Anastasi, A. and Urbina, S Psychological Testing. upper saddle River (NJ) : Prentice Hall.

Reference Book

3. Freeman, F.S. Theory and practice of psychological testing. New Delhi :Oxford and IBH.
4. Friedenberg, L.Psychological Testing : Design, Analysis and use Boston : Allyn and Bacon.
5. Guilford, J.P. Psychometric Methods ,New York : McGraw Hill.
6. Wechsler, D.The measurement and appraisal of adult intelligence. Baltimore : Williams and wilkins.
7. Weiner, I.B. Clinical methods in psychology. New York : Wiley inter science publication.

PL 372 Psychology Lab.-VI **0-0-4-2**

Assignments to be based on the course PL332 (Experimental Psychology), PL342(Psychopathology) and PL362 (Psychological Testing-II).

BT 271 Food Technology **2-0-0-2**

1. **Food & Fermentation Technology**: Origin, scope and development of fermented food products. **[2]**

2. **Development of novel food and food ingredients**: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. **[5]**

3. **General principles:** Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. **[9]**

4. **Packaging of foods:** Packaging Materials, Controlled atmosphere packaging. **[4]**

5. **Food plant Sanitation:** Disposal and treatment of food industry waste, food laws and current concepts in food safety **[6]**

Suggested Readings

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT 261 Food Technology Laboratory 0-0-2-1

Assignments are based on the course BT 251 Food Technology containing exercises on manufacturing and preservations of food products

BT 242 Plant and Animal Biotechnology 2-0-0-2

1. Introduction to animal tissue culture, Disaggregation techniques, Sterilization, Normal and transformed cell lines, primary culture, secondary culture, Media formulation, Growth characteristics, preservation of cell lines, Embryo culture and IVF **[12]**

2. Plant Tissue culture Introduction: Terms and Definition, Historical aspects and scope, Classical vs modern approach, Totipotency and cell theory; Growth and Differentiation; Culture media and its constituents; Sterilization **[9]**

3. Micropropagation Technique, Genetic Variability, Protoplast fusion Technique and somatic hybridization **[5]**

Suggested Readings

Text Book

1. Freshney Y; Culture of Animal Cells; John Wiley and Sons Publication, New York
2. Spler R.E. & Grifith J.B.; Aniaml Cell Biotechnology
3. Bhojwani S.S.; Plant Tissue Culture: Applications and Limitations; Elsevier, Amsterdam.

References

4. Razdan M.K; An Introduction to Plant Tissue Culture; Rastogi Publication, Meerut.
5. Chawla H.S; Introduction to Plant Biotechnology; Oxford and IBH Publishers, New Delhi.

BT 252 Tissue Culture Laboratory 0-0-2-1

Assignments are based on the course BT 242 Plant and Animal Biotechnology containing exercises on media preparation and different culturing methods of plant and animal cells.

BT 391 Medical Biotechnology 2-0-0-2

1. **Gene therapy** – background, types of gene therapy, vectors in gene therapy, epigenetic inheritance, problems & ethics. **[3]**

2. **Gene Delivery methods** – Viral delivery, Non-viral delivery, Antibody engineering. **[3]**

3. **Gene therapy Models** – Liver diseases, Lung diseases, Hematopoietic diseases, Circulated gene products, Cancer & Auto-immune diseases. **[4]**

4. **Vaccines** – Vaccine vectors, nucleic acid vaccines, immuno-enhancing technology. **[3]**

5. **Synthetic therapy** – synthetic DNAs, therapeutic Ribozymes, synthetic drugs. **[4]**

6. **Tissue Engineering** – Skin, Liver, Pancreas. **[3]**

7. **Xenotransplantation** – terminology, technology behind it, organ donors, social & ethical issues. **[3]**

8. **Drug delivery** – conventional & new approaches to drug delivery. **[3]**

Suggested Readings

Text Book

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W. Cancer Biology, Oxford University Press, Oxford, 1995.
3. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
4. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications,Oxford, 1988.

References

5. Leon Lachman et al Theory and Practice of Industrial Pharmacy, 3 Edition, Lea and Febiger, 1986
6. Remington's Pharmaceutical Science, Mark Publishing and Co.
7. A.R Leach, Molecular Modeling Principles and Applications, Longman, 1996
8. J.M. Haile, Molecular Dynamics Simulation Elementary methods, John Wiley and Sons ,1997

BC 312 Enzyme and Industrial Biochemistry **3-0-0-3**

1. **Extraction & Purification of Enzymes:** Different sources of enzymes, Extraction of soluble enzymes and membrane bound enzymes. Preliminary purification of enzymes by various fractionation methods – advanced purification methods **[5]**

2. **Enzyme Kinetics:** Factors affecting the enzyme rates. Kinetics of single substrate enzyme catalyzed reactions. Transformation of MM plots into Lineweaver Burk plot and Eddle Hofstee plots. Enzyme inhibitors, Introduction to irreversible and reversible. Allosteric enzymes, feedback inhibition and its significance in metabolic regulation. (Sequential and concerted). **[12]**

3. **Applications of Enzymes:** Importance of enzyme immobilization, Uses of enzymes in food and beverages, textile industries, leather industries and detergents. **[4]**

4. **Introduction to fermentation technology**: Isolation and screening of industrially important microbes, Inoculum preparation, strain improvement for better yield. Primary and secondary detection and assay of fermentation products. Microbial products: production of microbial enzymes-Amylase, cellulose, Pectinase and protease, Industrial production of alcohol, alcoholic beverages – Wine and **[10]**

Beer.

5. **Microbes and Environment**: Microbes in mineral recovery- Bioleaching and Biosorption, microbial recovery of petroleum. Microbial degradation of xenobiotics. Sewage biodegradation. **[8]**

Suggested Readings

Text Book

1. Trevor Palmer; Enzymes – Biochemistry, Biotechnology, Clinical chemistry, 2004 East – West Press Edition.
2. Patel A.H.; Industrial microbiology, 2nd edition, 2012, Macmillan India Limited
3. Prescott, Harley and Klein Microbiology, 2nd edition, 1993, W.C. Brown Publishing Co
4. Engal Paul; Enzyme 1977, John Willey and Sons Inc.
5. Pelczar. and Chan Microbiology, , McGraw – Hill Inc. NY
6. Ananthanarayanan. R. and Jayaram Panicker; Textbook of microbiology, C.K. Orient

References

7. Price Nicholas C. and Stevens Lewis; Fundamentals of Enzymology 2003 Oxford University Press.
8. Dixon; Enzymes, Web. Acad. Press.
9. Stanburry. P.Whitalcer and Hall, S.J. Principles of Fermentation technology, 1995.

BC 322 Enzyme and Industrial Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 312 Enzyme and Industrial Biochemistry containing exercises on enzymes and their application in industries.

SYLLABUS FOR NEW PAPERS OF BIOCHEMISTRY

BC 231 Metabolism 2-0-0-2

1. **Bioenergetics:** Role of high energy compounds as energy currency of the cell; free energy of hydrolysis of ATP and other organophosphates. Biological oxidation, redox potential, phosphate potential. **[4]**

2. **The basic metabolic pathways:** anabolic, catabolic and amphibolic pathways. Interrelation between carbohydrates, fat and protein metabolism. **[3]**

3. **Carbohydrate metabolism:** oxidation of pyruvate, metabolism of glycogen, pentose phosphate pathway, C3, C4 and CAM pathway, oxidative phosphorylation, Regulation of committed step in each pathway. **[5]**

4. **Oxidation of fatty acids:** Carnitine cycle; beta oxidation. Alpha oxidation and omega oxidation. Biosynthesis of saturated fatty acids, **[5]**

Biosynthesis of unsaturated fatty acids.

5. **Metabolism of amino acid:** Oxidative deamination, transamination, catabolism of carbon skeleton of amino acids. **[5]**

6. **Metabolism of purines:** de novo synthesis, salvage pathways; catabolism. Metabolism of pyramidines: - de novo synthesis, salvage pathways; catabolism. **[4]**

Suggested Readings

Text Book

1. Lehninger, L.S., et al., - Principles of Biochemistry. 4nd edition. CBS Publishers,
2. Murray, K. Robert, et al., - Harper's Biochemistry. 21st edition, 1998.

References

3. Voet and Voet - Biochemistry. 2nd edition. John Wiley and Sons, 1995.
4. Mathews, Freeland and Miesfeld - Biochemistry – a short course.Wiley & sons. 1996.

BC 212 Plant Biochemistry 2-0-0-2

1. **Photosynthesis:** Ultra structure and organization of chloroplast membranes, Biochemistry of RuBP carboxylase/oxygenase, Hatch and slack pathway, productivity of C4 plants, photorespiration and compensation point. **[7]**

2. **Nitrogen fixation**: nitrogenase and mechanism action of nitrogenase. Enzymes of nitrate metabolism, regulation of their synthesis and activity. **[4]**

3. **Plant growth regulators:** Plant growth regulators and their metabolic functions, synthetic growth hormones. **[7]**

4. **Secondary metabolites:** A brief account of secondary metabolites Importance of secondary metabolites: Protection of the producer plant from predators and insects. General biosynthetic pathways and functions of the secondary metabolites **[8]**

Suggested Readings

Text Book

1. H.D. Kumar and H.N. Singh; Plant Metabolism (1980) Publisher: Macmillan
2. Ramawat KG; Biotechnology: Secondary Metabolites (2000) Publisher: Science Publishers,U.S.
3. Dey PM and Harborne JB(Editors); Plant Biochemistry (1997) Publisher: Academic Press

References

4. Dennis, Turpin, Lefebvre and Layzell (Editors) Plant Metabolism (1997) Publisher: Longman.
5. Hans-Walter Heldt; Plant Biochemistry (3ed 2004) Publisher: Academic

BC 311 Nutritional and Clinical Biochemistry 2-1-0-3

Nutritional Biochemistry

1. **Basic Concepts Of Nutritional Biochemistry:** Introduction and definition of food and nutrition, functions of food, factors altering nutritional requirements, Macronutrients and Micronutrients and their functions. **[6]**

2. **Nutritive And Calorific Value Of Foods:** Basic concepts of energy expenditure, units of energy, measurement of energy expenditure by calorimetry, determination of amount of protein metabolized and calculation of total heat production; basal metabolic rate (BMR), energy requirements under physical activities, calculation of energy expenditure **[7]**

Clinical Biochemistry

3. **Basic Concepts Of Clinical Biochemistry**
   (a) Definition and scope of clinical biochemistry in diagnosis; setting up and solving problems related to operation of clinical biochemistry; internal and external quality assurance producers **[7]**
   (b) Collection and preservation of biological fluids; physical and chemical analysis of urine and CSF; physiological factors affecting the composition of body fluids.

4. **Diagnostic Enzymology**
   Principles of diagnostic enzymology; definition of functional and non-functional plasma enzymes, enzyme and enzymes pattern in health and diseases with special mention of plasma lipase, amylase, cholinesterase, alkaline and acid phosphates, SGOT, SGPT, LDH & CPK. Disorders of carbohydrate and lipid metabolism **[6]**

Suggested Readings

Text Book

1. Chatterjee M.N and Sinde R; Text book of Medical Biochemistry,
2. Thomas M. Devlin; Text book of Biochemistry with clinical correlation, , 3rd edition, A. John Wiley-Liss Inc. Publication.
3. Harold Varley; Practical Clinical Biochemistry, 4th edition, CBS Publication and Distributors, New Delhi.
4. Harrison T.R., Braunwald F, Isselbacher Principles of Internal Medicine, 14th edition, MC-graw hill, Newyork. Volume I and II.

References

5. Burtis C.A., Ashwood E.R. (eds) Tietz Fundamentals of Clinical Chemistry- (5th edition) Saunders WB Co.
6. Davidson S. and Passmore J.R. Human nutrition and dietetics.
7. Garraw IS, James WPT; Human nutrition and dietetics, , 10th edition
8. Wong DWS; Mechanism and theory in food chemistry, CBS New Delhi, 1996

BC 321 Nutritional and Clinical Biochemistry Laboratory 0-0-2-1

Assignments are based on the course BC 311 Nutritional and Clinical Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules and clinically important enzymes.

SYLLABUS FOR NEW PAPERS OF MICROBIOLOGY

MB 211 Microbial Physiology and Genetics 2-0-0-2

1. **Nutritional classification and metabolite transport:** carbon, energy and electron sources. Diffusion and active transport. **[3]**

2. **Chemolitho- and photo-trophic metabolism:** Physiological groups of aerobic and anaerobic chemolithotrophs. physiology of bacterial photosynthesis: light reactions, cyclic and non-cyclic photophosphorylation. **[5]**

3. **Microbial Energetics:** Concept of aerobic respiration, anaerobic respiration and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, Calvin and TCA cycle. bacterial electron transport, oxidation-reduction potential and energetic of electron transport. Oxidative phosphorylation. **[8]**

4. **Microbial Gene Transfer:** Transformation, Transduction, Conjugation, Plasmids, Transposons Life cycle and uses of following phages in microbial genetics- Lytic and Lysogenic phages. **[7]**

5. **Mutations**: Basic concepts of mutation, Molecular nature of mutations. [**3**]

Suggested Readings

Text Books

1. Moat AG and Foster JW. (2002). Microbial Physiology. John Wiley and Sons.

2. Madigan MT, and Martinko JM. (2006). Brock Biology of Micro-organisms. 8th edition. Parker J. Prentice Hall International, Inc.

3. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.

References

4. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

5. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.

MB 221 Microbial Physiology and Genetics Laboratory 0-0-2-1

Assignments are based on the course MB 211 Microbial Physiology and Genetics containing exercises on physiological and genetics aspects of microbes.

MB 212 Food and Industrial Microbiology 2-0-0-2

1. **Foods as a substrate for microorganisms:** Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. **[3]**

2. **Food preservation and Fermented foods:** Principles, physical methods of food preservation, chemical methods of food **[7]**

preservation, fermented dairy products: yogurt, kumiss, kefir, and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh and probiotics.

3. **Food borne diseases and control:** Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum* and mycotoxins; Indices of food sanitary quality and sanitizers. **[5]**

4. **Introduction to industrial microbiology:** Brief history and developments in industrial microbiology, Batch, fed batch and continuous fermentations, strain development, preservation and maintenance of industrial strains. Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract. **[6]**

5. **Down-stream Processing and industrial application:** Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying. Citric acid, ethanol, and enzymes **[5]**

Suggested Readings

Text Books

1. Adams MR and Moss MO. (1995). Food Microbiology. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.

2. Banwart JM. (1987). Basic Food Microbiology. 1st edition. CBS Publishers and Distributors, Delhi, India.

3. Davidson PM and Brannen AL. (1993). Antimicrobials in Foods. Marcel Dekker, New York.

4. Dillion VM and Board RG. (1996). Natural Antimicrobial Systems and Food Preservation. CAB International, Wallingford, Oxon.

References

5. Frazier WC and Westhoff DC. (1992). Food Microbiology. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.

6. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

7. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

MB 222 Food and Industrial Microbiology 0-0-2-1

Assignments are based on the course MB 212 Food and Industrial Microbiology containing exercises on the role of microbes in foods and industries.

MB 351 Medical Microbiology 2-0-0-2

1. **Normal microflora and Host-pathogen interaction:** Skin, throat, gastrointestinal tract, urogenital tract Definitions of invasion, pathogen, parasite, pathogenicity, toxigenicity, virulence, carriers and their types, nosocomial infections, opportunistic infections, septicemia, septic shock, transmission **[6]**

and spread of infection.

2. **Sample collection, transport and diagnosis:** Collection, transport and culturing of clinical samples, principles of different diagnostic tests. **[4]**

3. **Bacterial diseases:** *Bacillus anthracis, Streptococcus pyogenes, Escherichia coli, Salmonella typhi Neisseria gonorrhoeae, Mycobacterium tuberculosis.* **[7]**

4. **Viral, protozoan and fungal diseases:** Polio, Influenza AIDS, Malaria, Different types of mycoses. **[6]**

5. **Antimicrobial agents and drug resistance** Mechanism of action of important chemotherapeutic agents. Principles of drug resistance in bacteria. **[3]**

Suggested Readings

Text Book

1. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.

References

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.

4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton-Centuary-Crofts publication.

5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MB 361 Medical Microbiology Laboratory 0-0-2-1

Assignments are based on the course MB 351 Medical Microbiology containing exercises on the prevention and diagnosis of pathogenic microbes.

MB 312 Microbial Ecology 2-0-0-2

1. **Microorganisms & their natural habitats:** Terrestrial Environment, Aquatic Environment: Atmosphere: Aeromicroflora, Animal Environment, Extreme Habitats. **[6]**

2. **Biological Interactions:** Microbe–Microbe Interaction, Microbe–Plant Interactions, Microbe–Animal Interactions. **[6]**

3. **Biogeochemical cycles:** Carbon cycle, Nitrogen cycle, Phosphorous cycle, Iron cycle and Sulphur Cycle. **[6]**

4. **Solid/liquid Waste Management:** Sources and types of solid waste, methods of disposal of solid waste, primary, secondary and tertiary sewage treatment. **[5]**

5. **Bioleaching/Biodeterioration:** Microbial deterioration of metals (corrosion), textile and paper. **[3]**

Suggested Readings

Text Book

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/ Benjamin Cummings.
2. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press.

References

3. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA.
4. Atlas RM. (1989). Microbiology: Fundamentals and Applications. 2nd Edition, MacMillan Publishing Company, New York.

MB 322 Microbial Ecology Laboratory 0-0-2-1

Assignments are based on the course MB 312 Microbial Ecology containing exercises on the relationship of microbes with one another and with their environment.

NEW SYLLABUS FOR ENVIRONMENTAL STUDIES

EV 111 Environmental Science 1-0-0-1

1. Introduction to Environment and Environmental Studies, its scope and importance **[2]**
2. Ecology and Ecosystems: Ecology- Objectives and Classification Components of ecosystem **[2]**
3. Natural Resources: Renewable and Nonrenewable resources. **[2]**
4. Human Population and Environment: Population Growth, World and Indian scenario. **[2]**
5. Environmental pollution: Types of Environmental Pollution and cause, prevention of pollution. **[2]**
6. Global Environmental Issues: Climate Change, Global Warming and Green House Effect. **[3]**
   Visit to a local area to document environmental assets

Suggested Readings:

Text Book

1. Bharucha, E;. Environmental Studies; University Press, New Delhi
2. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
3. Odum, EP; Fundamentals of Ecology, 5 ed., Cengage Learning.
4. Anderson, SH, Beiswenger RE, Purdom; Environmental Sciences, Paperback.

References

5. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
6. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd.,

COURSE DESCRIPTION
B.Sc.CBZ/B.Sc(H)-Biotech/Chemistry

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome) [6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]
Porifera: Canal system; Endoskeleton, Reproduction. [3]
Coelenterata: Nematocysts, polymorphism. [3]
Ctenophora: Affinities. [1]
Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]
Annelida: Excretion in annelids. Type study – Earthworm. [6]
Mollusca: Respiration. [1]
Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]
Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]
Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes-mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing

exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton and Digestive system and Brain. [11]

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals.

Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:
Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated

dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster [6]

management – Floods, Earthquakes, Cyclones and Landslides.

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: *Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy.* [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.
3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson

and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.
5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY
6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, Kidney and Bone. [4]

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 **Mathematics and Statistics for Biology** **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

Mody University of Science & Technology

B.Sc. (Hons) Chemistry

Session 2019-2020

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (Hons.) Chemistry
Three Years Programme: Curriculum Structure
2018-2019 and onwards

FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Programme Core**									
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	3	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 111	Calculus	3	-	-	3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3	-	-	3	3	25	25	50
	PH 111	Mechanics, Properties of Matter and Relativity	3	-	-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	BO 111	Botany-I	3	-	-	3	3	25	25	50
	BO 121	Botany Laboratory-I	-	-	2	1	3	25	25	50
	BT 151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	25	25	50
	BC 111	General Biochemistry	3	-	-	3	3	25	25	50
	BC 121	General Biochemistry Lab	-	-	2	1	3	25	25	50
	ZO 111	Animal Diversity-I	3	-	-	3	3	25	25	50
	ZO 121	Animal Diversity Lab-I	-	-	2	1	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
		Total Credits Main	**20.5 with Math Group**				**24.5** with Bio Group			
	GE 101	Proficiency (Non-Credit) #	-	-	-	1	-	-		

FIRST YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Programme Core**									
	CH 182	Physical and Inorganic Chemistry-II	2			2	3	25	25	50
	CH 192	Organic Chemistry-II	2			2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II			3	1.5	4	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	BO 142	Gymnosperms and Taxonomy of Angiosperms	3	-	-	3	3	25	25	50
	BO 122	Botany-Lab II	-	-	2	1	3	25	25	50
	ZO 132	Animal Diversity-II	3	-	-	3	3	25	25	50
	ZO 142	Animal diversity lab-II	-	-	2	1	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Total Credits Main	**22.5** with Math Group				**17.5** with Bio Group			
	GE 102	Proficiency (Non-Credit) #	-	-	-	1	-	-		

SECOND YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Programme Core**									
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2			2	3	25	25	50
	CH 223	Organic Chemistry-III	2			2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-		3	1.5	4	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 211	Linear Algebra	3	-	-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	3	25	25	50
	BO 231	Plant Physiology and Metabolism	3	-	-	3	3	25	25	50
	BO 221	Botany Laboratory-III	-	-	2	1	3	25	25	50
	CH 283	Basic Mathematics	2	-	-	2	3	25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
		Foreign Language-I	3	-	-	3	3	25	25	50
		Total Credits Main	**25.5** with Math Group				**20.5** with Bio Group			
	GE 201	Proficiency (Non-Credit) #	-	-	-	1	-	-		

SECOND YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Programme Core**									
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4	25	25	50
	PROGRAMME ELECTIVES(Compulsory)									
	Students Passed XII with Mathematics Group									
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS222	Real Analysis	3	-	-	3	3	25	25	50
	PH 212	Mathematical Physics and Special theory of Relativity	3	1	-	4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	3	25	25	50
	Students Passed XII with Biology Group									
	ZO 232	Animal Developmental Biology	3	-	-	3		25	25	50
	ZO 242	Animal Developmental Biology Laboratory	-	-	2	1		25	25	50
	BT 212	Molecular Biology	3	1	-	4		25	25	50
	ABILITY ENHANCEMENT COMPULSORY COURSE									
		Foreign Language-II	3	-	-	3	3	25	25	50
		Total Credits Main	**23.5** with Math Group				**18.5** with Bio Group			
	GE 202	Proficiency (Non-Credit) #	-	-	-	1	-	-		

THIRD YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Programme Core**									
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 313	Instrumental Methods of Analysis	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	3	25	25	50
	CH 333	Laboratory Course for Instrumental Methods of Analysis	-	-	3	1.5	3	25	25	50
	CH 343	Project[$]	-	-	-	5	-	-	-	100
	PROGRAMME ELECTIVES(Select any one)									
	CH 323	Chemistry of Polymers and Petrochemicals	2	-	-	2	3	25	25	50
	CH 325	Reagents & Reactions	2	-	-	2	3	25	25	50
		Total Credits Main	**18.0** with Math Group & Bio Group							
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-	-		

THIRD YEAR

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Programme Core**									
	CH 392	Physical Chemistry-IV	2	-	-	2	3	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry-VI	2	-	-	2	3	25	25	50
	CH 334	Green and Environmental Chemistry	2	-	-	2	3	25	25	50
	CH 344	Organic Reaction Dynamics, Reactive Intermediates and Photochemistry	2	-	-	2	3	25	25	50
	CH 354	Pharmaceutical Chemistry	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	3	25	25	50
	CH 364	Photochemistry and Green Chemistry Laboratory	-	-	3	1.5	3	25	25	50
	CH 374	Pharmaceutical Chemistry Laboratory	-	-	3	1.5	3	25	25	50
	PROGRAMME ELECTIVES(Select any one)									
	CH 316	Advanced Materials	2	-	-	2	3	25	25	50
	CH 318	Organometallic Chemistry	2	-	-	2	3	25	25	50
		Total Credits Main	**18.5** with Math Group & Bio Group							
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-	-		

Total Course Credits: 117..5/128.5

Sr No	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Chemistry with **Botany and Zoology**	24.5	17.5	20.5	18.5	18	18.5	**117.5**
Chemistry with Physics and Maths	22.5	22.5	25.5	23.5			**128.5**

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.

Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

COURSE DESCRIPTION
B. Sc. Honors Chemistry

COURSE DESCRIPTION
B. Sc. Honors Chemistry
Compulsory Courses

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 J$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [7] [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int E.dr$. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their [10]

applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem.

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]
Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]
Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory

4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics,

Narosa Pub. House, New Delhi, 2002

2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998

3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998

4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.

2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992

3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of [10]

molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [6]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [8]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments.

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]
2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]
3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]
4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma [10]

transitions (no derivation).

PH 362 Statistical Mechanics 4-0-0-4

5. **Accelerators and Detectors:** Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, [5]

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation [5]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009

2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996

3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991

2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers,

Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix [13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

Group: Algebraic structure, Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

MS 1[illegible] Abstract Algebra **3-0-0-3**

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution [9]

of second order linear differential equations with variable coefficients(Complementary Functions only)

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970

2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, “Operating Systems”, New Delhi
2. Ritchie, “Operating System”, BPB Publication , New Delhi
3. Dhamdhere D. M. “System Programming and Operating System”, TMH New Delhi
4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.
5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, “Information Systems for Modern Management”, PHI, New Delhi

2. Jawadkar, “Management Information System”, TMH, New Delhi

Reference Books:

1. Sadagopan, “Management Information System”PHI, New Delhi

2. Parker, Case, Thomas, “Management Information System: Strategies and Action”, TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, ”System Analysis and Design”, TMH, New Delhi
2. Hawayszkiewyez Igor, “Introduction To System Analysis and Design” PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 **0-0-4-2**

Computational Numerical Analysis Laboratory

Assignments are based on the Course Numerical Analysis.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 Physical and Inorganic Chemistry-I 2-0-0-2

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 **Organic Chemistry-I** **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction.

Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid **[4]**

and liquid. Classification, structure of nematic and cholestric phases.

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.

4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.

3. Sarin; Genetics; Tata McGraw Hill, New Delhi

4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.

3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.

4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.

5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use [6]

and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication,

Meerut

2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.

2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base

catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic [5]

fertilization, significance of fertilization.

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, [5]

Antigenic determinants of antibody molecules.

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II 2-0-0-2

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009,

S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II 2-0-0-2

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV 2-0-0-2

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis

on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand

& Co. Ltd.

CH 262 **Laboratory Course in Chemistry-IV** **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

BT 151 **Cell Biology** **3-1-0-4**

Diversity of Cell: Size and shape, cell theory, structure of prokaryotic and eukaryotic cells [2]

Cell membrane: Molecular structure and models of cell membrane, Membrane transport – Passive (diffusion, osmosis and facilitated) and active transport, Cell junctions. [8]

Cell organelles 1: Structure, function and biogenesis of Mitochondria, Plastid, Endoplasmic reticulum, Golgi complex, Lysosome. [8]

Cell organelles 2: Ribosome, Centrioles, Cilia, Flagella and

Cytoskeletal system. Introduction to extra cellular matrix [7]

Nucleus: Interphase nucleus, Nuclear envelope, nucleoplasm, Nucleolus and Chromatin (nucleosome model, Structure of eukaryotic chromosome, Giant chromosome)

[6]

Cell Division: Cell cycle, mitosis and meiosis, structure and function of spindle apparatus, synapses and synaptonemal complex and crossing over [8]

Suggested Books:

1. De Robertis and De Robertis: Cell and Molecular Biology B.I. Publications, US.
2. Gardner, Principle of Genetics; John Willey and Sons, US.
3. Becker *et al*; The World of Cell; Pearson Publications, Singapore.
4. Strickberger; Genetics; MacMillan Publications, US.
5. Sarin; Genetics; Tata McGraw Hill Publications, New Delhi.
6. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut.

ZO 111 **Animal Diversity-I** **3-0-0-3**

Taxonomy: General principles of taxonomy, Five-kingdom concept. Protozoa, Metazoa and Levels of organization, Origin of metazoa, Coelom, metamerism and symmetry. [4]

Principles of Classification: Salient features and classification upto class level in non-chordates. [5]

Protozoa – Locomotion, nutrition, reproduction, Life cycle of parasite (plasmodium). [4]

Porifera: Canal system; Endoskeleton, Reproduction. [3]

Coelenterata: Nematocysts, polymorphism. [3]

Ctenophora: Affinities. [1]

Platyhelminthes and Aschelminthes: Reproduction and larval forms (Fasciola and Ascaris). [4]

Annelida: Excretion in annelids. Type study – Earthworm. [6]

Mollusca: Respiration. [1]

Arthropoda: Larval forms of crustacea, Mouthparts of insects, Social life in insects. [3]

Ecinodermata: Water vascular system, larval forms and their significance; Origin and phylogeny of echinoderms. [4]

Lower chordates: Taxonomic position and affinities. [1]

Suggested Books:

1. Kotpal R.L; Modern Textbook of Zoology - Invertebrate; Rastogi Publication, Meerut
2. Bhamrah H.S. and Juneja A. K; Textbook of Invertebrates; Anmol Publications Pvt. Ltd., New Delhi
3. Kapoor V.C; Theory and Practice of Animal Taxonomy; Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
4. Hickman C.P., Roberts, L.S. and Larson A; Integrated Principles of Zoology; WCB Mc Graw-Hill, New Delhi
5. Grove A.J; and Newell G. E; Animal Biology. University Book Stall, New Delhi

CH 181 Physical and Inorganic Chemistry-I 2-0-0-2

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
4. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

7. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
8. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
11. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
12. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in

hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

2. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
5. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
6. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 **Laboratory Course in Chemistry-I** **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

BC 111 **General Biochemistry** **3-0-0-3**

Basic Concepts: Law of mass action, pH and buffers, calculation of pH, biological importance of pH and buffers, law of thermodynamics, concept of free energy **[5]**

Carbohydrates: Structure, classification and function, properties of monosaccharide and its derivatives, structural and storage carbohydrates **[5]**

Proteins: Classification of amino acids, different reactions of –NH2 and –COOH group, Structure and classification of proteins, Bohr's effect, hemoglobin, myoglobin, antibodies **[5]**

Lipids: Basic structure of lipids, classification, importance of triacyglycerols, glycerolipids, sphingolipids, steroids, lipid bilayers **[6]**

Nucleic Acids: Nucleic acid as a genetic material, composition of DNA and RNA, linkage between purines and pyrimidines, types of DNA **6]**

Vitamin: Role of vitamin in the growth and differentiation of body, chemistry of fat and water-soluble vitamins, vitamins as coenzymes. Hormones as signal molecules **[6]**

Cellular Metabolism: Glycolysis, Gluconeogenesis, Krebs cycle, Electron transport chain, β-oxidation, Overview of amino acid metabolism [6]

Suggested Books:

1.Jain J.L.; Biochemistry; S. Chand Publication, New Delhi.

2. Cohn and Stump; Outline of Biochemistry; Cambridge,UK.

3. Nelson and Cox; Principles of Biochemistry; Panima, New Delhi.

4.Mathew *et al.;*Biochemistry; Pearson, New York.

5.Sadasivam and Manickam; Biochemical Methods; New Age International, New Delhi.

BT 161 **Cell Biology Laboratory** **0-0-2-1**

Assignments are based on the course BT 151 Cell Biology meiosis, mitosis etc.

ZO 121 **Animal Diversity Laboratory-I** **0-0-2-1**

Assignments are based on the course ZO 111 Animal Diversity-I containing exercises on taxonomy and organization of non-chordates

BC 121 **Biochemistry Laboratory** **0-0-2-1**

Assignments are based on the course BT 121 Biochemistry containing exercises on qualitative and quantitative analysis of biomolecules

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

ZO 132 **Animal Diversity-II** **3-0-0-3**

Chordata: General organization, classification upto class level. [9]

Comparative Anatomy of Chordates 1: Integument, Endoskeleton [11]

and Digestive system and Brain.

Comparative Anatomy of Chordates 2: Heart, Aortic arches and Venous system, Respiratory system, Urogenital system. [10]

Fishes: Accessory respiratory organs. [2]

Amphibia: Parental Care in Amphibia. [1]

Reptilia: Poison apparatus, snake venom, antivenin, biting mechanism and first aid. [2]

Aves: Flight adaptations. [2]

Mammals: Origin of mammals. [2]

Suggested Books:

1. Kotpal R. L; Modern Textbook of Zoology - Vertebrate; Rastogi Publication, Meerut.
2. Bhamrah H. S. and Juneja A. K; Textbook of Vertebrates; Anmol Publications Pvt. Ltd., New Delhi.
3. Young J.W; The Life of Vertebrates; Oxford University Press, New York.
4. Pough F. H., Jains C. M. and Heiser J. B; Vertebrate Life; Pearson Education Pvt. Ltd., Singapore.
5. Colbert E. H; Evolution of Vertebrates; Wiley Eastern Ltd, New Delhi.
6. Rastogi V. B; Organic evolution; Kedar Nath Ram Nath Publication, Meerut.

CH 182 Physical and Inorganic Chemistry-II **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter,

Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
4. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

7. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
8. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
9. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
10. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
11. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
12. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II 2-0-0-2

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
4. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

4. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
5. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
6. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II 3-0-0-1.5

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism.

[10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm.

[5]

Mutations: Chromosomal aberrations and meiotic consequences.

[4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics.

[5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

CA 141 **Application Software Laboratory** **0-0-4-2**

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology containing exercises on computer applications

ZO142 **Animal Diversity-II Laboratory** **0-0-2-1**

Assignments are based on the course ZO 132 Animal Diversity-II containing exercises on taxonomy and organization of chordates.

BT 162 **Genetics Laboratory** **0-0-2-1**

Assignments are based on the course BT 152 Genetics, Basic Mendelian concepts etc.

EV 101 **Environmental Studies** **3-0-0-3**

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BC 211 **Bio-Instrumentation** **3-1-0-4**

Principle of pH meter. [1]

Sterilization Techniques: Heat sterilization (Autoclave and Hot Air Oven), Filter sterilization, Incubator and Laminar Air Flow. [6]

Centrifugation: Principles of centrifugation, Design and care of rotor, Analytical and Preparative centrifugation, Safety aspects and applications. [8]

Spectroscopy: Principles of spectrophotometry, Ultra-violet and Visible Spectroscopy, Atomic spectroscopy. [8]

Electrophoresis: Principles of Gel electrophoresis, Agarose and SDS gel electrophoresis, IEF, 2-D PAGE. [8]

Chromatography: Principles of chromatography, Paper, Thin layer, Column chromatography, Permeation, Ion exchange and Affinity chromatography. [8]

Suggested Readings:

Text Book:

1. Wilson and Walker-Principles of Molecular Biology and Biochemistry, Cambridge University Press, 3rd Edition, New Delhi.
2. Upadhayay, Upadhayay and Nath-Biophysical Chemistry, Himalayan Publishers,4th Edition, New Delhi.

3. David T Plummer- An Introduction to Practical Biochemistry, Tata McGraw Hill, 2nd Edition, New Delhi.

Reference Book:

4. Lehninger: Principles of Biochemistry 4th edition -David L. Nelson and M.M. Cox (2005) Maxmillan/ Worth publishers/ W. H. Freeman & Company.

5. Fundamentals of Biochemistry 3rd edition- Donald Voet and Judith G Voet (2004), John Wiley & Sons, NY

6. J G Webster- Bioinstrumentation, John Wiley & Sons Inc, New York

ZO 212 **Animal Physiology** **3-0-0-3**

Physiology of Digestion: Digestion of food material, control of digestive juice secretion, Absorption of digested food material. [4]

Physiology of Respiration: External and internal respiration, control mechanism, transport of gases, respiratory pigments. [4]

Physiology of Circulation: Concept of haematopoesis and haemolysis, blood coagulation, heartbeat and cardiac cycle, mechanism of controlling heartbeat, electrocardiogram, blood pressure. [4]

Physiology of Excretion: Excretory products, Ornithine cycle, structure and function of kidney, mechanism of urine formation. [4]

Physiology of Muscle Contraction: Chemical composition, mechanism of muscle contraction. [4]

Nervous System: Basic concept of CNS, PNS, ANS, Propagation of nerve impulses, Synaptic transmission, Reflex action. [4]

Endocrine Glands: Structure and functions: Pituitary, adrenal, thyroid, parathyroid, pancreas, testis and ovary, Mechanism of hormone action, pheromones. [3]

Reproduction: Structure of male and female reproductive organs, hormonal control, menstrual cycle, implantation parturition and lactation in mammals. [4]

Homeostasis: Basic concept, osmotic conformers, osmoregulation, thermoregulation. [4]

Physiological Disorders: Disorders related to Brain, Blood, Heart, [4]

Kidney and Bone.

Suggested Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot.India.
2. Guyton et al.; Medical Physiology, W.B Sauders Co., Philadelphia Toronto.
3. Berry A.K.; Physiology, Rastogi Publication, Meerut
4. Tatora et al.; Human Physiology, Wiley International, New York.

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials.

Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

3. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
4. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

5. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L.

Gaus. 5rd Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
7. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with **[4]**

epoxides.

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

3. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
4. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 Bio-instrumentation Laboratory **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 Animal Physiology Laboratory **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 Molecular Biology **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in [5]

chromosome.

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre-vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [8]

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.
4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 **Physical Chemistry-II** **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and

specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

3. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
4. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

5. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
6. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
7. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
8. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

3. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
4. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

5. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
6. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
7. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
8. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 **Organic Chemistry-IV** **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction,

Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).

[6]

Suggested Readings:

Text Books:

3. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
4. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

3. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
4. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 313 **Instrumental Methods of Analysis** **2-0-0-2**

Spectroscopic techniques: Mass Spectrometry:Introduction, Ion production (EI and CI techniques), molecular ion peak, base peak, ion analysis, ion abundance, modes of fragmentation, metastable peak, retro-Diels Alder reaction, Mc-Lafferty rearrangement, double charged ion, nitrogen rule, double bond equivalent, mass spectral fragmentation of organic compounds (alkanes, alkenes, arenes, alcohols, aldehydes, ketones, acids and phenols). Basic Principles, instrumentation and applications of Atomic absorption, Photoelectron and Mossbauer spectroscopy. **[11]**

Chromatography: Theory, Behavior of solutes, Column efficiency and band broadening, Resolution,Column process, Reduced variable, Time of analysis, Qualitative & quantitative analysis, Problems.Gas Chromatography:Optimization of experimental condition, Retention time and Retention volume, Detectors: Thermionic, Flame photometric, Helium and Coulson conductivity detectors, Supercritical fluid chromatography, Qualitative and Quantitative analysis, Problems.Liquid Column Chromatography: Introduction, Solvent delivery system, Sample injection, Separation, columns detectors, Optimization of column performance, Problems.High Performance Liquid Chromatography: Adsorption HPLC, Partition HPLC, Ion Exchange HPLC, Exclusion HPLC, Problems**.** Ion Chromatography:Introduction, Technique and Applications **[11]**

Other Separation Methods:-Ultracentrifugation-Principle, sedimentation constant, sedimentation equilibrium, sedimentation velocity, methodology and applications. **[4]**

Suggested Readings:

Text Books:

1. B. K. Sharma, Instrumental methods of chemical analysis, 2008, Goel Publishing House.
2. B. Sivasankar, Instrumental methods of analysis, 2012, Oxford higher education.

Reference Books:

1. Mendham, Denney, Barnes, Thomas and Sivasankar, Vogel's: Textbook of quantitative Chemical Analysis; 2009, Pearson.
2. G. W. Ewing, Instrumental methods of Chemical analysis, 2003, Mc-Graw Hill.

CH 323 Chemistry of Polymers and Petrochemicals 2-0-0-2

Origin, formation & composition of petroleum:

Introduction, Occurrence of Petroleum by Biological method - Composition of Petroleum, Properties of Paraffins, Olefins, Naphthalene, Aromatics and Inorganic impurities (sulphur, nitrogen, chlorine) Exploration of Petroleum by gravity, Magnetic and Seismic Method -Refineries & its capacity in India **[6]**

Evaluation of petroleum properties: Evaluation of Petroleum, U.O.P Characterization factor, Correlation Index - TBP Apparatus and its necessity in Refinery - Testing methods and its importance – ASTM Distillation, Reid vapor pressure, Oxidation stability, Smoke Point, Aniline Point - Carbon residue by Rams bottom method, Copper Corrosion test and Softening point Test - Refinery Products and its uses - Definition of- Heat of Combustion, Specific heat, Latent Heat of fusion, Latent heat of Vaporization, Viscosity index. **[10]**

Polymers: Monomers, classification, polymerization methods: addition and condensation; mechanism and their kinetics, metallocene polymers and other newer techniques of polymerization, copolymerization, fire retarding polymers, electrically conducting polymers, biopolymers, contact lens, dental polymers, artificial heart. Inorganic Polymers: Silicones and Phosphazenes as inorganic polymers. Nature of bonding in triphosphazenes.

Organic Polymers: Condensation polymers- Polyesters, Polyamides, Phenol-formaldehyde resin, Urea-formaldehyde resin, Epoxy resins, Polyurathanes. **[10]**

Suggested Readings:

Text Books:

1. J. G. Speight, The Chemistry and technology of petroleum, 2007, CRC Press.
2. G. S. Mishra, Introductory polymer Chemistry, 2005, New Age International.

Reference Books:

3. D. S. G. Jones, Handbook of petroleum processing, 2006, Springer.
4. J. W. Nicholson, The Chemistry of polymers, 4th Edition, RSC Publications.

CH 325 **Reagents & Reactions** **2-0-0-2**

Reagents: Introduction, Fenton's Reagent, Gilman'sreagent, Wilkinson's catalyst, Lindlar catalyst, Adams' catalyst, Lithium aluminium hydride, Sodium borohydride, Anhydrous aluminium chloride, Dicyclohexylcarbodiimide, N-Bromosuccinimide, Lead tetra acetate, Osmium tetroxide, Perbenzoic acid, Raney nickel, selenium dioxide, 1,3-Dithiane (Umpolung reagent), Liquid ammonia. [10]

Reactions: Introduction, A detailed study of the following reactions: Reimer-Tiemann, Arndt-Eistert, Witting, Friedal craft, Aldol condensation, Cannizzaro, Diel's Alder, Mannich, Reformatsky, Favorskii, Hofmann, Curtius, Schmidt, Michael, Knoevenagel, Perkin , Shapiro reaction, Simmons-Smith reaction, Darzens reaction, McMurry reaction, Baeyer-Villeger, Heckreaction. [12]

Rearrangement: Introduction, nature of migration, migratory aptitude. A detailed study of the following rearrangements: Benzil – Benzillic, Beckmann, Claisen, Fries, Wagner-Meerwein, Pinacol-pinacolone, Demjanov. [04]

Suggested Books:

Text Books:

1. Reactions, rearrangements and reagents, S.N Sanyal, Bharti Bhawan.
2. Name reactions and Reagents in organic synthesis, 2nd Edition, B.P.Mundy , M.G.Ellerd, F.G.Favaloro Jr., WILEY, 2005.

Reference Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Uni. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.

CH 361 **Laboratory Course in Chemistry-V** **3-0-0-1.5**

Experiments based on the contents of CH 371, CH 381 and CH 391.

CH 333 **Laboratory Course for Instrumental Methods of Analysis** **3-0-0-1.5**

Experiments based on the contents of CH 313. .

CH 343 **Project** **3-0-0-1.5**

Problems will be based on the application part of the curriculum. . .

CH 392 **Physical Chemistry-IV** **2-0-0-2**

Colloidal State: Definition, classification of colloids. Solids in liquids (sols): properties-kinetic, optical and electrical; stability of colloids, protective action. Hardy-Schulze law, gold number. Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids. Liquids in liquids (emulsions): types of emulsions, preparation, emulsifier. **[6]**

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples). **[6]**

Physical Properties and Molecular Structure: Optical activity, polarization-(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and **[6]**

ferromagnetism.

Solutions: Dilute Solutions and Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes. **[8]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B.Sc. Part III, 2009, RBD.
2. K. R. Genwa, Physical Chemistry B.Sc. Part III, 2004, RBD.

Reference Books:

1. P.W. Atkins, The elements of Physical Chemistry, 7th Ed. 2003, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 7th Ed. 2009, Vishal Publishing Co.
3. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.

CH 334 **Green and Environmental Chemistry** **2-0-0-2**

Atmospheric Chemistry: Atmosphere, reactions in atmosphere, earth's radiation balance, particles, ion and radicals in the atmosphere, stratospheric chemistry: ozone layer, The role of chemicals in ozone destruction, The green-house effect and Global warming, El-Nino phenomenon. Hydrosphere : Complex formation in natural water and waste-water, micro-organism in aquatic chemical reactions, eutrophication, re-cycle of waste-water in process industry, treatment of sewage and reuse of water in industry and agriculture, nitrogen transformation by bacteria. Lithosphere: The terrestrial environment, soil formations, soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macronutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, classification of waste and disposal. **[15]**

Green Chemistry: Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. microwave and ultrasound assisted synthesis, green solvents- reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen, citral, urethane, adipic acid and styrene. **[11]**

Suggested Readings:

Text Books:

1. Sharma and Kaur, Environmental Chemistry; 2009, Krishna Publications.
2. Manahan, Fundamentals of Environmental Chemistry, 2001, Lewis publishers.

Reference Books:

3. A. K. Dey, Environmental Chemistry, 2003, APH Publishing Corporation.
4. C. Baird, W. H. Freem, Environmental Chemistry, 1998, Wiley Interscience.

CH 344 Organic Reaction Dynamics, Reactive Intermediates and Photochemistry 2-0-0-2

Organic Reaction Dynamics: General methods for the determination of reaction mechanism including energetics, energy profile diagrams, detection of intermediates, reaction kinetics and thermodynamics, substituent, solvent and isotope effects and stereochemical evidences. **[8]**

Reactive Intermediates: Classical and non-classical carbocations, carbanions, free radicals, arenes, carbenes and nitrenes, general methods of generation, structure, stability and reactivity of these reactive intermediates. **[8]**

Photochemistry: Basic principle, electron excitation, modes of dissipation of

energy, jablownski diagram, photochemistry of olefins, dienes, carbonyl compounds, Norrish type-I and Norrish type II cleavage, Paterno-Buchi reaction, photo reduction. Photo-Fries rearrangement, ethers, nitriles, pyridinium ylides, quantum efficiency and quantum yield. **[10]**

Suggested Readings:

Text Books:

1. B. S. Bahal and Arun Bahl, Advanced organic chemistry; 2002, S. Chand and Co.Ltd.

Reference Books:

2. A. C. Francis, Organic chemistry, 2000, Mc-Gra Hill.
3. Jerry March, Advanced organic Chemistry, 2000, Wiley Interscience.
4. Morrison and Boyd, Organic chemistry, 6th Edition, Pearson.
5. J. Singh, Photochemistry and Pericyclic reactions, 2008, New Age International.

CH 354 Pharmaceutical Chemistry 2-0-0-2

Introduction: Concept of drug, Structure activity relationship (SAR), quantitative structure-activity relationship (QSAR); Factors affecting bioactivity – resonance, inductive effect, isosterism, bio-isosterism, spatial considerations; Theories of drug activity – occupancy theory, rate theory, induced fit theory Concept of drug receptors-elementary treatment of drug-receptor interactions; Factors affecting modes of drug administration, absorption, metabolism and elimination; Significance of drug meta-bolism in medicinal chemistry. **[15]**

Antibiotics: Isolation, structure elucidation, synthesis, SAR and mode of action of following antibiotics: Penicillins, amoxicillins, streptomycin, tetracyclines and chloroamphanicol. **[12]**

Chemotherapeutic agents: Structure and applications of cardiovascular agents: cardiotonic, antiarrthymic drugs, antihypertensive agents, diuretics anti histamines, analgesics, antiviral, anti-inflammatory, antipyretic antimalarial, CNS drugs: hypnotics and sedatives, anticonvulsant drugs, CNS stimulants, anti-anxiety and tranquilizers. **[12]**

Suggested readings:

Text Books:

1. Patrick, G. L., An introduction to medicinal chemistry, Oxford press, 4th Ed.

Reference Books:

2. Alfred, Burger, Burger's Medicinal Chemistry; Drug discovery and development, 7th Ed. WileyIntersciencePublications.
3. D. Lednicer and L.A. Mitscher, TheOrganicChemistry ofDrugSynthesis; Vol. Ist, 2008, WileyInterscience.
4. Ashutosh Kar, MedicinalChemistry, 2005, New Age International.

CH 382 Laboratory Course in Chemistry-VI 3-0-0-1.5

Experiments based on the contents of CH 392, CH 314 and CH 324.

CH 364 Photochemistry and Green Chemistry Laboratory 3-0-0-1.5

Experiments based on the contents of CH 344. .

CH 374 Pharmaceutical Chemistry Laboratory 3-0-0-1.5

Experiments based on the contents of CH 354. .

CH 316 Advanced Materials 2-0-0-2

Supramolecules: Basic concept, definition, nature of supramolecular interactions, Host-guest interaction, Cation-binding hosts, Anion-binding hosts and Neutral molecules. Molecular recognition by Crown Ethers, Cyclodextrin, Calixarene. The Art of Building Supermolecules: Fullerenes, Dendrimers, Rotaxanes, Catenanes. [8]

Nanomaterials: Introduction to nanoscience, Properties of nanomaterials, preparation of nanomaterials, graphene, & CNT. Application of nanomaterials: Nano cosmetics, Textiles, Nano sensors, drug delivery, Cancer therapy, Tissue engineering, water purification, Nano computers, DPN, MRI, Nano catalysis, nanomaterials and energy. [8]

Organic Electronic Materials: Applications of Organic Electronics, electronic structure and electrical properties of materials electrically conducting polymers, concepts of polarons and solitons, Theory of charge transport and mobility in organic materials, basic electronic devices: organic solar cells, Organic Electro Chemical Transistors (OECTs), Organic Field Effect Transistors (OFETs). Organic semiconductors, organic light-emitting diodes, flexible organic light emitting diode (OLED). [10]

Suggested Books:

1) Supramolecular Chemistry by J. W. Steed & J. L. Atwood, 2nd Edn John Wiley, 2009
2) J. M. Lehn, Supramolecular Chemistry, VCH, Weinheim, 1995.
3) NANOWORLD-An introduction to nanoscience and technology by C N R Rao

Reference Books:

1) Nanoscience and Nanotechnology by T. Pradeep, McGraw Hill Education.
2) Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.
3) Supramolecular Chemistry – Fundamentals and Applications by Kunitake, T. and Ariga, K. Berlin: Springer-Verlag Heidelberg, 2006. 208 p. ISBN 978-3-540-01298-6.

CH 318 **Organometallic Chemistry** **2-0-0-2**

Organometallic compounds: Introduction, Classification based on Hapticity, polarity of M-C bond, Nomenclature of organometallic compounds, Characteristics of different types of organometallic compounds. **[6]**

Synthesis and bonding of Organometallic compounds: Preparative routes for Metal-carbon bond. Synthesis of organometallic compounds of transition and non-transition elements with σ-donors. Organometallic compounds with organic π-donors, synthesis of compounds with acyclic η^2, η^3 and η^4 and cyclic η^5 and η^6 ligands, sandwich compounds, bent metallocenes and compounds with mixed (cyclic and acyclic) donors. **[10]**

Elementary organometallic Reactions and Catalytic aspects: Insertions, eliminations and abstractions. Oxidative addition/ reductive elimination reactions. Hydrogenation of alkenes, hydroformylition of alkenes. Catalyst development and mechanistic aspects of Zeigler – Natta catalysis, Fischer – Tropsch synthesis, water – gas shift reaction, Monsanto process. **[10]**

Suggested Books:

Text Books:

1. R.B. King, Transition metal organometallic Chemistry, Academic Press, (1995)
2. R.C. Mehrotra and A. Singh, Organo-metallic Chemistry, A Unified Approach, New Age Publisher, (2000)
3. B D Gupta and A J Elias, Basic Organometallic Chemistry: Concepts, Synthesis and Applications By University Press (India) Pvt. Ltd. (2010)

Reference Books:

1. K.F. Purcell and J.C. Kotz, WB Saunders, Inorganic Chemistry, Philadelphia, (1997)
2. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, Oxford Univ. press. (1990)
3. H. Kurosawa and A. Yamamoto, Fundamentals of Molecular catalysis, ed. Elsevier (2003).

Mody University of Science & Technology

B.Sc. (Hons) Food and Nutrition

Session 2019-2020

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	BT151	Cell Biology	3	1	-	4	3	25	25	50
	BT 161	Cell Biology Laboratory	-	-	2	1	4	25	25	50
	BC 121	General Biochemistry Laboratory	-	-	2	1	4	25	25	50
	BC111	General Biochemistry	3	-	-	3	3	25	25	50
	FN 111	Principle of Nutrition	3	-	-	3	3	25	25	50
	FN 121	Nutrition through Life	3	-	-	3	3	25	25	50
	CH 113	Chemistry-I	3	-	-	3	3	25	25	50
	CH 123	Chemistry Lab-I	-	-	2	1	3	25	25	50
		Sub Total	17	1	6	21				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	CA 111	Fundamentals of Computers and Information Technology	3	-	-	3	3	25	25	50
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MB 331	General Microbiology	3	1	-	4	3	25	25	50
	MB 341	General Microbiology Laboratory	-	-	2	1	3	25	25	50
	FN 112	Food Science	3	-	-	3	3	25	25	50
	FN 122	Food Science laboratory	-	-	2	1	3	25	25	50
	CH 114	Chemistry-II	3	-	-	3	3	25	25	50
	CH 124	Chemistry Lab-II	-	-	2	1	3	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Sub Total	15	2	10	22				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2016 – 17 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	ZO 212	Animal Physiology	3	-	-	3	3	25	25	50
	ZO 222	Animal Physiology Laboratory	-	-	2	1	4	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	4	25	25	50
	FN 211	Food Safety	3	-	-	3	3	25	25	50
	FN 221	Family Nutrition	3	-	-	3	3	25	25	50
	BT 271	Food Technology	2	-	-	2	3	25	25	50
	BT 261	Food Technology Lab	-	-	2	1	4	25	25	50
		Foreign Language-I‡	3	-	-	3	3	25	25	50
		Sub Total	17	1	6	21				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN 212	Public Health Nutrition	3	-	-	3	3	25	25	50
	FN 222	Food Chemistry	3	-	-	3	4	25	25	50
	FN 232	Therapeutic Nutrition	3	-	-	3	2	25	25	50
	FN 242	Nutritional Laboratory-I	-	-	4	2	3	25	25	50
	ZO 232	Developmental Biology	3	-	-	3	3	25	25	50
	ZO 242	Developmental Biology Laboratory	-	-	2	1	4	25	25	50
		Foreign Language-II‡	3	-	-	3	2	25	25	50
		Sub Total	15	-	6	18				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Food and Nutrition
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester										
	BC 311	Nutritional and Clinical Biochemistry	2	1	-	3	3	25	25	50
	FN 311	Maternal and Child Nutrition	3	1		4	3	25	25	50
	BT 241	Mathematics and Statistics for Biology	2	1	-	3	3	25	25	50
	BT 324	Bioprocess Engineering	3	-	-	3	3	25	25	50
	BT 344	Bioprocessing Engineering Lab	-	-	2	1	4	25	25	50
	FN 321	Nutrigenomics & Personalised Nutrition	3	1	-	4	3	25	25	50
	FN 331	Nutritional Laboratory-II	-	-	4	2	4	25	25	50
		Sub Total	13	4	6	20				
	GE 301	Proficiency (Non-Credit) #	-	-	-	1	-			

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester										
	MB312	Microbial Ecology	2	-	-	2	3	25	25	50
	MB322	Microbial Ecology Lab	-	-	2	1	4	25	25	50
	FN 312	Dietetics	3	1	-	4	3	25	25	50
	FN 322	Food Services Management	3	-	-	3	3	25	25	50
	FN 332	Nutraceuticals and Health Foods	3	1	-	4	4	25	25	50
	FN 342	Food quality and sensory evaluation	3	1	-	4	3	25	25	50
	FN 352	Nutritional Lab-III	-	-	4	2	4	25	25	50
	BT 324	Entrepreneurship Development	2	-	-	2	3	25	25	80
		Sub Total	16	3	6	22				
	GE 302	Proficiency (Non-Credit) #	-	-	-	1	-			

FN 111 Principle of Nutrition 3-0-0-3

UNIT-I [7]
Indian foods - Food and culture, Traditional Indian Dietary patterns and Indian ethnic cuisines, Nutritional/medicinal quality of traditional foods - Traditional food beliefs, foods in Ayurveda. Food processing technologies

UNIT-II [6]
Nutrition and Food Science – Definition, history, RDA (Recent), factors affecting RDA – Methods used for deriving RDA, Basic four/five food groups and the functions of food, Food pyramid

UNIT-III [6]
Carbohydrates – classification, functions, digestion and absorption, Sources, deficiency diseases. Role fo fibre in human Nutrition

UNIT-IV [4]
Protein – classification – functions, sources digestion and absorption, sources and deficiency disorders.

UNIT-V [4]
Lipids – Classification, functions, digestion and absorption, sources, excess and deficiency disorder

UNIT-VI [6]
Vitamins – Fat soluble vitamins A, D, E & K, functions, sources, requirements deficiency diseases. Water soluble vitamins – B like thiamine, Riboflavin, Niacin, Phridoscin, Folic acid, B2 and Vitamin C and their functions sources requirements and deficiency diseases.

UNIT-VII [6]
Minerals – Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Flourine and their functions, sources requirements and deficiency diseases.

Text Book

1. Srilakshmi. B. (2010) Nutrition Science, V Edition, New Age International Publishers, New Delhi

References:

2. Chintapalli Vidya (2004) A Text book of Nutrition, New Delhi: Discovery Publishing House
3. Gopalan. C. Ramasastry, B.V. and Balasubramanian, S.C. (1976), Nutrition value of Indian Foods, Hyderabad: National Institute of Nutrition
4. 4. Swaminathan M. (1972), Essentials of Food and Nutrition, Philadelphia: Ganesh and Company

FN 121 Nutrition through life 3-0-0-3

UNIT-I [6]
Principles of meal planning: Balanced diet, Food groups, Food exchange list, Factors effecting meal planning and food related behavior, Dietary guidelines for Indians and food pyramid

UNIT-II [3]
Nutrient requirements: Dietary Concept, Overview of methods for assessment of

nutrient needs

UNIT-III [10]

Nutrition for adulthood and old age : Adult: Nutrient requirements for adult man and woman, RDA, nutritional guidelines, nutritional concerns, diet and lifestyle related diseases and their prevention, Elderly – Physiological changes in elderly, RDA, nutritional guidelines, nutritional and health concerns in old age and their management, factors contributing to longevity

UNIT-IV [10]

Nutrition during pregnancy and lactation: Pregnancy – Physiological changes in pregnancy, RDA, nutritional guidelines, nutritional needs, effect of nutritional status on pregnancy outcome, optimal weight gain and its components, nutrition related problems in pregnancy and ways to control them, Lactation – Physiology of lactation, RDA and nutritional needs of a nursing mother, nutritional guidelines

UNIT-V [10]

Nutrition during childhood: Growth and development, growth reference/ standards, RDA, nutritional guidelines, nutritional concerns and healthy food choices - Infants - Preschool children - School children – Adolescents

Text Book

1. Barrer. K. (2007) Basic Nutrition Counseling Skill Development Wadaworth Pub. Co.

References

2. Bendich. A. (1997) Preventive Nutrition Humana Press
3. Blackwell Scientific Publication. (1994). Manual Of Dietetic Practice.2nd ed.
4. British Nutrition Foundation. (1999). Obesity. Blackwell Science Pub.
5. Brown. J. (2002). Nutrition Through The Lifecycle. Wadsworth Pub Co.
6. Gable. J. (1997) Counselling skills for Dietitians, Blackwell Publishing House
7. Garrow .J.S (1993). Human Nutrition and Dietetics, 9th ed., Churchill Livingstone Pub.
8. Gibney, J. M. (2005). Clinical Nutrition. Blackwell Publishing House.
9. Gopalan .C.(2000). Nutritive Value of Indian Foods. NIN ICMR Pub.
10. ICMR Pub. (2000). Nutrient Requirement and Recommended Dietary Allowances for Indians

FN 112 Food Science 3-0-0-3

UNIT-I [10]

Cereals and Cereal Products: Structure Nutritive value of rice, wheat, maize and locally available millets, Enrichment and fortification. Batters and Doughs; Milling and parboiling; Malting of cereals. b. Pulses and Nuts : Composition and Nutritive value, factors affecting cooking quality of pulses, germination of whole grams.

UNIT-II [5]

Vegetables and Fruits – classification, Nutritive value, changes during cooking of vegetables, changes during ripening of fruits. Storage

UNIT-III [12]

Milk & Milk Products: Composition and Nutritive value, Different types of milk products; pasteurization of milk. b. Egg: Structure, Composition and Nutritive

value. Measure of quality, factors affecting foam formation, uses of egg in cookery. Home preservation and storage. c. Fleshy Foods: Composition and Nutritive value of meat, fish and poultry selection and storage – Effect of cooking on colour, texture and flavour. Factors affect tenderness.

UNIT-IV [12]

Fats & Oils : Composition and Nutritive value of common fats and oils, and reuse of oils, smoking temperature, rensidity of fat, absorption. b. Beverages : Classification, Nutritive value – Coffee, Tea, Cocoa, milk based fruit juices, aerated and alcoholic beverages. c. Spices and Condiments : Types, uses in Indian cookery

Text Book

1. Swaminathan, M. (6th Edition) Hand Book of Food Science and Experimental Food Text.

References:

2. Hughes and Benion, (1970), Introductory Foods.. McMillan Publishing Company.
3. Peckham, C.G. (1969) Foundation of Food Preparation, McMillan Publishing Company
4. Swaminathan, M. (1976) Essentials of Food and Nutritive Vol.I Bangalore Printing
5. 5. Potler, N. 5th Edition, Food Science. New York : Chapman & Hall

FN 122 Food Science laboratory 0-0-2-1

Experiments based on the contents of FN 112

CH 113 Chemistry - I 3-0-0-3

UNIT-I [6]

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements, effective nuclear charge.

UNIT-II [8]

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. *Critical Phenomena:* PV isotherms of real gases; continuity of states, the isotherms of Van der Waals equation, relationship between cirtical constants and Vander-Waals constants, reduced equation of state.

UNIT-III [10]

Mechanism of Organic Reactions: homolytic and heterolytic bond cleavage. Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Mechanisms of nucleophilic substitution SN1 and SN2. Reactive intermediates - carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Methods of determination of reaction mechanism.

UNIT-IV [5]

Periodic Properties : Atomic and ionic radii, ionization energy, electron affinity

and electronegativity - definition, methods of determination of evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

UNIT-V [10]

Stereochemistry of Organic Compounds : Optical Isomerism- Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, chiral and achiral molecules with two stereogenic centres, diastereomers, resolution of enantiomers, inversion, retention. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature, geometric isomerism in oximes and alicylic compound. Conformational isomerism: Conformational analysis of ethane, propane and n-butane by the Newman projection.

Text Book:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th Edition, PHI.

References

2. Malik, W.U., Tuli G.D. and Madan R.D. (2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
3. Puri, Sharma and Pathani (2013) Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
4. Stanley H Pine, Organic Chemistry, 5th Edition, Tata McGraw-Hill.
5. Mukherjee, S.M. and Singh, S.P. 3rd Edition; Reaction Mechanism in Organic Chemistry, Macmillan India Limited.

CH 123 Chemistry Laboratory-I 0-0-2-1

The laboratory experiment will be based on the theory paper CH 113

CH 114 Chemistry - II 3-0-0-3

UNIT-I [9]

Chemical Bonding: Covalent Bond: Valence bond Theory, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, concept of multicentric bonding, percentage ionic character. Ionic Solids: Ionic structures, radius ratio effect and coordination number, lattice energy and Born haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule.

UNIT-II **[9]**

S and p Block Elements: S-Block elements- Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies. P-Block Elements -Comparative study of groups 13-18 elements, compounds like hydrides, oxides, oxyacids and halides of groups 13-16, hydrides of boron- diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride. Structure of Xenon compounds.

UNIT-III **[7]**

Chemical Kinetics and Catalysis: Chemical kinetics and its scope, rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half-life and Radioactive decay as a first order phenomenon. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, collision theory, transition state theory. Catalysis & types of catalysis,

Mechanism of catalysis, Enzyme catalysis

UNIT-IV **[6]**

Alkanes and Cycloalkanes: Classification of carbon atoms in alkanes, isomerism, sources, methods of formation (with special reference of Wurtz reaction, Kolbe reaction, Corey house reaction and decarboxylation of carboxylic acids). Physical properties and chemical reaction of alkanes.

[8]

UNIT-V

Alkenes and Alkynes: Nomenclature, preparation and reactions of alkenes, Saytzeff and Hofmann elimination, Mechanisms of hydrogentation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization. Chemical reaction of alkynes, mechanism of electrophilic and nucleophilic addition reaction, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.

Text Book

1. Bahl, A. and Bahl, B. S.: A Textbook of Organic Chemistry, S. Chand and Co. Ltd. New Delhi.

References

2. Puri, Sharma and Pathania (2013): Principles of Physical Chemistry, S Chand and Co., New Delhi, India.
3. Malik, W.U., Tuli G.D. and Madan R.D.(2002) Selected Topics in Inorganic Chemistry, S Chand and Co. Ltd. New Delhi.
4. Morrison, R. T. and Boyd R. N. 6th Edition. Organic Chemistry, Prentice Hall, Englewood Cliffs, New Jersey.
5. R.K. Bansal; Organic Reaction Mechanisms, 3rd Ed., Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

CH 124 Chemistry Laboratory-II **0-0-2-1**

The laboratory experiment will be based on the theory paper CH 114

FN 221 Family Nutrition **3-0-0-3**

UNIT-I [7]

Principles of Nutrition - Nutrients and their functions. Food groups, meal planning, RDA, Over nutrition, under nutrition, malnutrition.

UNIT-II

Nutrition during Pregnancy and Lactation. Importance of Nutrition during pregnancy. Complications in pregnancy, food and nutritional requirements for lactating women. [8]

UNIT-III

Nutrition for Infants and Preschoolers Importance of breast milk, food and nutritional requirements for infants, weaning and supplementary foods for infants, food habits of preschoolers, nutritional requirements for preschool children. [8]

UNIT-IV

Nutrition for School Age and Adolescents. Nutritional requirements for school going children and adolescents, factors influencing food intake, nutritional disorders. [8]

UNIT-V

Nutrition during Adulthood and Old age. Food and nutritional requirements for adults. Importance of nutrition during old age, factors influencing food intake, nutritional requirements, nutritional problems and management of old age [8]

Text Book:

1. Gopalan, C. and Balasubramanian, B.C.Diet Atlas of India, NIN, Hyderabad, 1971.
2. Gopalan, C.Ramasastry, B.V. and Balasubramanian, S.C. Nutritive value of Indian foods, NIN, Hyderabad, 1976. 24

Reference:

3. Margaret Mc.Williams, "Food Fundamentals" John Wiley and Sons, London, 1974.
4. Swaminathan, M.Essentials of Food and Nutrition Vol.I& II BAPPCO., The Bangalore Printing and Publishing co., ltd., No.88, Mysore Road, Bangalore.

FN 211 Food Safety 3-0-0-3

UNIT-I [4]

Introduction to Food Safety

Definition, Types of hazards, biological, chemical, physical hazards Factors affecting Food Safety ,Importance of Safe Foods

UNIT-II [5]

Food Hazards of Physical and Chemical Origin

Introduction ,Physical Hazards with common examples ,Chemical Hazards(naturally occurring ,environmental and intentionally added , Packaging material as a threat ,Impact on health ,Control measures

UNIT-III [5]

Food Hazards of Biological Origin

Introduction ,Indicator Organisms, Food borne pathogens: bacteria, viruses and eukaryotes ,Seafood and Shell fish poisoning , Mycotoxins

UNIT-IV [4]

Management of hazards

Need ,Control of parameters ,Temperature control, Food storage

UNIT-V [5]

Hygiene and Sanitation in Food Service Establishments

Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal ,Pest and Rodent, Control Personnel Hygiene

UNIT-VI [4]

Food Safety Management Tools

Basic concept Prerequisites- GHPs, GMPs, HACCP ISO series TQM - concept and need for quality, components of TQM, Kaizen. Risk Analysis Accreditation and Auditing

UNIT-VII [5]

Microbiological criteria

Microbiological standards and limits (for processed food, water) Sampling Basic steps in detection of food borne pathogens Water Analysis

UNIT-VIII [3]

Food laws and Standards

Indian Food Regulatory Regime Global Scenario Other laws and standards related to food

UNIT-IX [4]

Recent concerns

New and Emerging Pathogens Genetically modified foods \ Transgenics Organic foods Newer approaches to food safety

Text Book

1. Lawley, R., Curtis L. and Davis,J. The Food Safety Hazard Guidebook , RSC publishing, 2004
2. De Vries. Food Safety and Toxicity, CRC, New York, 1997

Reference:

3. Marriott, Norman G. Principles of Food Sanitation, AVI, New York, 1985
4. Forsythe, S J. Microbiology of Safe Food, Blackwell Science, Oxford, 2000
5. Forsythe,S.J.The Microbiology of Safe Food , second edition, Willey-Blackwell,U.K.,2010

FN 212 Public Health Nutrition 3-0-0-3

UNIT-I [8]

Concept of public health nutrition- relationship between health and nutrition, role of public health nutritionists in the health care delivery. Public health and nutrition policies- plan of action and programs.

UNIT-II [6]

Food and nutrition security- food production, distribution, access, availability and consumption. Socio cultural aspects and dietary patterns: their implication for nutrition and health.

UNIT-III [4]

Health care facility- primary health care of the community, health care delivery system.

UNIT-IV [10]

Determinants of nutrition and health status- socio cultural, biologic, environmental and economic factor, indicators of health and malnutrition. Economics of malnutrition- impact on productivity and national development. Socio demographic, health and nutrition transitions

UNIT-V [11]

Approaches and strategies for improving nutritional status and health: national and international contributions, role of government and non-government organizations. Case studies of selected strategies and programs: their rationale and context- health based, intervention, food based interventions including fortification, genetic improvement of foods, supplementary feeding, and nutrition education for behavior change

Text Book

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers

Reference:

2. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill..
3. Sethi P and lakra P Aahaarvigyaan ,Poshanevam Suruksha, Elite Publishing house, 2015
4. Khanna K et al. Textbook of Nutrition and Dietetics;2013; Phoenix Publisher.

FN 222 Food Chemistry 3-0-0-3

UNIT-I [9]

Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam.

UNIT-II [8]

Carbohydrates:Monosaccharides,Oligosaccharides,Polysaccharides,Starch,Cellulose,Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber

UNIT-III [7]

Lipids: Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids.

UNIT-V [7]

Amino Acids, Peptides and Proteins: Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional properties of proteins, processing induced physical and chemical changes of protein.

UNIT-VI [8]

Food colorants: pigments in animal and plant tissues. Flavors: Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances.

Text Book

1. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.

Reference:

2. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
3. Fennema, O.R, 2006, Food Chemistry, Academic Press.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. Food Chemistry. Marcel Dekker.

FN 232 Therapeutic Nutrition 3-0-0-3

UNIT-I

Diet in Cardiovascular diseases : Aetiology, Symptoms, Risk factors, pathophysiology, dietary management and prevention of Atherosclerosis, Coronary Artery Disease, Myocardial Infarction, Ischemic Heart Disease, Rheumatic Heart Disease(RHD), Congestive Cardiac Failure (CCF), Hypercholesterolemia, Hypertension – classification, sodium restricted diet, dangers of severe sodium restriction [16]

UNIT-II

Diet in Diseases of Liver and Gall Bladder: Aetiology, Symptoms, Dietary treatment in Jaundice, Hepatitis, Pancreatitis, Cirrhosis, Hepatic Coma. Role of food and alcohol in developing liver diseases. Biliary Tract Diseases- Cholecystitis Cholelithiasis and Choled ocholithiasis [8]

UNIT-III

Diet in Renal disease: Causes, Symptoms and dietary management in Nephritis, Nephrosis, Acute and chronic renal failure, Renal calculi, Acid and alkali producing foods, End Stage Renal Diseases (ESRD), Dialysis. [7]

UNIT-IV

Diet in Cancer: Tumor markers and their applications, Types of cancer, Risk factors, Symptoms, Metabolic alterations and Nutritional problems of cancer and cancer therapy, Medical Nutrition Therapy, Role of food in prevention of cancer. [8]

Text Book

1. Kumar .P. Clark M (2005) , Clinical Medicine, 6th Edition, Elsevier Saunders Publishing Co.

Reference:

2. Gibney M J., Elia.M, Lingqvist. O (2005),Clinical Nutrition, Blackwell Science publishing Co.
3. Guthrie, H.A and Picciano, M.F, (1995), Human Nutrition, Mosby Publishing Co, New York.
4. Kris Etherton.P and Burus J.H.(1998), Cardiovascular Nutrition, American Dietetic Association ,Chicago, Illinosis.

FN 242 Nutritional Laboratory-I 0-0-4-2

Experiments based on the contents of FN 212, FN 222 and FN 232

FN 311 Maternal And Child Nutrition 3-1-0-4

UNIT-I [13]

Nutritional needs during pregnancy, common disorders of pregnancy (Anaemia, HIV infection, Pregnancy induced hypertension), relationship between maternal diet and birth outcome. Maternal health and nutritional status, maternal mortality and issues relating to maternal health.

UNIT-II [10]

Nutritional needs of nursing mothers and infants, determinants of birth weight and consequences of low birth weight, Breastfeeding biology, Breastfeeding support and counselling

UNIT-III [10]

Infant and young child feeding and care - Current feeding practices and nutritional concerns, guidelines for infant and young child feeding, Breast feeding, weaning and complementary feeding. Assessment and management of moderate and severe malnutrition among children, Micronutrient malnutrition among preschool children. Child health and morbidity, neonatal, infant and child mortality, IMR and U5MR; link between mortality and malnutrition;

UNIT-IV [6]

Overview of maternal and child nutrition policies and programmes.

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s Banarasidas Bhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 321 Nutrigenomics & Personalised Nutrition 3-1-0-4

UNIT-I [6]

Introduction. Concept of functional genomics, systems biology, nutrigenomics, nutrigenetics, personalised nutrition

UNIT-II [13]

Molecular biology and genomics: Nutritional requirements and metabolic responses at cellular level, Impact of a changing nutrient environment, Introduction to molecular diagnostics: nutrients influences on genomes

UNIT-III [9]

Diet and gene expression: nutrients as regulators of activity and transcription factors. Nutrients as epigenetic exchange agents.

UNIT-IV [11]

Diet in early life and metabolic programming. V Diet as a possible risk or preventive factor in illnesses. Gene polymorphisms and responses to diet. Examples related to cardiovascular disease, cancer, osteoporosis. Risk/benefit biomarkers

Text Book

1. Principles and Applications by FransKok, Laura Bouwman, Frank Desiere, CRC press

R**eference**:

2. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition by Lynnette R. Ferguson, CRC press

FN 331 Nutritional Laboratory-II 0-0-4-2

Exercises based on Courses BC 311, FN 311 and FN 321

FN 312 Dietetics 3-1-0-3

UNIT-I [3]
Concept of Diet therapy: growth and source of dietetics, purpose and principles of therapeutic diets, modification of normal diet, classification of therapeutic diets.

UNIT-II [3]
Role of Dietician: Definition of nutritional care, interpersonal relationship with patient, planning and implementary dietary care, Team approach to nutritional care.

UNIT-III [6]
Diet in surgical conditions, burns and cancer.
Obesity and leanness- causes, complication and health effects, dietary treatment and other recommendation

UNIT-IV [3]
Diet in fever and infections- Types- metabolism in fever, general dietary consideration diet in influenza, typhoid fever, recurrent malaria and Tuberculosis.

UNIT-V [3]
Diet in gastritits, peptic ulcer- symptoms, clinical findings, treatment, dietary modification, adequate nutrition, amount of food, and intervals of feeding, Chemically and mechanically irrigating foods, four stage diet (Liquid, soft, convalescent, liberalized diet).

UNIT-VI [3]
Diet in disturbances of small intestine and color. Diarrhoea- (child and adult)- classification, modification of diet , fibre, residue. Fluids & nutritional adequacy. Constipation- flatulence - dietary considerations. Ulcerative colitis (adults) - symptoms, dietary treatment. Spruce, coeliac disease- disaccharide intolerance, dietary treatment.

UNIT-VII [6]
Diet in diseases of the liver, gall bladder and pancreas, a) Etiology, symptoms and dietary treatment in - Jaundice, hepatitis, cirrhosis and hepatic coma. b) Role of alcohol in liver diseases. c) Dietary treatment in cholecystitis, cholelithiasis and pancreatitis. Gout- Nature and occurrence of uric acid, causes, symptoms and diet.

UNIT-VIII [3]
Diet in allergy and skin disturbances: Definition, classification, manifestations, common food allergies and test and dieteric treatment.

UNIT-IX [3]
Diet in Diabetes mellitus: a) Incidence and predisposing factors. b) Symptoms-types and tests for detection. c) Metabolism in diabetes d) Dietary treatment & meal management e) Hypoglycemic agent, insulin and its types. f) Complication of diabetes.

UNIT-X [3]
Diet in Renal diseases: Basic renal function, symptoms and dietary treatment in acute and chronic glomerulonephritis, Nephrosis, renal failure, dialysis. Urinary calculi-causes & treatment, acid and alkali producing and neutral foods and dietary treatment.

UNIT-XI [3]
Diet in Cardiovascular diseases: Role of nutrition in cardiac efficiency, incidence of Atherosclerosis, dietary principles, Hyperlipidenmia, Hypertension- causes and dietary treatment, Sodium restricted diet, level of sodium restriction, sources of sodium, danger of severe sodium restriction.

Text Book

1. Antia P. Clinical Dietetics and Nutrition, 2nd edition, Oxford University press.

Reference:

2. Garrrow J.S, James W. P.T, Ralph A, (2000), Human Nutrition and Dietetics, 10th edition, Churchill Livingston, London.
3. Guthrie H. A, Picciano M. F (1995), Human Nutrition, Mosby, St. Louis Missorie.

FN 322 Food Service Management 3-0-0-3

UNIT-I [6]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel

UNIT-II [6]

Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules. Theories about approaches to food service management

UNIT-III [10]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-IV [9]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance. Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of Kitchen records.

UNIT-V [8]

Financial management – Budgeting, costing and cost control, accounting. 8. Hygiene and sanitation in preparation and serving area – Personal hygiene, types and sources of contamination, prevention and safety measures. Methods of controlling infestation. Methods of dish washing.

Text Book:

1. Amerine, Pangborn & Roessler (1965). Principles of Sensory Evaluation of food, Academic Press, London.

Reference:

2. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.
3. Meilgard (1999). Sensory Evaluation Techniques, 3rd ed. CRC Press LLC, 1999.

FN 332 Neutraceuticals and Health Foods 3-1-0-3

UNIT-I

Nutraceuticals: (a) Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases (b) Definition, Classification, food and non-food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals. [13]

UNIT-II

Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [8]

UNIT-III

Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [9]

UNIT-IV

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India [9]

Text Book

1. Wadhwa A and Sharma S (2003). Nutrition in the Community-A Textbook. Elite Publishing House Pvt. Ltd. New Delhi.

Reference:

2. Park K (2011). Park's Textbook of Preventive and Social Medicine, 21st Edition. M/s BanarasidasBhanot Publishers, Jabalpur, India.
3. Bamji MS, Krishnaswamy K and Brahmam GNV (Eds) (2009). Textbook of Human Nutrition, 3rd edition. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

FN 342 Food Quality And Sensory Evaluation 3-1-0-3

UNIT-I [4]

Introduction to quality attributes of food, Appearance, flavour, textural factors and additional quality factors

UNIT-II [10]

Gustation: introduction and importance of gustation, Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands. Mechanism of taste perception Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami, Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold, Taste measurement- Electronic Tongue, Taste abnormalities

UNIT-III [10]

Olfaction: Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Theories of odour classification, chemical specificity of odour. Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc. Olfactory abnormalities

UNIT-IV [5]

Colour: Introduction and importance of colour, Dimensions of colour and attributes of colour; gloss etc. Perception of colour. Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, etc. Colour abnormalities

UNIT-V [10]

Texture: Introduction, definition and importance of texture, Phases of oral processing, Texture perception, receptors involved in texture perception, Rheology of foods Texture classification, Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation. Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products

Text Book

1. Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.

Reference:

2. Rao E. S. (2013). Food Quality Evaluation. Variety Books.
3. deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.

FN 352 Nutritional Lab-III **0-0-4-2**

Exercises based on Courses FN 312,FN 322, FN 332 and FN 342

BT 324 Entrepreneurship Development **2-0-0-2**

UNIT-I [10]

Introduction: Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship

UNIT-II

Establishing an Enterprise Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility, Financing the Enterprises, Fixed and Working Capital [8]

UNIT-III

Entrepreneurship and International Business, Marketing of Product Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports [8]

Text Book

1. Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference:

2. Holt DH. Entrepreneurship: New Venture Creation.
3. Kaplan JM Patterns of Entrepreneurship.

Mody University of Science & Technology

B.Sc. (Hons) Forensic Science
Session 2019-2020

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 151	Cell Biology	3	1	-	4	2	25	25	50
	BT 161	Cell Biology Lab	-	-	2	1	3	25	25	50
	CH 181	Physical and Inorganic Chemistry-I	2	-	-	2	2	25	25	50
	CH 191	Organic Chemistry-I	2	-	-	2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I	-	-	3	1.5	2	25	25	50
	FS 101	Introduction to Forensic Science and Criminology	2	1	-	3	3	25	25	50
	EL 101	Foundation Course in English	2	-		2	3	25	25	50
	FS 131	Criminal Law-IPC/CrPC/IEA	2	1	-	3	3	25	25	50
	FS 141	Trace Evidence Analysis	3	-	-	3	3	25	25	50
	FS 151	Trace Evidence Analysis in Lab	-	-	2	1	3	25	25	50
			16	**3**	**7**	**22.5**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 152	Genetics	3	1	-	4	3	25	25	50
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	3	25	25	50
	FS 102	Concepts of Physics in FS	2	-	-	2	3	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
	FS 132	Crime Scene Investigation	2	1	-	3	3	25	25	50
	FS 142	Crime Scene Investigation Practical	-	-	4	2	3	25	25	50
		Sub Total	**15**	**2**	**7**	**20.5**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BC 211	Bio-Instrumentation	3	1	-	4	3	25	25	50
	BC 221	Instrumentation Laboratory	-	-	2	1	3	25	25	50
		Foreign Language-I	3		-	3	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	3	25	25	50
	FS 231	DNA Profiling	2	1	-	3	3	25	25	50
	FS 241	DNA Profiling Lab	-	-	2	1	3	25	25	50
	FS 251	Forensic Anthropology and Personal Identification	2	1	-	3	3	25	25	50
	FS 261	Forensic Anthropology Practical	-	-	2	1	3	25	25	50
		Sub Total	**16**	**3**	**9**	**23.5**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 232	Forensic Toxicology	3	1	-	4	3	25	25	25
	FS 242	Forensic Toxicology Practical	-	-	2	1	3	25	25	25
	BT 242	Plant and Animal Biotechnology	2	-	-	2	3	25	25	50
	BT 252	Tissue Culture Laboratory	-	-	2	1	3	25	25	50
		Foreign Language-II	3	-	-	3	3	25	25	50
	CH 292	Organic Chemistry -IV	2	-	-	2	3	25	25	25
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	3	25	25	50
	FS 252	Fingerprint Science	2	1	-	3	3	25	25	50
	FS 262	Fingerprint Science Practical	-	-	2	1	3	25	25	50
		Sub Total	**16**	**2**	**9**	**22.5**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 371	Forensic Serology and Blood Splatter Analysis	2	1	-	3	3	25	25	50
	FS 381	Serology Practical	-	-	2	1	3	25	25	50
	MB 232	Immunology	3	1	-	4	3	25	25	50
	MB 321	Immunology Laboratory	-	-	2	1	3	25	25	50
	FS 391	Digital Forensics	2	1	-	3	3	25	25	50
	FS 313	Digital Forensics Practical	-	-	2	1	3	25	25	50
	FS 323	Programing in C++	2	1	-	3	3	25	25	50
	FS 333	Programing Lab in C++	-	-	4	2	3	25	25	50
	FS 343	Forensic Photography, Digital Imaging and Portrait Parley	3	1	-	4	3	25	25	50
	FS 353	Digital Imaging Lab	-	-	2	1	3	25	25	50
			12	**5**	**12**	**23**	-			
	GE 301	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 372	Instrumentation in Forensic Science	2	1	-	3	3	25	25	50
	FS 382	Instrumentation Practical	-	-	2	1	4	25	25	50
	FS 392	Wildlife Forensics	2	1	-	3	3	25	25	50
	FS 314	Multimedia Forensics	2	1	-	3	3	25	25	50
	FS 324	Questioned Document Examination	2	1	-	3	3	25	25	50
	FS 334	Questioned Document Examination Practical	-	-	2	1	3	25	25	50
	BT 352	Bioinformatics	2	1	-	3	3	25	25	50
	BT 314	Bioinformatics Lab	-	-	2	1	4	25	25	50
	FS 344	Forensic Ballistics and Toolmarks	2	1	-	3	3	25	25	50
	FS 370	SUMMER INTERNSHIP*				4		100		
		Sub Total	**12**	**6**	**6**	**25**	-			
	GE 302	Proficiency (Non-Credit) #	-	-	-	1				

Total = 137

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination* Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.#* Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

*Each student will be required to submit a report based on a week long attachment they would be provided after 2 years of their course at any Central/State Forensic Science Laboratory. Weightage would be 100 marks.

B.Sc. (H) Forensic Science
Three-Year Programme
Academic Curriculum (2017 – 18 onwards)

FIRST SEMESTER

CELL BIOLOGY

BT 151 **3-1-0-4**

CELL BIOLOGY LAB

BT 161 **0-0-1-1**

PHYSICAL AND INORGANIC CHEMISTRY-1

CH 181 **2-0-0-2**

ORGANIC CHEMISTRY-I

CH 191 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-I

CH 171 **0-0-3-1.5**

INTRODUCTION TO FORENSIC SCIENCE AND CRIMINOLOGY

FS 101 **2-1-0-3**

Course Contents:

Unit I: Types of Crime and Criminal Behavior [9]

Definition: Crime, Criminal and Criminology; Criminology as Science, The field and scope of Criminology; Methods and Techniques in Criminology; Concept of a criminal and classification of criminals. Organized crime; White – collar crimes/ Occupational crimes; Murders; Sexual offences; Terrorism; Serial Crimes; Crime against women and children.

Unit II: Juvenile Delinquency and Punishment [10]

Definition, Types of Juvenile Delinquents ; Classification of Juvenile Delinquents; Factors in Juvenile Delinquency, Custody of juvenile delinquents; Juvenile courts procedure; behavior modification techniques; Preventive Programmes. Concept of punishment, kinds of punishments, Humanitarian approach to concept of punishment, capital punishment in India, Introduction to criminal Laws: IEA, IPC and CRPC

Unit III: Police Administration [10]

Role of police in regard to criminals; Police role in the society; Custodial crimes: Complaints against police personnel; Interrogation of suspects and offenders; interviewing the criminals; improving the Police force. Evidence Applicability in Court**;** Definition, Various types of evidences, the law of evidence, Expert's testimony and admissibility of scientific evidence in court of Law.

Unit IV: Introduction to FS and History [10]

Definition, description, principles, concept, needs and scope. History of Forensic Science and Forensic Science Labs; Progressive development and transformation of Forensic Science Labs. Forensic Science Laboratories: Main Authority, Organizational structure of Forensic Science Laboratory – roles and responsibilities, Sections/ Divisions, Services

Provided. Mobile forensic science laboratory – their distribution in India, functions, need and utility.

Text:

1. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

1. Ellis, L. and Walsh, Anthony, Criminology – A Global Perspectiven, Allyn and Bacon, Boston, 2000.
2. Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.
3. Abaadinsky, H., Organised Crime (2nd Edn.), Nelson – Hall, Chicago, 1998.
4. Adler, F., Mueller, G. O. W. and Laufer, W. S., Crminology, McGraw – Hill, Boston, 1991.
5. Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rd Edn.), Oxford University Press, Oxford, 2002.
6. Ahuja, R., Criminology, Rawat Publication, ND, 2000.
7. Bajpai, G. S., Development without Disorders. Vishwavidyala, Prakashan, Sagar (M. P.), 2002.
8. Maguire, M.: Morgan, R and Reiner, R., The Oxford Handbook of Criminology (3rd Edn.), Oxford University Press, Oxford, 2002.
9. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
10. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; an Introduction to Criminalitics, McGraw Hill, New York, 1983.
11. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
12. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
13. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida, 1999.

FOUNDATION COURSE IN ENGLISH

EL101 **2-0-0-2**

CRIMINAL LAW-IPC/CrPC/IEA

FS 131 **2-1-0-3**

Unit I: Indian Penal Code [13]
Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b) Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), Sections pertaining to poisons; General exceptions, Offences against person, Offences against property, Attempt to suicide, Sexual offences.

Unit II: Criminal Procedure Code [13]
Code of Criminal Procedure- Introduction, organization and powers of Criminal Law Courts in India, Police powers of arrest, search and seizure; Introduction and general idea of sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176.

Unit III: Indian Evidence Act [13]
Indian Evidence Act-Admissions, Confessions, Dying Declarations. Of Experts, Oral and Documentary Evidence; Introduction and general idea of sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159.

Text:

1. Criminology by Ram Ahuja

References:

1. Criminology and Penology by Prof Panjape N.V.
2. Introduction to forensic Science by Dr. B.S.Naber.
3. Synopsis of Forensic Medicine by Dr.K.S.Narayan Reddy.
4. Police and Polity in India by P.D.Sharma.
5. Karnataka Police Manual.
6. Criminal Major Acts Eastern Law Publications, Allahabad.

TRACE EVIDENCE ANALYSIS

FS 141 **2-1-0-3**

Course Contents:
Unit I: Introduction of Physical Evidences [9] Definition, Collecting, packaging, preservation and forwarding of evidences: biological fluids, chemicals, poisons, firearms, fingerprints and tool marks; Linking a Crime Scene with the suspect through field notes, witnesses and interrogation, Reconstruction of crime scene and associative/ corroborative evidences.
Unit II: Crime and Suspect [10] Search and seizure, privilege against self – incrimination, subpoenas deposition, Miranda rights, condemned of court, FIR, types of cognizable and non-cognizable offences; Expert's Testimony: the role of the expert as witness; Acceptance of evidence in the Court of Law; Mcnaughton Rule; child witness in the court, admissibility of scientific evidence; Expert Testimony: The role of the expert as witness; Acceptance of evidence in the Court of Law; Mcnaughton Rule; child witness in the court, admissibility of scientific evidence; Examination in the Court: Direct examination, cross – examination and re-examination of Prosecution lawyer and Defense lawyer and Court presentation, Law of evidence: testimonial and real evidence.
Unit III: Glass and Soil Examination [10] Glass: Composition, Comparing glass fragments, glass fractures. Examination of soil, Color, density, size distribution of soil particles, mineral analysis and chemical analysis of soil, collection of preservations of soil. Analysis Techniques-Physical, Chemical, instrumental
Unit IV: Forensic Paint Examination [5] Introduction, paint chemistry, forensic examination of household paints and automobile paints. Analysis Techniques-Physical, Chemical, instrumental
Unit V: Forensic Examination of Hair and Fiber [5] Examination of Hair; Importance, nature, location, collection, evaluation; Classification of fibers, preliminary examination, properties of fiber, microscopic and chemical examination of fibers. Analysis Techniques-Physical, Chemical, Instrumental

Text:

1. Saferstein, Richard, Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2. Sharma, B.R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd., New Delhi, 2001.

References:

1. Bodziak, W., Footwear Impression Evidence (2nd Ed.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
4. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
5. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida. 1999.
6. Heard, B. J., Handbook of Firearm and Ballistics, Wiley & Sons, Chichester, England, 1997.

7. James, S. H., and Nordby, J. J., (Edt), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

TRACE EVIDENCE ANALYSIS IN LAB

FS 151 **0-0-2-1**

1. Physical Analysis of Glass-Density
2. Physical Analysis of Glass-RI
3. Physical Analysis of Soil-Density
4. Analysis of Microscopic Glass Chip
5. Microscopic Examination of Hair
6. Microscopic Examination of Fiber
7. Fabric Count
8. Instrumental analysis of Paint Chip
9. Instrumental analysis of Paint Smear
10. Microscopic Examination of Paint Chip

SECOND SEMESTER

GENETICS

BT 152 **3-1-0-4**

PHYSICAL AND INORGANIC CHEMISTRY-II

CH182 **2-0-0-2**

ORGANIC CHEMISTRY

CH 192 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-II

CH 172 **0-0-3-1.5**

CONCEPTS OF PHYSICS IN FS

FS 102 **2-0-0-2**

Course Contents
Unit I: Motion & Force Definition of motion, position and displacement, average velocity, average speed, acceleration, acceleration of freely falling body, projectile motion, uniform circular motion, relative motion in one dimension and two dimension. Newtonian mechanics, Newton's Ist law, force, mass, Newton's II law, Newton's III law, friction, properties of friction, drag force and terminal speed.
Unit II: Kinetic Energy and Work Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, work done on system by external force, conservation of energy.
Unit III: Rotation The rotational variable, rotation with constant angular acceleration, relating linear and angular variables, kinetic energy of rotation.
Unit IV: Gravitation and Waves Newton's law of gravitation, gravitation near earth's surface, gravitation inside the earth. Types of waves, transverse and longitudinal waves, wavelength and frequency, speed of traveling wave, the wave equation, sound waves, speed of sound, intensity and sound level, the Doppler effect, shock waves.

Text:

1. Herbert Goldstein: Classical Mechanics, 2nd ed, 1980

References:

1. Amato, Joseph (December 1996). "The introductory calculus-based physics textbook". Physics Today 49 (12): 46–51.
2. Thomas Brody (1993.) "The Philosophy Behind Physics"pp 18–24 (Chapter 2)
3. Glimm, James; Jaffe, Arthur (1987), 'Quantum physics: a functionalintegral point of view'(2nd ed.), New York, [NY.]: Springer.

ENVIRONMENTAL STUDIES

MDC 003 **3-1-0-4**

CRIME SCENE INVESTIGATION

FS 132 **2-1-0-3**

Course Contents:
Unit I: Crime Scene [9] Defining a crime scene, Importance, problem, location and processing of Crime Scene and Crime scene Management.
Unit II: Types of Crime Scenes [8] Mobile, Indoor and outdoor crime scenes; various searching techniques used for locating physical evidences at scene of crime.
Unit III: Recording the Scene of Crime [5] Barricading of crime scene; Crime Scene Photography; Sketching; Notes making; Handling clues and evidences.
Unit IV: Crime scene reconstruction [5] Procedure and requirement for Crime Scene Reconstruction; Guidance from field notes; Modus operandii, role of Investigating Officer.
Unit V: Physical Evidences [12] Definition, types of physical evidences, Collection, packaging, preservation and forwarding of physical evidences, Chain of custody.

Text:

1. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

References:

1. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press,

CRIME SCENE INVESTIGATION PRACTICAL

FS 142 **0-0-4-2**

1. Crime Scene Processing
2. Crime Scene Searching
3. Indoor Crime Scene-Baseline Method
4. Outdoor Crime Scene-Baseline Method
5. Indoor Crime Scene-Triangulation Method
6. Outdoor Crime Scene-Triangulation Method
7. Outdoor Crime Scene- Polar Coordinate Method
8. Packing and Packaging of Evidence

THIRD SEMESTER

BIO-INSTRUMENTATION

BC 211 **3-1-0-4**

INSTRUMENTATION LABORATORY

BC 221 **0-0-2-1**

FOREIGN LANGUAGE-I

ORGANIC CHEMISTRY-III

CH 223 **2-0-0-2**

PHYSICAL CHEMISTRY-I

CH 291 **2-0-0-2**

INORGANIC CHEMISTRY-I

CH 213 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-III

CH 281 **0-0-3-1.5**

DNA PROFILING

FS 231 **2-1-0-3**

Course Contents:
Unit I: Introduction to DNA Fingerprinting [6] Definition, Importance of DNA Fingerprinting in Forensic Science., Structure of DNA, RNA, Chromosome, Nuclear DNA and Mitochondria DNA
Unit II: DNA Isolation Techniques [5] Collection and types of evidences for DNA fingerprinting, Different types of DNA Isolation techniques (Organic, Inorganic and Mechanical), FTA cards for isolation of DNA. DNA isolation from different evidences.
Unit III: Techniques for DNA Fingerprinting [10] Electrophoresis and Southern blotting, Polymerase Chain Reaction (Denaturation, annealing and extension, Detection of PCR products).
Unit IV: Types of DNA Fingerprinting Techniques [10] Mini satellites and Micro-satellites., VNTR and RFLP, STRs and Genotyping.
Unit V: Practical application of DNA Fingerprinting [8] Paternity testing and Personal identification. DNA databank, Limitations of DNA Fingerprinting; Legality of DNA Fingerprinting in India.

Text:

1. Sharma, B. R. (3rd Edition) Forensic Science in Criminal Investigation and Trials, Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

2. Norah Rudin and Keith Inman (2nd Edition) An Introduction to Forensic DNA Analysis, CRC Press, New York, 2002.

3. John M. Butler (1st Edition) Fundamentals of Forensic DNA Typing, Academic Press, 2005.

DNA PROFILING LAB

FS 241 **0-0-1-2**

1. Isolation of Plasmid and Genomic DNA
2. Restriction Digestion
3. DNA Fragment Size Détermination
4. PCR Demonstration and Principal
5. DNA Estimation through Spectroscopy
6. Isolation of Microbes through Soil, Air and Water Samples
7. Study of Bacterial Slides

FORENSIC ANTHROPOLOGY and PERSONAL IDENTIFICATION

FS 251 **2-1-0-3**

Unit I: Anthropology and Personal Identification [9] Definition, scope and application of Forensic Anthropology; and related sciences. Human and animal remains; Reconstruction Process: Superimposition, Facial reconstruction and its importance; Importance and need for personal identification, cases that will require personal identification. Documents proof, scars, professional marks, personal articles, Finger printings, dentures, sketches and photographs
Unit II: Victim Identification [10] Assessing and determining the time and cause of Death, Study of burned bones and bone fragments; Attribution of Sex, Estimation of Age and reconstruction of stature from long bones and their medico legal implication. Establishment of Partial and Complete identity of skeletal material and dead bodies; Craniometry: Identification of human skull, determining the age ,race and sex of the skull and its measurement;
Unit III: Odontology and Bite Marks [10] Odontology: Introduction to human dentition, structure of teeth, types and functions of different teeth, age and sex determination, identification in mass disasters; Bite Marks: Types of bite marks; collection and preservation of DNA samples, forensic importance of bite marks; identification - Case studies
Unit IV: Autopsy [10] Ante and Post – mortem examinations; external examination; internal examination; collection, preservation and packaging of viscera.

Text

1. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001
2. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References

1. Modi, A Text Book of Medical Jurisprudence & Toxicology.
2. Parikh, A Text Book of Medical Jurisprudence & Toxicology.
3. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
4. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
5. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

FORENSIC ANTHROPOLOGY PRACTICALS

FS 261 **0-0-2-1**

1. Estimation of height, weight using long bones
2. Determination of age, sex, using skull, pelvic bones, long bones, etc.

FOURTH SEMESTER

FORENSIC TOXICOLOGY

FS 232 **3-1-0-4**

Unit I: Toxicology and Drugs of Abuse [9] Definition, dosage, administration of poisons, Classification of poisons on analytical basis and medical basis; Sedatives, Narcotics, Stimulants and Hallucinogens, Drug Addiction and its signs and symptoms, Drugs and Crime; The role of drug recognition expert, Interpreting drug findings
Unit II: Toxicology of Alcohol [9] The fate of ethyl alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, analysis of blood for alcohol
Unit III: Metallic Poisons, Barbiturates and Corrosive Poisons [5] Arsenic, Mercury. Nature, administration, symptoms, postmortem findings, Detection and medicolegal aspects; Barbiturates: Classification, administration, symptoms, postmortem findings, detection and medico-legal aspects; Corrosives: HCl, H_2SO_4, HNO_3 Corrosive poisons-2: Alkalis; NaOH, KOH
Unit IV: Insecticides, Volatile Poisons [8] Organophosphorous compounds, Organochloro Compounds and Carbamates- Nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal findings; Volatile Poisons: Methyl alcohol, Chloroform. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings
Unit V: Miscellaneous Poisons [8] Animal poisons: Snake, Vegetable Poisons: Opium, Cannabis Dhatura, Oleander, Abrus precatrious, etc. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings.

Text:

1. Saferstein, Richard, Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

References:

1. Benjamin, D. M., Forensic Pharmacology. In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentic-Hall, Englewood Cliffs, New Jersey, 1993.
2. Caplan, Y. H., The Determination of Alcohol in Blood and Breath, In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, New Jersey, 1982.
3. James, S. H. and Nordby, J. J. (Eds)., Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. Karch, S. B., The Pathology of Drug Abuse. (2nd Edn.) CRC Press, Boca Raton, Florida, 1996.
5. Reject Paul. M.P, Forensic Toxicology, SSBT,New Delhi,2009

FORENSIC TOXICOLOGY PRACTICAL

FS 242 **0-0-2-1**

1. Analysis of metallic poison
2. Analysis of volatile and non-volatile poisons.
3. TLC of insecticides, Barbiturates and other drugs
4. Analysis of vegetable poisons
5. TLC of different kinds of inks
6. Lab Tests for Hallucinogens

PLANT AND ANIMAL BIOTECHNOLOGY

BT 242 **2-0-0-2**

TISSUE CULTURE LABORATORY

BT 252 **0-0-2-1**

FOREIGN LANGUAGE-II

ORGANIC CHEMISTRY-IV

CH 292 **2-0-0-2**

INORGANIC CHEMISTRY-II

CH 282 **2-0-0-2**

PHYSICAL CHEMISTRY-II

CH 272 **2-0-0-2**

LABORATORY COURSE IN CHEMISTRY-IV

CH 262 **0-0-3-1.5**

FINGERPRINT SCIENCE

FS 252 **2-1-0-3**

Course Contents:
Unit I: History and Introduction [5] Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation.
Unit II: Class and Individual Characteristics [10] Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints.
Unit III: Classification of Fingerprints [10] Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC
Unit IV: Fingerprint Developmental techniques [7] Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.
Unit V: AFIS & Biometrics [7] AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications

Text:

1. Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.
2. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.

References:

1. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
2. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
3. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
4. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
5. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

FINGERPRINT SCIENCE PRACTICALS

FS 262 **0-0-2-1**

1. Contact Prints
2. Rolled Prints
3. Analysis of Class and Individual Characteristics
4. Ridge Counting
5. Ridge Tracing
6. Identification based on Chance Prints
7. Fingerprint Lifting
8. Fingerprint Development: Iodine, Ninhydrin

FIFTH SEMESTER

FORENSIC SEROLOGY and BLOOD SPLATTER ANALYSIS

FS 371 **2-1-0-3**

Course Contents
Unit 1:Blood and its Properties [8] The nature of blood, collection, preservation and packing of blood evidence, procedures and precautions; Tests used in Blood Analysis: Identification of bloodstains by microscopic methods, Catalytic tests, crystal tests, Spectrophotometric method, chromatographic and immunological methods. Electrophoresis methods; Introduction to Body Fluids: Introduction to various body fluids, their nature and characteristics; Forensic analysis of Body Fluids: Forensic analysis of Semen, Saliva, Urine, Sweat etc.
Unit 2: Species of Origin& Grouping of Bloodstains [8] Determination of species of origin, Ring test, Immunoelectrophoresis, single diffusion, double diffusion, Crossed-Over electrophoresis, ABO system, Rh system and MN system; Techniques for the determination of blood groups.
Unit IV: Introduction to Bloodstain Pattern Analysis [10] Basic tenets of bloodstain pattern analysis, The purpose and function, history, application of basic scientific method, biohazards associated with bloodstain patterns, Characteristics of liquid blood and blood droplets under force, the effects of surface tension on individual droplets and pools of blood, the effects of terminal velocity on free falling droplets, characteristics of blood droplets on impact, effect of the volume, effect of target surface characteristics, limitations of determining distance fallen for individual droplets, relationship of angle of impact to stain shape.
Unit V: Recognition and Creation of Basic Stain Patterns [13] Passive Stains: a. Drip Patterns, Flow Patterns: Pools, saturation stains; Projected and Impact Spatter stains: Impact Patterns, splashes, cast-off patterns, arterial spurt and gush patterns, expired bloodstain patterns, transfer stains, wipe patterns, swipe patterns, transfer/contact patterns, void patterns, fly spot patterns, bubble rings, perimeter/skeletonized bloodstains. Point (Area) of Origin Determinations. Determine the impact angle, Determine directionality, determine point (area) of convergence, "stringing" and/or mathematical methods for point (area) of origin determinations, limitations

Text

1. Saferstein, R. (1998).Criminalistics, An Introduction to Forensic Science, 6th Ed. 6th Ed. Prentice –Hall

References

1. Eckert, W.G., & James S.H., Interpretation of bloodstain evidence at crime scene, CRC Press, Florida, 1989.
2. James, S.H. and Nordby, J.J. (Eds.), Forensic Science - An introduction to Scientific and investigative Techniques, CRC Press, London, 2003.
3. Kirk, P.L., Introduction in crime investigation (2nd), John Willey and, New York, 1974

SEROLOGY PRACTICALS

FS 381 **0-0-2-1**

1. Presumptive and Confirmatory tests for blood
2. Examination and Identification body fluids
3. Blood Splatter Analysis: Drop Direction, Force applied, Angle of Attack
4. Gel Immuno Diffusion tests for species origin
5. Blood Grouping

IMMUNOLOGY

MB 232 **3-1-0-4**

IMMUNOLOGY LABORATORY

MB 321 **0-0-2-1**

DIGITAL FORENSICS

FS 391 **2-1-0-3**

Course Content:

Unit 1: Cyber Crimes [8]

Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.

Unit 2: Basics of Computers [8]

Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations

Unit 3: Computer Forensics [10]

Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.

Unit 4: Forensic Tools and Processing of Electronic Evidence [13]

Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images

Text:

1. Fred Cohen, Digital Forensic Evidence Examination, Copyright (c) Fred Cohen 2009-2013 5th Edition

References:

1. C. Altheide& H. Carvey Digital Forensics with Open Source Tools, Syngress, 2011. ISBN: 9781597495868.
2. Cert-In Guidelines
3. Online Course management System: https://esu.desire2learn.com/

DIGITAL FORENSIC PRACTICAL

FS 313 **0-0-2-1**

1. Open Source Forensic Tools-Linux and Windows
2. Disk Forensics and Data Recovery
3. Anti-forensic techniques: TrueCrypt, Shredder
4. Steganography
5. Key loggers
6. Network monitors
7. Flowchart management
8. Algorithm designs
9. Registry Forensics

PROGRAMMING IN C++

FS 323 **2-1-0-3**

Course Contents:

Unit I: Introduction [10]

Introduction, Advantage, C and C++, Exception Handling, Object Oriented Programming, Standard Template Library, Types and declarations, Types, Booleans, Integer Types, Floating-Point Types, Sizes, Void, Enumerations, Declarations

Unit II: Pointers, Arrays and Structures [10]

Pointers, Arrays, Pointers into Arrays, Constants, References, Pointers to void, Structures, Expressions and Statements, A Deck Calculator, Operator Summary, Statement Summary, Comments and Indentation

Unit III: Functions [10]

Function Declarations, Argument Passing, Value Return, Overloaded Function Names, Default Arguments, Pointer to Function, Macros, Namespaces and Exceptions, Namespaces, Exceptions Source Files and Programs, Separate Compilation, Linkage, Using Header Files, Programs

Unit IV: Classes [9]

Classes, Access Control, Constructors, Member functions, Static members, Destructors, Memory allocation, Member initialization, Operator overloading, Introduction, Operator Functions, A Complete Number Type, Conversion Operators, Friends, Large Objects, Essential Operators, Subscripting, Functions Calls, Dereferencing, Increment and Decrement, A String Class, Derived class, Introduction, Derived Classes, Abstract Classes, Design of Class, Hierarchies, Class Hierarchies and Abstract Classes

Text:

1. Sumita Arora, “Introduction to C++”

References:

1. “C++ programming language” 3 rd edition by Bjarne Stroustrup.

PROGRAMING LAB IN C++

FS 333 **0-0-4-2**

1. Types and Declaration
2. Pointers
3. Arrays
4. Structures
5. Expression
6. Statement
7. Function
8. Classes
9. Derived Classes

FORENSIC PHOTOGRAPHY, DIGITAL IMAGING AND PORTRAIT PARLEY

FS 343 **3-1-0-4**

Course Contents:

Unit 1: Photography [10]

Basic principles and techniques of photography, cameras and lenses, exposing, developments and printing, Different kinds of developers and fixtures, modern developments in photography, linkage of cameras and film negatives, digital photography, digital water marking and digital imaging, photogrammetry, videography/ high speed videogaphy, crime scene and laboratory photography

Unit II: Digital Image Processing [20]

Digital image fundamentals - Digital Image through scanner, digital camera. Concept of gray levels. Gray level to binary image conversion. Sampling and quantization. Relationship between pixels. Imaging Geometry; Image

Transform; Image enhancement Point processing. Histogram processing. Spatial filtering; Image Segmentation; Image Processing

Unit III: Portrait Parley [15]

Composite Imagery: Graphic images composed of individually described characteristics of the human face; Image Modification/Identification: Methods of manipulation, enhancement and comparison; Demonstrative Evidence: Visual information used for court purposes; Reconstructive/Postmortem Drawings: Methods of identifying human remains in various conditions of decomposition

Text

1. Gonzales & Woods "Digital Image Processing" (3rd Addition) 2011

References:

1. Henry Horeustein, Colour Photography A Working Manual; Little Brow Company, Boston; (1995)
2. B.H.E. Jacobson, Sidney Ray GG Attridge, The Manual of Photograph Focal Press, London; (1998)
3. Jahne B; Digital Image Processing; Heidelberg Springer (1996)
4. Workinson, J; Art of Digital Video; Oxford Focal Press (1994)

DIGITAL IMAGING LAB

FS 353 **0-0-2-1**

1. Digitizing Image
2. Scaling Image
3. Filtering an Image
4. Image Normalization
5. Image Enhancement
6. Portrait Parley: Free Tools

SIXTH SEMESTER

INSTRUMENTATION IN FORENSIC SCIENCE

FS 372 **2-1-0-3**

Unit I: Spectroscopy [9]
Principal; Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection; Fluorescence and phosphorescence spectrophotometry: Atomic absorption spectrometry; Atomic emission spectrometry; X-ray spectroscopy, X-ray diffraction; Infrared spectrophotometry: Dispersive and Fourier Transform spectrophotometry, sample handling, quantitative analysis and interpretation of IR spectra;

Unit II: Centrifugation Techniques [10]
Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges

Unit III: Microscopy [10]
Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infrared Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

Unit IV: Mass Spectrometry [10]
Sample flow, Ionization methods, Mass Analyzer, Vaccum Systems, Correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS),

Text:

1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).

References:

2. Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993)
3. Skoog, Holler, Crouch, principles of instrumental analysis, 6th edition, 2007.
4. Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.
5. N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.

INSTRUMENTATION PRACTICAL

FS 382 **0-0-2-1**

1. Experiments in Stoichiometry
2. Molarity of Solution
3. Molality of Solution
4. Beer-Lambert Law
5. Qualitative Analysis using UV-Visible Spectrometer
6. Quantitative Analysis using UV-Visible Spectrometer
7. Sample Preparation for IR Spectrometer
8. IR Spectrometer Demonstration

WILDLIFE FORENSICS

FS 392 **2-1-0-3**

Course Contents:

Unit I: Wildlife Forensics [10]
Definition, introduction, gravity of the crime, endangered wild flora and fauna, various types of the evidences encountered their location, collection and packing; Introduction to forensic medicine and microbiology.

Unit II: Forensic Entomology [9]
Forensic importance of various insects, importance of various insect growth stages, Entomological evidences, their location, collection and packing, Determination of time since death from entomological evidences.

Unit III: Forensic Botany [9]
Introduction to Forensic Botany, Plants as Evidence, Evidence Collection and analysis, Moss as evidence, forensic microscopy, Palynology, phytoforensics, algae in forensics investigations, DNA methods in plant identification, Plant physiology and growth in forensic botany (gravesite analysis, time of deposition, geomorphology, Forensic Wood Science, Forensic mycology - spores, fruiting bodies, botanical decomposition, site conditions, commercial concerns.

Unit IV Forensic Biology [11]
Introduction, importance of various biological evidences (hair, fiber, pollens, wood), collection and evaluation in general, bite marks, human skeletal remains, importance and examination.

Text:

1. Wildlife Law News Quarterly (2007-2014), Center for Wildlife Law, University of New Mexico School of Law Wolfe, M. L. 1995. An overview of legal systems for managing wildlife, in J. A. Bissonette and P. A. Krausman (eds.) Integrating people and wildlife for a sustainable future.

References:

2. Anderson, G. S. 1999. Wildlife forensic entomology: determining time of death in two illegally killed black bear cubs. Journal of Forensic Sciences, 44:856-860.
3. Bowen, G. J., L I. Wassenaar and K. A. Hobson. 2005. Global application of stable hydrogen and oxygen isotopes to wildlife forensics. Oecologia 143:337-348.
4. Buck, S. J.. 2006. Ch 6: Managing Wildlife and Public Lands in Understanding Environmental Administration and Law, 3rd edition. Island Press.
5. Freyfogle, E. T. and D. D. Goble. 2010. Wildlife Law: A Primer. Island Press.
6. Manel, S., P. Berthier and G. Luikart. 2002. Detecting Wildlife Poaching: Identifying the Origin of Individuals with Bayesian Assignment Tests and Multilocus Genotypes.Conservation Biology 16:650-659.
7. Rawley, Edwin V. and LeeAnn Rawley. 1967. A brief history of the Utah Fish and Game: http://wildlife.utah.gov/about/history.php Utah Division of Wildlife Resources various Guide Books and publications. 2016/2017: http://wildlife.utah.gov/hunting-in-utah/hunting-information.html

MULTIMEDIA FORENSICS

FS 314 **2-1-0-3**

Unit I: Multimedia [13]
Various modalities of device fingerprints, Extraction and representation of device fingerprints, Enhancement of device fingerprints, Source device identification based on device fingerprints, Content/device linking based on device fingerprints, Content integrity verification based on device fingerprints, Source-oriented image/video clustering based on device fingerprints, Digital content hashing, Data hiding, Digital watermarking for copyright protection, Digital watermarking for content authentication, Steganography, Steganalysis

Unit II –Speech Recognition [13]

Introduction-Regular Expressions and automata-Words and transducers-N-grams Part of speech tagging-Hidden Markov and Entropy models, Speech-Phonetics-Speech synthesis-Automatic speech recognition-Speech Recognition advanced topics-Computational Phonology

Unit III – Speech Parsing and Semantics of Speech Recognition [13]

Formal grammar of English-Syntactic parsing-Statistical parsing-Features and Unification-Language and complexity, Semantics and Pragmatics-The representation of meaning-Computational Semantics-Lexical semantics- Computational lexical semantics-Computational discourse

Text:

1. Daniel Jurafsky and James Martin "Speech and Language Processing", 2nd edition, Prentice- Hall, 2008.

References:

1. Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, "Spoken Language Processing", Prentice- Hall, May 2001.
2. Paul Taylor,"Text-to-Speech Synthesis", Cambridge University Press, February 2009.
3. Samir Nanavati, Michael Thieme, Raj Nanavati "Biometrics – Identity Verification in a Networked World", WILEY- Dream Tech Edition 2009.(UNIT 1,2,3,4,)
4. Paul Reid "Biometrics for Network Security", Pearson Education.2009. (UNIT – V)
5. John D. Woodward, Jr. Wiley Dreamtech Biometrics- The Ul
6. Perry J. Gait analysis. Normal and Pathological Fuction. SLACK Incorporeted, 1992

QUESTIONED DOCUMENT EXAMINATION

FS 324 **2-1-0-3**

Course Contents:
Unit I: Introduction to Questioned Documents [8] Document and Questioned documents, Various types, Characteristic features of genuine handwriting/ signatures, Forgery and its types, characteristic components of forged documents and its examination, Disguise writings, features of disguised writings and its examination. Procedure adopted for collection of standards for comparison of documents, admitted signature/writing, specimen signature/writings.
Unit II: Principle of Handwriting Identification [8] Introduction of Handwriting, Principle of handwriting identification, Handwriting characteristics: Class and individual characteristics, Natural variations in handwriting, causes of variations, Tampered Documents: addition, alteration, obliteration, secret writing. Examination of the documents for the ink, paper, photocopies/ xerox, printouts and scanned documents.
Unit III: Various Questioned Documents Cases [10] Disputed documents - wills, deeds, cheques, suicide letters, anonymous letters, threatening letters, stamps fraud, fake currencies, fake paintings and printing, fake rubber stamps and seals, Tampered documents, charred documents, Computer generated/ electronic documents/ typed and photocopied documents.
Unit IV: Signature Verification [7] Handwriting characteristics, natural variations, principles of identifications, features encountered in forged handwriting/ signatures, characteristic features of disguised handwriting/ features, external and internal factors affecting handwriting.
Unit V: Instrumentation in Questioned Documents [6] Camera, Compound microscope, Stereo microscope, magnifying glasses, illuminated torch, Video Spectral Comparator, Docu-centre, color filters, Osborn's scale, geometrical requirements, Projectina, ESDA, Transmitted light apparatus, Oblique light, UV and IR radiations, TLC and Paper Chromatography.

Text:

1. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.

References:

1. Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998.
2. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
3. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.
4. Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
5. Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.
6. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
7. Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
8. Kurtz, Sheila, Grapholypes a new plant on handwriting analysis, Crown Publishers Inc., USA, 1983.
9. Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
10. Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.

QUESTIONED DOCUMENT EXAMINATION IN LAB

FS 334 **0-0-2-1**

1. Studying Individual Characteristics
2. Hiatus Calculation
3. Handwriting Comparison
4. Author Identification
5. Signature Verification
6. Free Hand Forgery
7. Transmitted Light Forgery
8. Auto-Forgery
9. Ink Identification

BIOINFOMATICS

BT 352 **2-1-0-3**

BIOINFOMATICS LAB

BT 314 **0-0-2-1**

FORENSIC BALLISTICS AND TOOL MARKS

FS 344 **2-1-0-3**

Course Contents:
Unit I: Arms and Ammunition [7] Definition, Indian Arms Act, Forensic Importance; Nature of firearms, parts of a firearm, classification of firearm; Ammunition: Types, Bullet comparisons, cartridge case examination, class and individual characteristics of identification.
Unit II: Analysis and Reconstruction [8] Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, and primer residues; Reconstruction of the sequence of events in a shooting case. Presentation of evidence in the court. accidental firing
Unit III: Firearm injuries [7] Terminal Ballistics, Entrance wound, exit wound and internal wound, evaluation of firearm injuries.
Unit IV: Tool Marks [8] Definition, nature, types, significance, decipherment of tool marks and techniques; Examination of tool marks
Unit V: Tyre marks, Footprints, Shoeprints and other Impressions [9] Definition, nature, its types, skid marks, tread marks, significance and examination; Introduction to Footprints and Shoeprints: Definition, nature, its types, significance and Examination; Miscellaneous impressions: Lip print, Bite marks and their examination

Text:

1. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

References:

1. James, S. H. And Nordby, J. J. (Ed), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
2. Modi, A Text Book of Medical Jurisprudence & Toxicology.
3. Saferstein, Richard, Criminalistics - An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
4. Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.
5. Bridges, B. C., Vollmar, A. Monir, M., Criminal Investigation, Practical Fingerprinting, Thumb Impression, Handwriting, Expert Testimony Opinion Evidence, The University Book Agency, Allahbad, 2000.
6. James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.
7. Nanda, B. B., and Tewari, R. K., Forensic Science in India. Select Publishers, New Delhi, 2001.
8. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

SUMMER INTERNSHIP

FS 370 **Credits: 4**

Each student will be given a short term lab attachment during the summer vacation after completing two years of the course. They are supposed to submit a project report based on the lab visit they conduct. The same shall be evaluated out of a maximum marks of 100 and the student may be evaluated on Content, Presentation and Viva.

The presentation should preferably be performed in front of a panel.

Mody University of Science & Technology

B.Sc. (Hons) Physics
Session 2019-2020

Curriculum Structure

B. Sc. (Hons.) Physics

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)

No. of Seats: 20

Objectives:

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The programme offers core skills in physics as well as maths, which instills in the knowledge about the fundamental aspects of physics. With this course, Mody University aims to open many doors for their students by offering Courses in Atomic and Molecular Physics, Electronics, Applied Electronics, Nuclear Physics, Nano sciences, etc. The student will be able to select various options for higher studies like M.Sc. in Physics, Applied Physics, and Electronics. In addition, the programme provides good combinations to create interest of undergraduate students towards M. Tech. in Allied Sciences including Electronics, Astrophysics, Material Science, Laser Technology, Nuclear Science, Opto- electronics and Nanoscience. Further, they have scope for absorption in research Labs.

The first batch of this programme in MUST/ Mody University proposed to be admitted in the session 2015-16.

Input Qualification:

A pass in 10+2 examination of CBSE, or its equivalent from any Board, in Science stream with Physics and Mathematics as subjects and adequate proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of MUST/ Mody University shall be followed.

B. Sc.(Hons.) Physics

Three-Year Programme

Academic Curriculum (2015 – 16 onwards)

First Year

First Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total	**20/19**	**-**	**7/8**	**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

Second Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental Studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total	**15/17**	**-**	**11/ 12**	**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

Third Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total	**21/21**	**1/1**	**7/8**	**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

Fourth Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special Theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢	**16/15**	**2/2**	**7/8**	**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry****<u>Or</u>* ***Computer Science*** *may only be opted in first four semesters.*

B.Sc. (H) Physics
Batch 2016-17 and onwards
Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 323	**Statistical Mechanics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 333	**Fiber Optics**	**3**	**1**	**-**	**4**	3	25	25	50
	PH 343	**Computational Physics**	**2**			**2**	3	25	25	50
	PH 321	**Physics Laboratory V**			**4**	**2**	4	25	25	50
	PH 353	**Computational Laboratory**			**4**	**2**	4	25	25	50
	PH 363	**Project (Minor)**				**2**				
		Total Credits				**20**				
	GE 301	Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	**Elements of Nuclear Physics**	**2**	**-**	**-**	**2**	3	25	25	50
	PH 334	**Microwaves**	**4**	**-**	**-**	**4**	3	25	25	50
	PH 372	Basics of Nanoscience and Exotic Materials	3	-	-	3	3	25	25	50
	PH 332	**Physics Laboratory VI**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 344	**Electronic Laboratory**	**-**	**-**	**4**	**2**	4	25	25	50
	PH 354	**Project (Major)**				**4**				
		Sub Total	**14**	**-**	**8**	**20**				
	GE 302	Proficiency (Non-Credit) #				**1**				

Course Description

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata

McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]
2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)
2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields
2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics
2. Frederick Reif : Fundamentals of Statistical and Thermal Physics

3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions

using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect. [12]

Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable [13]

coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application)

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:

4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter. [8]

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation [4]

(Basic Concepts only).

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic [6]

Crystals, reciprocal lattice, Brillouin Zones

3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, S. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials. [6]

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5thEdition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points.	[8]
Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates.	[8]
Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.	[8]
Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes.	[8]
Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems.	[7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix	[13]

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad.

MS 112 Abstract Algebra 3-0-0-3

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition. [11]

Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group [10]

Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem. [10]

Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation. [8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.
   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines. [4]

First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form. [14]

Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters [12]

Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only) [9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.

2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension [12]

Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis. [10]

Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces. [9]

Inner Product Space: Inner produt space, norm of a vector, Orthogality. [8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.
   D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant [14]

coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients.

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation formulae, Sterling, Bessel Formula. [8]

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems

and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as [8]

Traversal, Insertion, Deletion, Searching.

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, “Operating Systems”, New Delhi
2. Ritchie, “Operating System”, BPB Publication , New Delhi
3. Dhamdhere D. M. “System Programming and Operating System”, TMH New Delhi
4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi

3. Parasons D., "Object Oriented Programming With C++",BPB, New Delhi
4. LaelorSteaven C., "The Art of Programming Computer With C++", Vikas Publication.
5. Dietel&Dietal, "Introduction to C++".

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, "Information Systems for Modern Management", PHI, New Delhi
2. Jawadkar, "Management Information System", TMH, New Delhi

Reference Books:

1. Sadagopan, "Management Information System"PHI, New Delhi
2. Parker, Case, Thomas, "Management Information System: Strategies and Action", TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, "System Analysis and Design", TMH, New Delhi
2. Hawayszkiewyez Igor, "Introduction To System Analysis and Design" PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks "An Introduction To System Analysis Techniques" PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, "System Analysis and Design Methods", TMH. New Delhi
3. Manish soni&SanjeevPatwa "System Analysis and Design" UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of

corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint

2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. **[8]**

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in

crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint

2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 **Organic Chemistry-II** **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.

3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 **Laboratory Course in Chemistry-II** **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 **Genetics** **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 **Basic Physics** **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India. [6]

Human Population and the Environment: Population [5]

growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

CH 291 Physical Chemistry-I **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their

differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004,

RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213 **Inorganic Chemistry-I** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[6]**

Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[5]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 **Organic Chemistry-III** **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid

and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 Laboratory Course in Chemistry-III **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

Mody University of Science and Technology

School of Liberal Arts and Sciences

BSc PCM
2019-20

Department of Science

B. Sc. (PCM/PMC)
Physics, Mathematics, Computer Science/ Chemistry
Three-Year Programme
Academic Curriculum (2012 – 13 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Courses***								
	EL 101	Foundation Course in English	2	-	-	2	3	25	25	50
	CA 111	Fundamentals of Computer and Information Technology	3	-	-	3	3	25	25	50
		Physics								
	PH 111	Mechanics, Properties of Matter and Relativity	3		-	3	3	25	25	50
	PH 121	Electromagnetism	2	-	-	2	3	25	25	50
	PH 131	Physics Laboratory-I	-	-	4	2	4	25	25	50
		Mathematics								
	MS 111	Calculus	3			3	3	25	25	50
	MS 121	Matrices & Theory of Equations	3			3	3	25	25	50
		Computer Science[¢]								
	CA 121	Programming Concepts using C Language	3	-	-	3	3	25	25	50
	CA 151	C Language Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 181	Physical and Inorganic Chemistry-I	2			2	3	25	25	50
	CH 191	Organic Chemistry-I	2			2	3	25	25	50
	CH 171	Laboratory Course in Chemistry-I			3	1.5	4	25	25	50
		Sub Total				**23.5/ 23**				
	GE 101	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
	CA 141	Application Software Laboratory	-	-	4	2	4	25	25	50
	MDC 003	Environmental studies	3	1	-	4	3	25	25	50
		Physics								
	PH 122	Thermodynamics and Statistical Physics	3	-	-	3	3	25	25	50
	PH 132	Oscillations and Waves	2			2	3	25	25	50
	PH 142	Physics Laboratory-II	-	-	4	2	4	25	25	50
		Mathematics								
	MS 112	Abstract Algebra	3	-	-	3	3	25	25	50
	MS 122	Differential Equations – I	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 122	Data Structure through C	3	-	-	3	3	25	25	50
	CA 162	Data Structure Laboratory	-	-	4	2	4	25	25	50
	CA 112	Operating System	3	-	-	3	3	25	25	50
		Chemistry[§]								
	CH 182	Physical and Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 192	Organic Chemistry-II	2	-	-	2	3	25	25	50
	CH 172	Laboratory Course in Chemistry-II	-	-	3	1.5	4	25	25	50
		Sub Total				**24.5/ 27**				
	GE 102	Proficiency (Non-Credit) #	-	-	-	1				

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Compulsory Course***								
		Foreign language-I	3	-	-	3	3	25	25	50
		Physics								
	PH 211	Semiconductor Physics and Electronics	3	-	-	3	3	25	25	50
	PH 221	Optics and Lasers	3	-	-	3	3	25	25	50
	PH 231	Physics Laboratory-III	-	-	4	2	4	25	25	50
		Mathematics								
	MS 211	Linear Algebra	3		-	3	3	25	25	50
	MS 221	Differential Equations – II	3	1	-	4	3	25	25	50
		Computer Science[¢]								
	CA 241	Object Oriented Programming through C++	3	-	-	3	3	25	25	50
	CA 271	Object Oriented Programming Laboratory	-	-	4	2	4	25	25	50
	CA 231	Management Information System	3	-	-	3	3	25	25	50
		Chemistry[$]								
	CH 291	Physical Chemistry-I	2	-	-	2	3	25	25	50
	CH 213	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 223	Organic Chemistry-III	2	-	-	2	3	25	25	50
	CH 281	Laboratory Course in Chemistry-III	-	-	3	1.5	4			
		Sub Total				**25.5/ 26**				
	GE 201	Proficiency (Non-Credit) #	-	-	-	1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Compulsory Courses***								
		Foreign Language-II‡	3	-	-	3	3	25	25	50
		Physics								
	PH 212	Mathematical Physics and Special theory of Relativity	3	1		4	3	25	25	50
	PH 222	Physics Laboratory-IV	-	-	4	2	4	25	25	50
		Mathematics								
	MS 212	Numerical Analysis	3	1	-	4	3	25	25	50
	MS 222	Real Analysis	3	-	-	3		25	25	50
		Computer Science[¢]								
	CA 132	System Analysis and Design	3	-	-	3	3	25	25	50
	CA 272	Computational Numerical Analysis Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 272	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH 282	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH 292	Organic Chemistry-IV	-	-	-	2	3	25	25	50
	CH 262	Laboratory Course in Chemistry-IV	-	-	3	1.5	4			
		Sub Total ¢				**23.5/ 21**				
	GE 202	Proficiency (Non-Credit) #	-	-	-	1				

‡ *Refer to the Foreign Languages Section*

§ *Refers* ***Chemistry courses***

¢ *Refers* **Computer Science**

Note: *In addition to the compulsory courses, <u>either</u> all courses of* ***Chemistry*** *<u>Or</u>* ***Computer Science*** *may only be opted in each semester.*

Third Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester		***Physics***								
	PH 311	Quantum Mechanics and Spectroscopy	3	1	-	4	3	25	25	50
	PH 321	Physics Laboratory-V	-	-	4	2	4	25	25	50
		Mathematics								
	MS 311	Optimization Theory	3	1	-	4	3	25	25	50
	MS 321	Complex Analysis	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 221	Database Management System	3	-	-	3	3	25	25	50
	CA 261	Database Management System Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 371	Physical Chemistry-III	2	-	-	2	3	25	25	50
	CH 381	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH 391	Organic Chemistry-V	2	-	-	2	3	25	25	50
	CH 361	Laboratory Course in Chemistry-V	-	-	3	1.5	4			
		Sub Total				**20.5/18**				
		Proficiency (Non-Credit) #				**1**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester		***Physics***								
	PH 312	Solid State Physics and Devices	3	-	-	3	3	25	25	50
	PH 322	Elements of Nuclear Physics	2	-	-	2	3	25	25	50
	PH 332	Physics Laboratory VI	-	-	4	2	4	25	25	50
		Mathematics								
	MS 312	Special functions and Transforms	3	1	-	4	3	25	25	50
	MS 322	Dynamics and Mechanics	3	-	-	3	3	25	25	50
		Computer Science[¢]								
	CA 222	Computer Networks	3	-	-	3	3	25	25	50
	CA 262	Windows Programming Laboratory	-	-	4	2	4	25	25	50
		Chemistry[§]								
	CH 392	Physical Chemistry-IV	2	-	-	2	*3*	25	25	50
	CH 314	Inorganic Chemistry-IV	2	-	-	2	3	25	25	50
	CH 324	Organic Chemistry–VI	2	-	-	2	3	25	25	50
	CH 382	Laboratory Course in Chemistry-VI	-	-	3	1.5	4			
		Sub Total				**21.5/19**				
		Proficiency (Non-Credit) #				**1**				

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

$ *Evaluation of internship would comprise project report and viva-voce.*

Optional Courses

§ -***Chemistry courses***

¢ -**Computer Science**

Note: **1**.*The Programme includes two different combinations:*

(i) PCM (Physics, Chemistry and Maths) &

(ii) PMC (Physics, Maths and Computer Science)

2. *In addition to the compulsory courses, either all courses of* ***Chemistry Or Computer Science*** *may only be opted in each semester*

Overall Credits: Physics: 41; Mathematics:40; Chemistry: 41: Computer Science: 36 (+5)

Total Credits (With Chemistry as optional) 135
Total Credits (With Computer Science as optional) 130

Course Description

Compulsory Courses

Physics

PH 111 Mechanics, Properties of Matter and Relativity 3-0-0-3

Mechanics: Laws of motions, Inertial and non-inertial frames of reference, Rotating frame, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, Conservation of linear and angular momenta. [8]

Properties of Matter: Elasticity, Young's modulus, Modulus of rigidity, Poisson's ratio, relation connecting different elastic-constants, twisting couple of a cylinder(solid and hallow), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever, Determination of Young's modulus by bending of beam. [10]

Fluid Mechanics: Kinematics of moving fluids, equations of continuity, Euler's equation, Bernaulli's theorem, viscous fluids, streamline and turbulent flow, Poiseulle's law, Capillary tube flow, Reynold's number, Stokes law. [7]

Relativity: Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum. [14]

Text Books:

1. D.S.Mathur. Mechanics, S. Chand Publications, New Delhi
2. Resanick and Halliday: Physics Part –1

Reference Books:

1. H.C.Verma : Concept in Physics Vol. I
2. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol I.

PH 121 Electromagnetism 2-0-0-2

Vector Calculus: Gradient, divergence and curl operators, Physical significance [7]

Electromagnetism: Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, Biot and Savart's law, calculation of H order in simple geometrical situations, Ampere's Law $\nabla.B=0$, $\nabla xB=\mu_0 \mathbf{J}$, field due to magnetic dipole, magnetization current, magnetization vector, Half order field, magnetic permeability (linear cases), interpretation of a bar magnet as surface distribution of Solenoidal current. [10]

Time Varying Fields: Electromagnetic induction, Faraday's law, electromotive force, $\varepsilon = \int$ E.dr. integral and differential forms of Faraday's Law. Mutual and self inductance, transformers, energy in a static magnetic field, Maxwell's displacement current, Maxwell's equations, Electromagnetic field density. [10]

EM wave propagation: The wave equation satisfied by E and B, Plane electromagnetic waves in vacuum, Poynting's vector, Reflection at plane boundary of dielectrics, Polarization by reflection and total internal reflection, Faraday effect, Waves in a conducting medium [12]

Text Books:

1.David J. Griffiths: Introduction to Electrodynamics (3rd Edition)

2. Gupta and Kumar: Electromagnetics

Reference Books:

1.P. Lorrain and O. Corson: EM Waves and Fields

2.A. S. Mahajan and AA Rangwal: Electricity and Magnetism

PH 131 Physics Laboratory-I 0-0-4-2

Assignments are based on the course PH 111 and PH 141

PH 122 Thermodynamics and Statistical Physics 3-0-0-3

Thermodynamics: Reversible and irreversible processes, Carnot's cycle and Carnot's theorem, Second law of thermodynamics, Thermodynamic scale of temperature. [7]

Concept of entropy: Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram [8]

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations, Clapeyron equations, Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem. [10]

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Vander Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to super fluidity [6]

Statistical Mechanics: State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters. [8]

Text Books:

1. K.W. Zeemansky: Heat and Thermodynamics
2. BrijLal and N. Subramanyam.:Heat and Thermodynamics

Reference Books:

1. B.K. Agarwal: Thermal Physics

2. Frederick Reif : Fundamentals of Statistical and Thermal Physics
3. R.K. Pathria: Statistical Mechanics (2nd Edition):

PH 132 Oscillations and Waves 2-0-0-2

Oscillations: Simple harmonic oscillations, Differential equation of SHM and its solution, Amplitude, Frequency, Time Period and Phase, Velocity and acceleration. Kinetic, Potential and total energy and their time average values. Free oscillations of systems with one degree of freedom : (i) Mass-Spring system, (ii) Simple Pendulum, (iii) Torsional Pendulum, (iv) Compound pendulum (v) Bar Pendulum. [6]

Superposition of Two Collinear Harmonic Oscillations: Linearity and superposition principle. (i) Oscillations having equal frequencies and (ii) Oscillations having different frequencies (Beats). Superposition of N Collinear Harmonic oscillations [6]

Free Oscillations; Damped oscillations; Damping coefficient, Log decrement; Forced oscillations : Transient and steady states, Amplitude, Phase, Resonance, Sharpness of resonance, Power, Dissipation and Quality Factor. [7]

Waves: Plane and spherical Waves, Longitudinal and transverse waves, Plane progressive (Traveling) waves. Wave equation. Particle and wave velocities. Differential Equation. Pressure of a longitudinal wave. Velocity of waves : Velocity of transverse vibrations of stretched strings, Newton's formula for velocity of sound; Laplace's correction [7]

Text Books:

1. N.K. Bajaj: The Physics of Waves and Oscillations, Tata cGraw-Hill, 1988.
2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Oscillations and Waves, CBC, Jaipur
3. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.

Reference Books:

1. A. P. French : Vibrations and Waves ,CBS Publications, 1987
2. BrijLal and N. Subramanyam: Waves and Oscillations

PH 132 Physics laboratory-II 0-0-4-2

Assignments are based on the course PH 122 and PH 132, etc.

PH 211 Semiconductor Physics and Electronics 3-0-0-3

Semiconductor Physics: Intrinsic and extrinsic semiconductors, P-N junction diode, Diode equation, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode. [9]

Electronics : Transistor circuits, Input, Output characteristics and CB and CE modes, DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response. [6]

Hybrid parameter: Analysis of transistor amplifier (with and without load) using h- parameters, simplified hybrid model, brief idea about hybrid model Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier [10]

Feedback in amplifiers: Positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits. Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. [8]

Digital Electronics: Diode and transistor equivalent circuits of basic and derived gates, Universal gates, X-OR and equivalence. Simplification of Boolean expressions using K- maps. Sequential circuits, Flip flops. [6]

Text Books:

1. Millman and Halkias: Integrated Electronics:
2. Chattopadhyay and Rakshit: Electronics Fundamental and Application

Reference Books:

1. Malvino and Leach: Principle of Digital Electronics:
2. Gupta and Kumar: Hand book of Electronics

PH 221 Optics and Lasers 3-0-0-3

Interference: Young's experiment, Conditions for sustained interference, Theory of interference, Fresnel's biprism, Determination of wavelength of light, Interference in parallel and edge shaped films, Colour of thin films. Newton's rings determination of wavelength of light, Michelson interferometer and their applications. [10]

Diffraction: Definition, Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, Plane transmission grating and its resolving power. [10]

Polarization: Polarized light and its mathematical representation, Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light, Optical activity. [9]

Lasers: Einstein's A and B coefficients, Spontaneous and Stimulated conditions for laser action population inversion, optical pumping, Working of different types of lasers: semiconductor, rubey and He-Ne Lasers. [10]

Fiber optics: Working, Numerical aperture

Text Books:

1. N. Subrahmanyam, Brijlal and M. N. Avadhanulu: A textbook of Optics
2. A.Ghatak: Optics, Tata McGraw-Hill

Reference Books:

1. B. K. Mathur and T. P. Pandya: Physical Optics

PH 231 Physics laboratory-III 0-0-4-2

Assignments are based on the course PH 211 and PH 221

PH 212 Mathematical Physics and Special Theory of Relativity 3-1-0-4

Curvilinear Coordinates: Orthogonal curvilinear coordinate systems, scale factors, expression for grade, divergence, curl and their application to Cartesian, circular cylindrical and spherical polar coordinate systems. [9]

Coordinate transformation and Jacobean, Transformation of covariant, contra variant and mixed tensor. Addition, multiplication and contraction of tensors. Metric tensor and its use in transformation of tensors [7]

Dirac-delta function and its properties. Lorentz transformation and rotation in space-time, time like and space like vectors, world line, and macro-causality [6]

Four vector formulation: energy- momentum Four vector, relativistic equation of motion invariance of rest mass, orthogonality, four force and four velocity, Lorentz [12]

force as an example of four force transformation of four frequency vector, longitudinal and transverse Doppler's effect.
Transformation of electric and magnetic fields between two inertial frame

Differential Equations: The second order liner differential equation with variable coefficient and singular points, series solution method and it application to the Hermite's Legendre's and Laguerre's differential equation. Basic properties (without proof) like orthogonality, recurrence relation, Graphical representation and generating functions of Hermite, Lagendre, Leguerre and Associated Legendre functions (very simple application) [13]

Fourier Analysis: Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms [5]

Text Books:

1. George Arfken: Mathematical Method for Physicists (Academic Press).
2. S.L.Kakani, C. Hemrajani, T.C. Bansal: Mathematical Physics and Special Theory of Relativity, CBC, Jaipur
3. D. E. Bourne, P C Kendall: Vector Analysis and Cartesian Tensors, 3ed (Chapman & Hall, 1992)

Reference Books:

1. A.P. French: Special Relativity
2. P. K. Chattopadhyay: Mathematical Physics.
3. Gupta and Kumar: Mathematical physics

PH 222 Physics Laboratory IV 0-0-4-2

Assignments are based on Course PH 211 etc.

PH 311 Quantum Mechanics and Spectroscopy 3-1-0-4

Failure of Classical Physics: Black body radiation (without derivation), Photoelectric effect, Compton effect Wave Packets and Uncertainty Relation: de-Broglie hypothesis, Wave-particle duality, Wave packets, Group velocity and phase velocity, Uncertainty principle. [10]

Wave Mechanics: Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Commutation relations [15]

Schrödinger Wave Equation and Applications: Particle in one dimensional Box, Square well, Rectangular potential barrier and tunneling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom. [12]

Spectroscopy: Quantum futures for spectra of single valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect, Two valence electron atoms: LS and JJ coupling schemes and resulting spectra, Idea of normal and inverted doublets. [15]

Text Books:

1. V. Devanathan:Quantum Mechanics

2. S.L.Kakani, C. Hemrajani, T.C. Bansal, Elementary Quantum Mechanics and Spectroscopy, CBC, Jaipur

Reference Books:

1. Loknathan and Ghatak:Quantum Mechanics
2. S. Gasiorowicz: Quantum Physics
3. B. H. Bransden and C. J. Joachain: Quantum Mechanics:
4. H.E. White, Introduction to Atomic Physics
5. R.P. Feynimann, R.B. Leigton and M Sands, The Feymann Lectures on Physics, Vol VIII.

PH 331 Electromagnetic Theory 4-0-0-4

1. **Maxwell's Equations:** Concept of Displacement Current, Vector and Scalar Potentials, Boundary Conditions at boundary of different media, Wave equations and plane waves in Dielectric media, Poynting Theorem, Physical concept of Electromagnetic field, Energy density, Momentum density. [8]

2. **Reflection and Refraction of EM Waves:** Reflection and refraction of a plane wave by interface between dielectrics, Fresnel Formulae, Total internal reflection, Brewster's angle, Waves in conducting media, Metallic reflection for normal incidence. [10]

3. **Plasma and Ionosphere:** Concept of skin depth, Microscopic media (Plasma) and Maxwell's equations, Plasma frequency, Refractive index, Conductivity of an ionized Gas, Propagation of e.m. waves through Ionosphere. [12]

4. **Polarization of EM Waves:** Different types of polarizations (Linear, Circular and Elliptical), e.m. Fresnel's formula, Uniaxial and biaxial crystals, Polarization by double refraction, Nicol Prism, Ordinary and Extraordinary Refractive indices, Phase retardation plates: Quarter-Wave and Half-Wave Plates, Analysis of Polarized Light, Polarimeter. [10]

5. **Rotatory Polarization:** Optical rotation, Biot's Laws for [8]

Rotatory Polarization, Fresnel's Theory of Optical Rotation, Experimental verification of Fresnel's Theory, Specific Rotation, Laurent's Half-Shade Polarimeter.

6. **Fiber Optics:** Planar Optical Wave Guides, Propagation through optical fiber, Types, Numerical aperture, Modes of Propagation (Basic Concepts only). [4]

Text Books:

1. A.Z. Capri and P.V. Panat: Introduction to Electrodynamics, Narosa Pub. House, New Delhi, 2002
2. David J. Griffiths: Introduction to Electrodynamics, 3rd Edition, Benjamin Cummings 1998
3. J. D. Jackson: Classical Electrodynamics, 3rd Edition, Wiley, New York, 1998
4. M. Lifshitz and L. D. Landau: Classical Theory of Fields (Course of Theoretical Physics), 2nd Edition, Pergamon Pr., 1981.

Reference Books:

1. Joseph A. Edminister: Electromagnetics, 2nd Edition, Tata McGraw Hill, New Delhi, 2006.
2. M.A.W. Miah: Fundamentals of Electromagnetic, Tata McGraw Hill,1992
3. Liang Chi Shen, Jin Au Kong: Applied electromagnetism, PWS Pub. Co., 1995.

PH 341 Atomic and Molecular Physics 4-0-0-4

1. **Atomic Physics:** Spectra of Hydrogen, Deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules. [7]

2. **Earth Spectra:** Singlet and triplet fine structure in alkaline earth spectra [5]

3. **Week spectra:** continuous X-ray spectrum and its dependence on voltage, Duane and Hunt's law. Characteristic X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra. [8]

4. **Molecular Physics:** Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotational and vibrational spectra. [10]

5. **Vibration Spectra**: Dissociation limit for the ground and other

electronic states, transition rules for pure vibration and electronic vibration spectra. [6]

6. **Raman Effect:** raman Effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. [8]

7. **Spectroscopic Techniques**: Sources of excitation, prism and grating spectrographs for visible, UV and IR, absorption spectroscopy, double beam instruments. [8]

Text Books:

1. Robert Eisberg and Robert Resnick: Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons Inc, 1985
2. H.E. White: Introduction to Atomic Spectra, McGraw-Hill book company, Inc.
3. C.N. Banwell: Molecular Spectroscopy, Tata-McGraw Hill Publishers, New Delhi, 1993

Reference Books:

1. R.C. Johnson: Introduction to Molecular Spectra, Pitman Publishing Corp., New York, 1949
2. D. P Khandelwal : Optics and Atomic Physics, Shiva Lai Agarwala & Company, Educational Publisher, 1973
3. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.

PH 351 Elements of Classical Mechanics 2-0-0-2

1. System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field. [10]

2. Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. [6]

3. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity. [10]

Text Books

1.H. Goldstein: Classical Mechanics: 3rd Edition, Addison-Wesley Pub, 2001

2. L . D. Landau and E. M. Lifshitz: Classical Mechanics: A Course of Theoretical Physics, Vol.1, 3rd Edition , Pergamon Press, 1976.

3. K. C. Gupta: Classical Mechanics of Particles and Rigid Bodies, Wiley Eastern, New Delhi, 1988

Reference Books:

1. R. G. Takwale and Puranik: . Introduction to Classical Mechanics, 24th Edition, Tata-McGraw Hill, New Delhi, 1991

2. N. C. Rana and P. Joag: Introduction to Classical Mechanics, Tata McGraw Hill, 1992.

PH 361 General and Optics Based Laboratory 0-0-4-2

Assignments are based on the course PH 341,etc

PH 371 Electronics Laboratory 0-0-4-2

Assignments are based on the course PH 331,etc

PH 342 Solid State Physics 3-0-0-3

1. **Structure**: Crystal structure, periodicity, lattices and bases, fundamental translational vectors, unit cell, lattice types, Bravais lattices, Miller indices for direction and planes, Common crystal structures like NaCl, ZnS and Diamond; Close packed structures, Lau theory of X-ray diffraction, X-ray diffraction, Bragg's law. [9]

2. **Bonding**: Potential between a pair of atoms, concept of cohesive energy, covalent, Vander Waals, ionic and metallic Crystals, reciprocal lattice, Brillouin Zones [6]
3. **Thermal Properties**: Lattice vibrations, Vibrational modes of continuous medium, Debye's model: lattice specific heat, Phonons, Density of states. [7]
4. **Electronic Properties**: Free electron gas, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors; Hall Effect, Fermi surface [10]
5. **Magnetic Properties**: Magnetic moment, magnetic susceptibility, Dia-, Para and Ferromagnetism, Ferromagnetic domains. [7]

Text Books:

1. C. Kittel: Solids State Physics, 6th edition, John Wiley & Sons, NY, 1986
2. R. L. Singhal, Solid state Physics, KNRN Pub., Meerut, 1998

Reference Books:

1. Decker: Solids State Physics, Prentice-Hall, New York, 1962
2. Azarof: .Introduction to Solids, Mc-Graw-Hill Book Co., Inc.
3. S.O. Pillai, Solid State Physics, 6th Edition, New Age International Pub, 2005.

PH 352 Nuclear and Particle Physics 4-0-0-4

1. **Nuclear Structure**: Properties of Nuclei and Models, Introduction to the nucleus, Fermi gas model, Deutron Binding energy, Semiemperical mass formula, Mass diffect, Packing fraction and its application to explain most stable isobars and nuclear fission, Magnetic dipole moment, quadrapole moment, angular momentum, Effect of mass number on size of nucleus Condition of stability for isobars. [9]

2. **Nuclear Models**: Liquid drop model, fission and potential barrier, N-N and P-P chains, Nuclear reactors, Nuclear fission and fusion. [6]

3. **Nuclear Force and Two-Nucleon System:** Properties of nucleon-nucleon interaction, General forms of nucleon- nucleonpotential, Neutron-proton scattering for low energies: scattering length, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well). [10]

4. **Nuclear Stability:** Nucleon emission, separation energy, Alpha decay and its energy spectrum, WKB Approximation, Beta decay and its energy spectrum (for example,137Cs), Need for neutrinos, Q-values, Gamma decay, Parity and Selection rules for gamma transitions (no derivation). [10]

5. **Accelerators and Detectors**: Cyclotron, Betatron, Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector. [5]

6. **Elementary Particles**: Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion), energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness. [5]

7. **Classification of Particles:** Interactions, Quantum numbers, Quarks as the building blocks of hadrons, Colour degree of freedom. [7]

Text Books:

1. S. S. M. Wong: Introductory Nuclear Physics, 2nd Edition, John Wiley & Sons, New York, 1998
2. D.C. Tayal, Nuclear Physics, Himlaya Publishing House, 5th Ed, 1992
3. S.L.Kakani, C. Hemrajani, T.C. Bansal, Nuclear Physics, CBC, Jaipur, 2005
4. S. N. Ghosal: Nuclear Physics, **S**. Chand Limited, 1997

Reference Books:

1. B. L. Cohen: Concepts of Nuclear Physics, Tata McGraw-Hill New Delhi, 1971
2. H.A. Enge, Introduction to Nuclear physics, Addison Wesley, Publishing company, Inc. New York, 1 974
3. A. Bieser, prospective of Modern Physics, 22nd Reprint, Tata McGraw-

Hill, New Delhi, 2008

PH 362 Statistical Mechanics 4-0-0-4

1. **Random Walk Problem:** Probability distribution, Mean and Dispersion and Simple Numerical Problems. [8]

2. **Basic Concepts of Statistical Physics**: Entropy and thermodynamic probability, Ensemble theory, partition function, applications to classical ideal gas, Gibbs paradox; Statistical equivalence of three ensembles. [7]

3. **Classical Theory of Radiation:** Properties of Thermal Radiation, Blackbody Radiation, Stefan-Boltzmann Law and Wien's Displacement law. [6]

4. **Quantum Nature of Radiation:** Planck's Postulates. Planck's Law and Blackbody Radiation, Experimental Verification. Derivations of Wien's Distribution Law, Rayleigh-Jeans Law from Planck's Law. [8]

5. **Bose-Einstein's Condensation:** B-E Distribution law, Completely Degenerate Bose Gas, Bose-Einstein condensation, Properties of liquid He, Radiation as photon gas. [10]

6. **Fermi-Dirac Statistics:** F-D Distribution Law, ideal completely Degenerate Fermi Gas and Thermodynamic functions, Fermi Energy, Electron gas in a metal, Specific Heat of Metals. Maxwell-Boltzmann statistics as a classical limit, Comparison of the three statistics, White Dwarf Stars, Chandrasekhar Mass Limit. [13]

Text Books:

1. Frederick Reif: Fundamentals of Statistical and Thermal Physics, Waveland Press 2009
2. R. K. Patharia: Statistical Mechanics, Oxford: Butterworth, 1996
3. K. Huang: Statistical Mechanics, Wiley, 1987 .

Reference Books:

1. S. Lokanathan and R.S. Gambhir: Statistical and Thermal Physics: an introduction, P.H.I., 1991
2. F. Reif: Statistical Physics, Berkeley Physics Course Volume 5, Tata McGraw-Hill Company Ltd, 2008

PH 372 Basics of Nano-Science and Exotic Materials 3-0-0-3

1. **Physics for Nano-Science:** Electron Band Structure and Its [6]

Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

2. **Basic Concepts of Nanomaterials:** Physical, Chemical and Bio-routes for Synthesis of Nanomaterials (basic idea), Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Nano photonics, Some applications of Nano Materials. [15]

3. **Introduction to Exotic Materials:** High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Some Application of CMR materials. [14]

4. **Quasicrystals:** Basic definition of quasicrystal and Structure of Quasicrystals. [4]

Text Books:

1. C.P. Poole and F.J. Owens: Introduction to Nanotechnology, John Wiely & Sons, NJ, 2003

2 .C.M. Niemeyer and C.A. Mikin: Nanobiotechnology : Concepts, Applications and Perspectives, John Wiley & Sons, NJ, 2004

Reference Books:

1. Charles Kittel: Introduction to Solid State Physics, 5th Edition, John Wiley & Sons, NY, 1986.

PH 382 Solid State and Nuclear Laboratory 0-0-4-2

Assignments are based on the course PH 342, PH 352, etc

PH 392 Optoelectronics Laboratory 0-0-4-2

Combined Assignments are based on Lasers, Optical Fibers, PH 341, etc.

Mathematics

MS 111 Calculus 3-0-0-3

Curvature: Curvature, Radius of curvature for Cartesian curves, parametric curves, Polar curves and Pedal curves, Centre of curvature. Circle of curvature, Chord of curvature, Tests for concavity and convexity, Points of inflexion, Multiple points. [8]

Asymptotes and Curve Tracing:: Asymptotes in Cartesian and polar coordinates, Intersection of a curve with its asymptotes**, a**pplication of differential calculus in curve sketching in Cartesian and polar co-ordinates. [8]

Differentiation: Partial differentiation, Euler's theorem for homogeneous functions,Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers. [8]

Integral Calculus:*:* Double integrals in Cartesian and polar coordinates, Change of order of integration, Triple integral, Applications of double and triple integrals in finding areas and volumes. [8]

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems (without proof) and problems based on these theorems. [7]

Text Books:

1. Thomas and Finney: Calculus and Analytic Geometry, Ninth Edition.
2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

1. N. Saran and S.N. Nigam: Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.
2. Differential and Integral Calculus: Shanti Narayan.
3. D. C. Gokhroo, Differential Calculus, Navkar Prakashan.
4. N. Piskunov: Differential and integral Calculus. Peace Publishers, Moscow.
5. Gorakh Prasad: Differential Calculus. Pothishasla Pvt. Ltd., Allahabad.
6. Gorakh Prasad: Integral Calculus. Pothishala Pvt. Ltd., Allahabad.

MS 121 Matrices and Theory of Equations 3-0-0-3

Matrix: Matrices, Symmetric, Skew symmetric, Hermitian and skew Hermitian matrices. Elementary Operations on matrices Rank of a matrices, Inverse of a matrix. Linear dependence and independence of rows and columns of matrices, Row rank and column rank of a matrix, [13]

Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding the inverse of a matrix

Applications of Matrices: Applications of matrices to a system of linear (both homogeneous and non–homogeneous) equations. Theorems on consistency of a system of linear equations. Unitary and Orthogonal Matrices, Bilinear and Quadratic forms [9]

Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots. Common roots and multiple roots. Transformation of equations. [9]

Solution of equations: Nature of the roots of an equation, Descarte's rule of signs. Solutions of cubic equations (Cardon's method). Biquadratic equations and their solutions . [8]

Text Books:

1. Higher Algebra: A. Kurosh (Moscow Mir Publisher 1972).
2. Theory of Equations: (Lecture notes for inter University Leadership project in Mathematics by R.N. Gupta, Surjeet Singh and R.J. Hans.

Reference Books:

MS 112 Abstract Algebra 3-0-0-3

1. H.S. Hall and S.R. Knight: Higher Algebra, H.M. Publications 1994.
2. Shanti Narayan: A Text Books of Matrices.
   Chandrika Prasad: Text Book on Algebra and Theory of Equations.
   Pothishala Private Ltd., Allahabad.

Group: Algebraic structure**,** Definition of a group with examples and simple properties, Abelian group, semi group, Order of an element of a group, Cyclic groups, Coset decomposition.	[11]
Subgroup and quotient Groups: Subgroups, Normal subgroups, Normalizer of an element, Quotient group	[10]
Group Morphism: Homomorphism, kernel of homomorphism, Isomorphism and automorphism, Fundamental theorem of Homomorphism, Cayley's theorem.	[10]
Permutations: Definition and examples of Permutation, group of permutations, Cyclic Permutation, Even and odd permutation.	[8]

Text Books:

1. I.N.Herstein: Topics in Algebra, 2nd edition, Wiley Eastern Ltd. 1988.
2. P.B.Bhattacharya, S.K.Jain and S.R.Nagpaul: Basic Abstract Algebra, 2nd Edition, Cambridge University Press 1995.

Reference Books:

1. J.B.Fraleigh : A first course in Abstract Algebra, 3rd Edition Addison-Wesely/Narosa 1998..
2. Surjeet Singh and QuaziZameeruddin : Modern Algebra, Revised Edition,Vikas Publishing House, 1992.

   D. C. Gokhroo: Algebra, Navkar publication, Ajmer, Revised Edition , 2005.

MS 122 Differential Equations-I 3-0-0-3

Basic Concepts: order and degree of differential equation, primitives, solutions of differential equations, Integral curves, isoclines.	[4]
First Order Differential Equations: Differential equation of first order and first degree, Homogeneous form and reducible to homogeneous form, Linear equations and equations reducible to linear form, Exact differential equations, Equations reducible to exact forms, First order higher degree equations solvable for x,y,p Lagrange's equations, Clairaut's equations, Equation reducible to Clairaut's form.	[14]
Second order differential equations: Second order differential equations with variables coefficients, Homogeneous and exact forms, Change of dependent equations, change of independent variables, normal form, Method of variation of Parameters	[12]
Series Solution: Regular singular points, ordinary points, , series solution of second order linear differential equations with variable coefficients(Complementary Functions only)	[9]

Text Books:

1. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India) . 1967
2. A.R.Forsyth : A Treatise on Differential Equations, Machmillan and Co. Ltd. London

Reference Books:

1. D. C. Gokhroo : Ordinary Differential equations, NavkarPrakashan.
2. S.L.Ross: Differential Equations, John Wiley & Sons
   B.Rai& D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House, Pvt. Ltd.

MS 211 Linear Algebra 3-0-0-3

Vector Space: Vector spaces, subspaces, Sum and Direct sum of subspaces, Linear span, Linearly Independent and dependent subsets of a vector space. Finitely generated vector space, Existence theorem for basis of a finitely generated vactor space, Finite dimensional vector spaces, Invariance of the number of elements of bases sets, Dimensions, Quotient space and its dimension	[12]
Linear transformations: Linear transformations and linear forms on vactor spaces, Vactor space of all the linear transformations, Kernal and range of a linear transformation, Rank and Nullity, Matrix of a Linear Transformation, Change of basis.	[10]
Dual Spaces: Dual Spaces, Dual Basis, Bidual Spaces, annihilator of subspaces of finite dimentionalvactor spaces.	[9]
Inner Product Space: Inner produt space, norm of a vector, Orthogality.	[8]

Text Books:

1. I.N. Herstein : Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2^{nd} edition).

Reference Books:

1. VivekSahai and VikasBist : Algebra, Narosa Publishing House.
2. I.S. Luther and I.B.S. Passi : Algebra, Vol.-II, Narosa Publishing House.

D. C. Gokhroo : Linear Algebra, NavkarPrakashan.

MS 221 Differential Equations-II 3-1-0-4

Partial Differential equations: Formation, order and degree, Linear and Non-Linear Partial differential equations of the first order, Complete solution, singular solution, General solution, Solution of Lagrange's linear equations, Charpit's general method of solution. [13]

Second and higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non-homogeneous equations with constant co-efficients, Partial differential equation with variable co-efficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, Equations reducible to linear equations with constant co-efficients. [14]

Solution of Second order PDE: Classification of linear partial differential equations of second order, Hyperbolic, parabolic and elliptic types, Reduction of second order linear partial differential equations to Canonical (Normal) forms and their solutions, Solution of linear hyperbolic equations, Monge's method. [12]

Text Books:

1. Ian N. Sneddon : Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
2. S.B. Rao and H.R. Anuradha : Differential Equations, University Press, 1996.

Reference Books:

1. W.T.H. Piaggio : Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.
2. D.A.Murray: Introductory Course on Differential Equations, Orient Longman, (India), 1967
3. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc. New York, 1999
4. Frank Ayres : Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972
   J.N. Sharma &Kehar Singh : Partial Differential Equations

MS 212 Numeric Analysis 3-1-0-4

Interpolation: Interpolation with equal intervals: Newton's forward and Newton's backward interpolation formulae. Newton's divided difference, Lagrange's Interpolation formulae. [10]

Central Differences: Gauss forward and Gauss's backward interpolation [8]

formulae, Sterling, Bessel Formula.

Iterative Methods: Newton Raphson Method, Successive Bi-Section, RegulaFalsi, Successive Approximation Method. [11]

Numerical Methods: Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rule, Picard method, Euler method, Runge-Kutta Methods. [10]

Text Books:

1. Babu Ram: Numerical Methods, Pearson Publication.
2. R.S. Gupta, Elements of Numerical Analysis, Macmillan's India 2010.

Reference Books:

1. M.K. Jain, S.R.K.Iyengar, R.K. Jain : Numerical Method, Problems and Solutions, NewAge International (P) Ltd., 1996
2. S.S.Sastry: Introductory Methods of Numerical Analysis, 3rd edition(2000), Prentice Hall of India Pvt. Ltd., New Delhi.5. C.E. Froberg : Introduction to Numerical Analysis (2nd Edition).
   S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

MS 222 Real Analysis 3-0-0-3

Neighborhood and Limit Points: Boundedness of the set of real numbers, least upper bound, greatest lower bound of a set, neighborhoods, interior points, limit points, open sets, closed set, interior of a set, closure of a set in real numbers and their properties. Bolzano-Weierstrass theorem. [10]

Sequence: Real Sequences and their convergence, Theorem on limits of sequence, Bounded and monotonic sequences, Cauchy's sequence. [9]

Infinite series: Convergence and divergence of Infinite Series, Comparison Tests of positive terms Infinite series, D-Alembert's ratio test, Cauchy's general principle of Convergence of series, Leibnitz test, Absolute and conditional convergence. [12]

Riemann integral: Lower and upper Riemann integrals, Riemann Integrability, Mean value theorem of integral Calculus, Fundamental theorem of Integral Calculus. [8]

Text Books:

1. R.R. Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi, 1970
2. S.C. Malik : Mathematical Analysis, Wiley Eastern Ltd., Allahabad.

Reference Books:

1. Shanti Narayan : A Course in Mathematical Analysis, S.Chand and company, New Delhi.
2. D. C. Gokhroo, Real analysis, NavkarPrakashan.
3. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985

   Earl D. Rainville : Infinite Series, The Macmillan Co., New York

Computer Science

CA 121 Programming Concepts using C Language 3-0-0-3

Development of Algorithms and Flowcharts: Importance, Symbols and Structure. [5]

Structure: Basic Structure of C Program, Constant, Variable, Data Types, Data Declaration, Operations (Arithmetic, Relational, Logical), Increment and Decrement Operators, Assignment Operator, Precedence of Arithmetic Operators, Operator Expression, Type Conversions in Expressions, Assignment Statements. [8]

Control Structure: Input and Output using getchar and putchar, Printf, Scanf Functions, Condition Statements, Simple if- else, Switch, Concept of Loop (While, For, Do-While), Break and Continue. [8]

Array: One Dimensional Array, Iterative Programs, 2-D Arrays, Matrix Operations. [5]

Concept of Sub Programming: Functions, External Variable Scope Rules, Header Files, Static Variables, Parameter Passing (Call By Values And Call By Reference), Recursion, C Preprocessor, Pointers. [7]

Advanced C concepts: Structure, Union, Argument Passing Using Pointer, Array of Pointers. [6]

CA 151 C Language Laboratory 0-0-4-2

Assignments are based on the Course CA 121 Programming Concepts Using C Language.

CA 122 Data Structure Through C 3-0-0-3

Introduction: Concept of Data Structure, Types of Data Structure. [3]

Array: Representation of Single and Multidimensional Array. [2]

Stack and Queue: Introduction and Primitive Operations on Stack: Stack Application; Infix, Postfix, Prefix Expressions, Evaluation of Postfix Expression, Conversion from Infix to Postfix (Algorithms only), Introduction and Primitive Operations on Queues. [9]

Sorting Techniques: Insertion Sort, Selection Sort, Merge Sort and Quick Sort. [7]

Searching Techniques: Linear Search, Binary Search. [6]

List: Introduction to Linked List, Sequential and Link Lists Operation such as Traversal, Insertion, Deletion, Searching. [8]

Tree: Introduction and Terminology, Traversal of Binary Trees, Recursive Algorithms for Tree Operation (Concept). [4]

Text Books:

1. Schaum Series, "Data Structures",TMH, New Delhi
2. Langsam , Augenstein, Tannenbaum, "Data Structure Using C and C++", PHI,

Reference Books:

1. Horowithz and Sahani, "Fundamentals of Data Structure", Galgotia Book Source Pvt. Ltd.
2. Kanitker Y., "Let us C", BPB Publication New Delhi
3. Balagurusamy E , "Programming in C", TMH, New Delhi
4. Schaum Series, "Programming in C", TMH, New Delhi

CA 112 Operating System 3-0-0-3

Introduction: Various Categories of Software, Operating System and its functions, Types of Operating Systems, Structure of Operating System. (Case study of Unix, DOS). [4]

Process Management: Process Concept, ProcessStates, Process Control Block, Interprocess Communication, and Scheduling Algorithms, Performance Evaluation. [7]

DeadLock: Deadlock Characterization, Prevention, Avoidance, Detection of Deadlock, SafeState, Banker's Algorithm. [7]

Memory Management: Swapping, Memory Allocation Schemes, Paging, Segmentation, Virtual Memory Concept, Page Replacement Algorithms. [6]

File Management: Directories, File System Implementation, Allocation Methods, Free Space Management. [6]

Device Management: Disk Structure, Disk Scheduling, Disk Management Control of Various Devices, Device Drivers, Interrupt Driven and Poll Driven Data Transfer. [5]

Security and Protection Mechanism: Computer Security classification, Authentication, System threats, Goals of Protection, Access Matrix. [4]

Text Books:

1. Silbersachatz and Galvin, "Operating System Concepts", Pearson Education.
2. Tannenbaum, "Operating Systems", PHI, New Delhi

Reference Books:

1. William Stalings, "Operating Systems", New Delhi
2. Ritchie, "Operating System", BPB Publication , New Delhi
3. Dhamdhere D. M. "System Programming and Operating System", TMH New Delhi

4. Achyut S Godbole, “Operating Systems”, TMH, New Delh

CA 162 Data Structure Laboratory 0-0-4-2

Assignments are based on the Course CA 122 Data Structure through C.

CA 241 Object Oriented Programming through C++ 3-0-0-3

Introduction: Structured Programming vs. Object Oriented Programming, Basic Concepts (Encapsulation, Information Hiding, Inheritance, Polymorphism), Difference Between C and C++. [4]

Basics of C++: Token, Keyword, Identifiers, Basic Data Type, User Define Data Type, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Scope Resolution Operators, Member Referencing Operators, Operator Precedence, Control Structures. [8]

Function: Definition, Function Prototype, Call By Reference, inline Function, Function Overloading. [8]

Classes and Objects: Classes, Defining Member Function, Private, Public and Protected Member Elements and Function, Static Data Member, Static Member Function, Array Object, Constructors, Destructors, this Pointer, Operator Overloading, Comparison Between Structures and Classes, Copy Constructor, Dynamic Constructor, Friend Function, Friend Classes. [8]

Inheritance: Introduction, Derived Classes, Types of Inheritance (Single Inheritance, Multiple, Hierarchical, Hybrid), Virtual Base Classes, Abstract Classes. [6]

Virtual Functions: Introduction to Virtual Function, Virtual Function in Derived Classes, Overview of Exception Handling. [5]

Text Books:

1. KanitkerYashwant, “Let Us C++”, BPB Publication, New Delhi
2. GopalVenu, Rajkumar , Ravishanker, “Mastering C++” , TMH, New Delhi

Reference Books:

1. HerbertsSchildt, “C++ The Complete Refernce”, TMH, New Delhi.
2. Lafore R, “Object Oriented Programming Using C++”, GalgotiaPulications, New Delhi
3. Parasons D., “Object Oriented Programming With C++”,BPB, New Delhi
4. LaelorSteaven C., “The Art of Programming Computer With C++”, Vikas Publication.

5. Dietel&Dietal, “Introduction to C++”.

CA 231 Management Information System 3-0-0-3

MIS and Concept of Management: Elements, Characteristics, Need, Objectives, Importance, and Limitations, Relationship between MIS and Computer and Role of MIS in the Functions of Management. [9]

Information Concept: Classification of Information, Levels of Information, Techniques of Data Collection, Quality aspect of Information, Value of Information, Relation between MIS and Information. [6]

Decision Making: Decision Making Concepts, Rationality in Decision Making, Decision Support System, MIS as a Technique for Programmed Decisions, Model of Decision Making, Methods, MIS and Role of Decision Making. [6]

Manager and Computers: Database Concept, Database Models, Database Design, RDBMS, MIS and RDBMS, Introduction, Topology, LAN, MAN, WAN and Data Communication, Introduction to ERP. [5]

Typical Information Systems: MIS for Marketing, Financial, Production Management, Human Resource Management Information System. [6]

Development of MIS: Strategic and Project Planning for MIS, Conceptual System Design, Detailed Design, Implementation, Evaluation and Maintenance of the MIS. [7]

Text Books:

1. Murdick R G, Ross J E, Clagget J R, “Information Systems for Modern Management”, PHI, New Delhi
2. Jawadkar, “Management Information System”, TMH, New Delhi

Reference Books:

1. Sadagopan, “Management Information System”PHI, New Delhi
2. Parker, Case, Thomas, “Management Information System: Strategies and Action”, TMH, New Delhi.

CA 271 Object Oriented Programming Laboratory 0-0-4-2

Assignments are based on the Course CA 241 Object Oriented Programming through C++.

CA 132 System Analysis and Design 3-0-0-3

System: Concept, Types and Characteristics, Elements, Computer based Information Systems, Candidate System, Role of System Analyst. [5]

System Development Life Cycle: Recognition of Need, Feasibility Study, Design, Implementation and Maintenance, System Planning and Alternatives. [7]

Feasibility and Proposal: User and Management Involvement, Alternative Design Consideration, System Feasibility, The System Proposal. [5]

System Analysis: Effective Communication in System Analysis, Tools of System Analysis, Problem Definition, Classification of Data Collection and Analysis. [9]

System Cost Determination: Types of Costs/Benefits, System Cost and System Benefits and Data Processing Costs. [8]

Implementation: System Testing, Quality Assurance, Implementation and Software Maintenance. [5]

Text Books:

1. Awad Elias M, ”System Analysis and Design”, TMH, New Delhi
2. Hawayszkiewyez Igor, “Introduction To System Analysis and Design” PHI, New Delhi

Reference Books:

1. Mark Lejk& David Deeks “An Introduction To System Analysis Techniques” PHI, New Delhi
2. Jeffrey L Whitten & Lonnie, D Bentey, “System Analysis and Design Methods”, TMH. New Delhi
3. Manish soni&SanjeevPatwa “System Analysis and Design” UBH Jaipur

CA 272 Computational Numerical Analysis Laboratory 0-0-4-2

Assignments are based on the Course Numerical Analysis.

EL 101 **Foundation Course in English** **2-0-0-2**

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct). [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative). [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most). [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing. [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation. [4]

Reading Comprehension: Efficient reading and note taking. [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, UK.
2. Leech Geoffery: English Grammar for Today, Longman Publications, US.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, UK.
4. Wren and Martin: English Grammar & Composition, S.Chand & Co., NewDelhi.
5. Quirk and Greenbaum: University English Grammar, Longman Publications, US.
6. Sharma R.C. and Krishna Mohan: Business Correspondence and Report writing; Tata McGraw Hill Publications, New Delhi.

CH 181 **Physical and Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: De Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ^2, quantum numbers, Zeeman and Stark effect, shapes of s, p and d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Effective nuclear charge. **[5]**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between

critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[8]**

Covalent Bond: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. **[5]**

Ionic Solids: Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[4]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part I, P.D. Sharma, A. P. Bhargava, 2011, RBD.
2. Inorganic Chemistry B.Sc. Part I, Shivahare, Lavania, 2008, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus, 3rd Edition, 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 4thEdition, 1998, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
5. Essentials of Physical Chemistry, R.L. Madan, G. D.

Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R. D. Madan, G.D. Tuli, reprint 2008, S. Chand & Co. Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 191 Organic Chemistry-I **2-0-0-2**

Structure and Bonding: Hybridization, bond length, bond angles, bond energy, localized and delocalized chemical bond, hyperconjugation, inductive effect, hydrogen bond, clathrates, inclusion compounds, charge-transfer compounds and field effects. **[5]**

Stereochemistry of Organic Compounds: Isomerism, Types of isomerism, Optical Isomerism : Elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. **[7]**

Geometric isomerism: Determination of configuration of geometric isomers, E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism: Conformational analysis of ethane and n-butane, Newman projection and Sawhorse formulae. Fischer and flying wedge formulae. Difference between configuration and conformation. **[6]**

Chemistry of Alkanes, Alkenes and Cycloalkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and **[8]**

chemical reactions of cycloalkenes.

Suggested Readings:

Text Books:

1. Organic Chemistry B.Sc. Part I, P. Singh, 2006, RBD.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Stereochemistry: Conformation and Mechanism, P.S.Kalsi, 6th 2006, New Age International.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd.

CH 171 Laboratory Course in Chemistry-I **3-0-0-1.5**

Experiments based on the contents of CH 181 and CH 191.

CA 111 **Fundamentals of Computers and Information Technology** **3-0-0-3**

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing-Data, Information, Knowledge and Wisdom [8]

Data Representation: Representation of Data, Bits and Bytes, Number System, Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Numbers, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language, Machine Language, Assembly Language, High Level Language, Generations of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha P.K.; Fundamental of Computers; BPB Publication, Meerut.
2. Norton P; Introduction to Computers; Tata MacGraw Hill, New Delhi
3. Taxali R.K; PC Software for Windows; Tata MacGraw Hill, New Delhi.
4. Coutrer; Mastering Office 2000; BPB Publication,Meerut.
5. Introduction to Computer Science; Pearson Education, Singapore.
6. Rajaraman V.; Introduction to Computer; PHI,India.

CH 182 **Physical and Inorganic Chemistry-II** **2-0-0-2**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[4]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law

of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[5]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counter, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

s-Block Elements : Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron affinity, electronegativity, catenation (including diagonal relationship).Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[6]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds. Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L. Soni, 1999, S. Chand & Co. Ltd.
2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli & Arun Bahl, 1999, S. Chand & Co. Ltd.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P. L. Gaus. 3rd Ed. 1995, Wiley Interscience.
2. The elements of Physical Chemistry, P.W. Atkins, 3rd Ed. 1993, Oxford.
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
4. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Edition, 2006, S. Chand & Co.Ltd.
5. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised

Ed. 2005, S. Chand & Co. Ltd.
6. Inorganic Chemistry, R.L. Madan, G.D. Tuli, reprint 2003, S.Chand & Co .Ltd.

Practical Chemistry: Giri, Bajpai and Pandey, reprint 2005, S. Chand & Co. Ltd

CH 192 Organic Chemistry-II **2-0-0-2**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H. M. Chawla,28th Ed. 1999, S. Chand & Co Ltd.
2. Organic Chemistry, A. K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 6th Ed. 1998,

Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Bahl, 19th Ed. 2007, S. Chand & Co. Ltd.
3. Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 172 Laboratory Course in Chemistry-II **3-0-0-1.5**

Experiments based on the contents of CH 182 and CH 192.

BT 152 Genetics **3-1-0-4**

Mendelian inheritance and gene interaction: Mendel's Law of Inheritance, Allelic and non-allelic, complementary, supplementary, epistasis, hypostasis and lethal genes. Multiple alleles and pleiotrophism. [10]

Theory of sex determination: A brief account, linkage and crossing over, linkage maps. Sex linked traits: Eye color and lethals in drosophila, Hemophilia and color blindness in humans. Primary and secondary non-disjunction of sex chromosomes. Sex influenced traits: horn character in sheep, sex limited traits: Cock feathering in poultry and baldness in man [10]

Extranuclear inheritance: Plastid, mitochondria and cytoplasm. [5]

Mutations: Chromosomal aberrations and meiotic consequences. [4]

Human genetics: Chromosomal and genetic disorders; genetic counseling, somatic cell genetics. [5]

Population genetics: Gene pool and gene frequencies, Hardy Weinberg Law, change in gene frequencies (mutation, selection and migration), random drift. Heterosis. [5]

Suggested Books:

1. Gardner, Principle of Genetics; John Willey and Sons, New York,US.
2. Strickberger; Genetics; MacMillan, UK.
3. Sarin; Genetics; Tata McGraw Hill, New Delhi
4. Rastogi V.B.; Genetics; Kedar Nath and Ram Nath, Meerut**.**
5. Gupta, P.K., Genetics, Rastogi publications, Meerut.

PH 112 Basic Physics **2-0-0-2**

Optics: Ray optics (Reflection and Refraction), Interference, Fresnel's biprism, Optical filters, Diffraction, Plane diffraction grating, Grating and prism spectra, Polarization, Brewsters's law, Light as electromagnetic wave [9]

Modern Physics: Corpuscular nature of light, Photoelectric effect, de Broglie wavelength, X-rays, Radioactivity, Half-life and mean life [6]

Semiconductor Physics: Intrinsic and extrinsic semiconductors, Diodes, Semiconductor Devices [3]

Lasers and Fibre Optics: Basic principles of Lasers, He-Ne laser, Optical fibre communication, Applications in Biosciences [5]

Physics in Biosciences: Application of Physics in Biological science, Introduction to Biophysics [3]

Suggested Books:

1. Ghatak A. Optics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.
2. Subrahmanyam N., Lal B and Avadhanulu M N. A Text Book of Optic S Chand & Co Ltd, New Delhi.
3. Sears, Zemansky and Young, University Physics Narosa Publishing House, New Delhi.
4. Pattabhi V and Gautham N. Biophysics Narosa Publishing House, New Delhi.
5. Beiser A. Concept of Modern Physics Tata McGraw-Hill Publishing Comp Ltd, New Delhi.

EV 101 Environmental Studies 3-0-0-3

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, Need for public awareness. [2]

Natural Resources (Renewable and Non-renewable Resources): Natural resources and associated problems. Forest resources – Use and over-exploitation, Mining, Dams and their effects on forest and tribal people. Water resources – Use and over-utilization of surface and Ground Water, Floods, Water Logging, Salinity, Drought, Dams – Benefits and problems. Mineral resources – Use and exploitation, Role of an individual in conservation of natural resources [6]

Ecosystems: Ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structures and functions of Forest, Grassland and Desert ecosystems [7]

Biodiversity and its Conservation: Introduction to Genetics, Species and Ecosystem Diversity, Population Growth, Variation among Nations, Biogeographical classification of India. Value of Biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega-diversity nation. Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity – *In-situ* and *Ex-situ* conservation of biodiversity. [7]

Environmental Pollution: Definition, Causes, Effects and Control measures of Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution and Thermal Pollution, Nuclear hazards. Disaster management – Floods, Earthquakes, Cyclones and Landslides. [6]

Social Issues and the Environment: Urban problems related to Energy, Water conservation, Rainwater Harvesting, [6]

Watershed management, Environmental ethics – Issues and possible solutions, Climate change, Global Warming, Acid Rain, Ozone layer depletion, Nuclear accidents and holocaust, Environmental Protection Laws in India.

Human Population and the Environment: Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. [5]

Visit to a local area to document environmental assets: River/forest/grassland/hill/ mountain. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems—pond, river, hill slopes, etc.

Suggested Books:

1. Sharma P.D; Ecology and Environment; Rastogi Publication, Meerut
2. Rastogi V.B. & Jayraj M.S.; Animal Ecology and Distribution of Animals, Kedar Nath Ram Nath Publication, Meerut
3. Kumar H.D; General Ecology; Vikas Publishing House Pvt. Ltd, India

BT 241 Mathematics and Statistics for Biology **2-1-0-3**

Algebra: Number system, Logarithms, Permutations and Combinations. [3]

Calculus: Functions, Derivative of standard function, Successive Differentiation. [5]

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. [5]

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance [6]

Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. [7]

Suggested Books:

1. Kapoor and Gupta; Fundamental of Mathematical Statistics; S. Chand and Company, New Delhi.
2. Gupta, S.P., Statistical methods; S.Chand and Company, New Delhi.
3. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
4. Bailey; Statistical Methods in Biology; Cambridge

Publications, UK.

CH 291	**Physical Chemistry-I**	**2-0-0-2**
	Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. First Law: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition.	**[7]**
	Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, kirchoff's equation. Second law: Need, Statements, Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Third law: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.	**[8]**
	Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects.	**[11]**

Suggested Readings:

Text Books:

1. Physical Chemistry B. Sc. Part II, P. D. Sharma and A.P. Bhargava, 2011, RBD.
2. Physical Chemistry B.Sc. Part II, K.R. Genwa, 2004, RBD.

Reference Books:

1. The elements of Physical Chemistry, P. W. Atkins, 3rd Ed. 1993, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 6th Ed. 2009, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.

CH 213	**Inorganic Chemistry-I**	**2-0-0-2**
	Chemistry of Elements of First Transition series: Characteristic properties of f-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[6]**
	Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[5]**
	Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
	Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.	**[8]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P.L. Soni, 1999, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part II, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F.A. Cotton. G. Wilkinson and P.L. Gaus. 5rd Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Inorganic Chemistry, R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint, 2005, S. Chand & Co.Ltd.

CH 223 Organic Chemistry-III **2-0-0-2**

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[6]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic .

substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Suggested Readings:

Text Books:

1. Text Book of Organic Chemistry, P. L. Soni and H.M. Chawla, 29th Ed. 2003, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, 7th Ed. 2005, Morrison & Boyd, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl, 20th Ed. 2008, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 281 **Laboratory Course in Chemistry-III** **3-0-0-1.5**

Experiments based on the contents of CH 291, CH 213 and CH 223.

BC 221 **Bio-instrumentation Laboratory** **0-0-2-1**

Assignments are based on the course BC 211 Instrumentation containing exercises on principle and working of instruments and performance of important techniques.

ZO 222 **Animal Physiology Laboratory** **0-0-2-1**

Assignments are based on the course ZO 212 Animal Physiology containing exercises on structural and physiological different in animals.

BT 212 **Molecular Biology** **3-1-0-4**

Introduction: Molecular basis of life, genetic material and its properties, structure of DNA, central dogma, organization of DNA in chromosome. [5]

DNA Replication: Nature of DNA replication, prokaryotic and eukaryotic DNA replication, fidelity of replication in prokaryotes and eukaryotes. [5]

DNA Damage and DNA Repair: Mutations, Causes of mutation and their mechanisms, effect of mutation on DNA, Mutation detection – Ames test to detect mutagenicity and carcinogenicity. DNA repair – Excision repair, Mismatch repair. [5]

Transcription: Enzymatic synthesis of RNA, classes of RNA molecule, transcription in prokaryotes and eukaryotes, splicing mechanism [8]

Translation: Outline of translation, genetic code, ribosome as protein synthesis machinery, protein synthesis in pro- and eukaryotes – initiation, elongation and termination [8]

Gene Regulation: Regulation of gene activity and gene products in prokaryotes and eukaryotes. [8]

Suggested Books:

1. Chunnarayappa; Molecular Biotechnology; Universities Press, London.
2. Gupta P.K.; Elements of Biotechnology; Rastogi Publication, Meerut.
3. Singh B.D.; Biotechnology; Kalyani Publication, New Delhi.

ZO 232 Developmental Biology **3-0-0-3**

Introduction: History and scope of animal developmental biology [1]

Male Gonads and Spermatogenesis: Structure of seminiferous tubule, interstitial cells, morphology of sperm, process and control mechanism of spermatogenesis. [4]

Female Gonads and Oogenesis: Ovarian Structure, Oogenesis: pre- vitellogenesis and vitellogenesis, types of eggs. Control mechanism of ovulation [5]

Reproductive Cycles: Breading and non-breading seasons**,** Estrous and Menstrual cycles – regulation. [4]

Fertilization: Types and Mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, significance of fertilization. [5]

Parthenogenesis: Types and significance [1]

Cleavage: Planes, patterns and rate of cleavage, mitotic peculiarity, physiology and significance of cleavage. [3]

Embryonic Development: Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, Concept of fate maps (Frog and Chick). [5]

General Concepts of Differentiation: Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept [8]

and embryonic induction. Embryo sexing and ageing.

Brief Introduction: Birth control, impotency, Artificial insemination, test tube baby and GIFT. [3]

Suggested Books:

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut.
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi.
3. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi.
4. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi.
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

MB 311 Immunology **3-1-0-4**

Historical Background: Innate immunity, adaptive immunity, natural and artificial immunity, active and passive immunity, humoral and cell-mediated immune response. [4]

Cells and Organs of Immune System: Lymphoid organs – Mast cells, basophils, eosinophils, monocytes, macrophages, neutrophils, NK cells, B and T lymphocytes. [5]

Antigens: Characteristics of antigens, characteristics of B-cell and T-cell epitopes, haptens and adjuvants. [5]

Immunoglobulins: Structure and functions, Classes and subclasses, Antigenic determinants of antibody molecules. [5]

Antigen-Antibody Interactions: Forces involved in Ag-Ab interactions, antibody affinity and avidity, primary and secondary interactions and agglutination and precipitation reactions. [5]

Humoral Immune System: Development and activation of B-lymphocytes, Primary and secondary response, Complement system – components, activation pathways and biological consequences [5]

Cell Mediated Immune Response: Development and activation of T-lymphocytes, Antigen processing and presentation, Major histocompatibility complex – structure and cellular distribution, Leukocyte trafficking, Cytokines, Tc-cell mediated target cell killing [5]

Immune System in Health and Disease: Immunodeficiency diseases, autoimmune diseases, hypersensitivity and allergies, transplantation immunology, tumor immunology, concept of vaccines development. [5]

Suggested Books:

1. Rao C.V.; An Introduction to Immunology; Narosa Publication, New Delhi.
2. Goldsby *et al;* Kuby Immunology; Freeman and Company, New York
3. Tizzard, I; Principle of Immunology, Thomson Publication, Singapore.

4. Ananthanarayn and Panicker; Textbook of Microbiology; Orient Longman Publishers, Hyderabad.

CH 272 Physical Chemistry-II **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3-H_2O$) and ($CuSO_4-H_2O$) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-$HCl-H_2O$ and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass **[12]**

electrodes.

Chemical Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[4]**

Suggested Readings:

Text Books:

1. Physical Chemistry B.Sc. Part III, P. D. Sharma and A.P. Bhargava, 2009, RBD.
2. Physical Chemistry B.Sc. Part III, K. R. Genwa, 2008, RBD.

Reference Books:

1. The elements of Physical Chemistry, P.W. Atkins, 5th Ed. 2004, Oxford.
2. Principles of Physical Chemistry, Puri, Sharma, Pathania, 5th Ed. 2003, Vishal Publishing Co.
3. Physical Chemistry, R.L. Madan, G.D. Tuli, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. Practical Chemistry : Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 282 Inorganic Chemistry-II **2-0-0-2**

Chemistry of Actinide Elements: General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[8]**

Oxidation and Reduction: Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. Text Book of Inorganic Chemistry, P. L.Soni, 2005, S. Chand & Co. Ltd.
2. Inorganic Chemistry B.Sc. Part III, Shivahare, Lavania, 2004, RBD.

Reference Books:

1. Basic Inorganic Chemistry F. A. Cotton. G. Wilkinson and P. L. Gaus. 4th Ed. 2005, Wiley Interscience.
2. Selected Topics in Inorganic Chemistry, Wahid U. Malik, G.D. Tuli, R.D. Madan, 17th Ed. 2006, S. Chand & Co. Ltd.
3. Inorganic Chemistry,R.L. Madan,G.D. Tuli, reprint 2003, S.Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 292 Organic Chemistry-IV **2-0-0-2**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides.

Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Suggested Readings:
Text Books:

1. Text Book of Organic Chemistry, P.L. Soni and H.M. Chawla, 28th Ed.1999, S. Chand & Co. Ltd.
2. Organic Chemistry, A.K. Srivastava, 1st Ed. 2002, New Age International.

Reference Books:

1. Organic Chemistry, Morrison & Boyd, 7th Ed. 2005, Prentice Hall.
2. Advanced Organic Chemistry, Bahl and Arun Bahl , 19th Ed. 2005, S. Chand & Co. Ltd.

Practical Chemistry : Giri, Bajpai and Pandey, reprint, 2009, S. Chand & Co. Ltd.

CH 262 **Laboratory Course in Chemistry-IV** **3-0-0-1.5**

Experiment based on the contents of CH 272, CH 282 and CH 292.

Mody University of Science & Technology

M.Sc. Food and Nutrition
Session 2019-2020

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum (2019 –20 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FN 511	Basic Principle of Ayurvedic Diet	1	-	-	1	2	20	-	80
	FN 521	Basics of Human Physiology	3	-	-	3	3	25	25	50
	FN 531	Human Nutrition	3	-	-	3	3	25	25	50
	BC 531	Biomolecules	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	FN 541	Basic Research Methodology	2	-	-	2	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	-	-	100
		Sub Total	**18**	1	**4**	**21**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BC 522	Nutritional Biochemistry	3	-	-	3	3	25	25	50
	FN 512	Food Packaging and Quality Control	3	-	-	3	3	25	25	50
	FN 522	Women Nutrition and Health	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	FN 532	Nutrition For Health And Fitness	3	-	-	3	3	25	25	50
	FN 542	Nutraceuticals & Functional Foods	3	-	-	3	3	25	25	50
	FN 552	Seminar	-	-	-	1	-	-	-	100
	FN 562	Food and Nutrition Laboratory -I	-	-	4	2	4	-	-	100
		Sub Total	**18**	**-**	**4**	**21**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Food & Nutrition
Two-Year Programme
Academic Curriculum
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	FN 611	Public Health and Nutrition	3	1	-	4	3	25	25	50
	FN 621	Institutional Food Administration	3	1	-	4	3	25	25	50
	FN 631	Clinical and Therapeutic Nutrition	3	1	-	4	3	25	25	50
	FN 641	Food Service Management	3	-	-	3	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	FN 651	Food and Nutrition Laboratory -II	-	-	4	2	4	100		
		Sub Total	**15**	**3**	**4**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	FN612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	-	-	**20**				
		Total Credits				**80**				

$Evaluation of proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Dissertation and presentation will carry 50% weightage each.

(II year curricular and structure and syllabus got passed in AC 30, Syllabus in AC30 minutes)

FN 511 BASIC PRINCIPLES OF AYURVEDIC DIET 1-0-0-1

History of Ahara Nutrition, Vedic and Madhyayugin diet and its processing, Basic Principle: Ayurveda and Aharashastra, Ayurvedic components, Ritucharya (Seasonal regimen) [4]

Ayurvedic Principles: Lokpurushasamya (Doctrine of Macrocosm and Microcosm), Karyakarana Siddhanta (Principles of Caouse and Effect), Samanya-Vishesh Siddhanta (Principles of Similarity and Dissimilarity), **Panchamahabhoota Siddhanta** (Theory of Five Elements), Swabhavoparmvada Siddhanta (Theory of Healing)- in relation with diet and its importance [5]

Fundamentals of Dosha-Dhatu-Mala: Doshavigyana Dhatuvigyana - Tissue/ Cell metabolism, Malavigyana – Excretary, Vigyana Strotovidyana – Systematic circulation, Dhatusharta - Cell replenishing, Prakriti – Constitution, Dosha-Dhatu-Mala vigyana – The importance of diet in physiological process. [4]

Text Book:

1. Tripathi B. (2007) (Ed.) Acharya Charaks' Charak Samhita, Chowkhamba Surbharati Prakashan Varanasi.
2. Panda S.K. (2006) Basic Principles of Kriya Sharira, Chaukhamba Orientalia, New Delhi.

References:

3. Lochan Kanjiv (2007). Astanga Hridayam, (Sutrasthana), Chowkhamba Sanskrit Bhawan Varanasi
4. Srikanthamurthy K.R. (2005), (Ed.) Acharya Vagbhatas' Ashtanga Samgraha, Chaukhamba Orientalia, Varanasi.
5. Lochan Kanjiv, Dietary Rules & Prohibitions in Different Diseases, Chowkhamba Sanskrit Bhawan Varanasi. 2004
6. Sushruta, Sushruta Samhita (1994) 5th Edition, Motilal Banarasidas , New Delhi.
7. Brahmavarchas (2005) Ayurved Darshan,Vedmata Gayatri Trust, Shantikunj, Haridwar.
8. Radhakrishnan Sarvapalli (1999) Indian Philosophy, Vol.1, Oxford University Press, London.

FN 521 BASICS OF HUMAN PHYSIOLOGY 3-0-0-3

Cell structure and function

Levels of cellular organisation and fucntion-organelles, tissues, organs and systems-Brief review. Cell membrane, transport across cell membrane and intercellular communication. Regulation of cell multiplication. [4]

Nervous system [4]

Review of structure and function of neuron, conduction of nerve impulse, synapses, role of neurotransmitters.

Organisation of central nervous system, structure and function of brain and spinal cord, afferent and efferent nerves, Blood brain barrier, CSF. Hypothalamus and its role in various body function-obesity, sleep, memory.

Endocrine system [4]

Endocrine glands-structure, function, role of hormones, regulation of hormonal secertion. The neuroendcrime axis.Disorders of endocrine glands. Emphasis on physiology of diabetes and stress hormones.

Sense organs [3]

Review of structure and function. Role of skin, eye, ear, nose and tongue in preception of stimuli.

Digestive System [4]

Review of structure and function. Secretory, Digestive and absorptive functions. Role of liver, pancreas and gall bladder and their dysfunction. Motility and hormones of GIT

Respiratory system [4]

Review of structure and function. Role of lings in the exchange of gases. Trasport of oxygen and CO_2. Role of haemoglobin and buffer sstems. Cardio-respiratory response to excercise and physiological effects of training.

The circulatroy system [3]

Structure and function of heat and blood vessel. Regulation of cardic output and blood pressure, heart failure, hypertension.

Blood formation, compsotion, blood clotting and haemostasis [3]

Formation and function of plasma proteins. Erythropoesis. Blood groups and histocompatibility. Blood indices. Use of blood for investigation and diagnosis of specific disorders. Anemia.

The excretory system [2]

Structure and function of nephron. Urine formation. Role of kidney in maintaining ph of blood. Water, electrolytes and acid base balance, diuretics

The Musculo-skeletal system [2]

Structure and function of bone, cartilage and connective tissue. Disorders of the skeletal system. Types of muscles, structure and function.

Immune System [3]

Cell mediated and humoral immunity. Activation of WBC and production of anitbodies. Role in inflammation and defence.

Reproduction [3]

Menstrual cycle, spermatogenesis, physiological changes in pregnancy

Text Book:

1. Jain A.K. (2010) Textbook of Physiology, Vol. I and II, Avichal

publishing co., New Delhi.

2.

References:

1. Applied Physiology, MFM 001 Course, Indira Gandhi National Open University

2. Vander A.J., Sherman J.H., Luciono D.S. (2000) Human Physiology. 7th edition, New York, McGraw Hill

3. Guyton A.C. and Hall J.B. (1996) Textbook of Medical Physiology. 9th edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.

FN 531 HUMAN NUTRITION 3-0-0-3

Energy: Energy content of foods. Physiological fuel value-review. Measurment of energy expenditure: BMR, RMR, Thermic effects of feeding and physical activity, methods of mesaurment. Estimating energy requirments of individuals and groups. Regulation of energy metabolism: control of food intake, digetio, absorption and body weight. [4]

Carbohydrates: Types, calssification, digestion and transprt-review, dietry fibre, fructo-oligosaccharides, resistant strach-chemical copmposition and physilogical effects. Glycemic index of food. Sweeteners-nutritive and non-nutritive. [5]

Proteins: Classification, digestion, absorption and transport – review. Metabolism of proteins: Role of muscle, liver, and gastro intestinal tract. Protein quality, metods of evaluating protein quality. Protein and amino acid requirements. Therapeutic applications of specific amino acids: Branched chain, glutamine arginine, homocysteine, cysteine, taurine. [4]

Lipids: Classification, digetion, absorption, transport-review. Functions of EFA. Role of n-3, n-6 fatty acids in health and disease. Requirements of total fat and fatty acids. Trans fatty acids. Prostaglandins. [6]

Water: Regulation of intra and extra cellular volume. Osmolality, water balance and its regulation. [7]

Minerals: (Note: For each nutrient sources, bioavailability, metabolism, function, requirements, RDI/ESDDI, deficiency and toxicity, interactions with other nutrients are to be discussed).

Macro minerals: calcium, phosphorus, magnesium, sodium, potassium and chloride.

Micro minerals: Iron, copper, zinc, manganese, iodine, fluoride.

Trace minerals: selenium, cobalt, chromium, vanadium, silicon, boron, nickel.

Vitamins: Historical background, structure, food sources, absorption and transport, metabolism, biochemical function, assrssment of status. Interactions with other nutrients. Physiological, pharmacological and [7]

therapeutic effects, toxicity and deficiency with respect to the following:

a) *Fat soluble:* Vitamins A,D, E & K.
b) *Water soluble:* Thiamine, riboflavin, niacin, biotin, pyridoxine, folic acid, pantothenic acid, ascorbic acid, cyanocobalamin, choline, inositol.

Non-nutritive food components with potential health effects: Polyphenols, tannins, phytate, phytoestrogens, cyanogenic compounds, lectins and saponins. [6]

Nutritional regulation of gene expression.

Nutrition management in special conditions: Space travel, high altitudes, low temperatures, submarines.

Text Book:

1. Bamji M.S., Rao N.P., Reddy V. Eds. (2009). Textbook of Human Nutrition. 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.

References:

2. ICMR (1990). Nutrient Requirements and Recommended Dietary Allowances for Indians.
3. FAO/WHO/UNU (2004). Human Energy Requirements. Report of a Joint Expert Consultation.
4. WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.
5. Nutrition in Developmental Transition. (2006). NFI-WHO (SEARO) Symposium. NFI
6. ICMR. A Manual of Laboratory Techniques.
7. Gibney M.J., Margetts B.M., Kearney J.M., Arab L. (2004). Public Health Nutrition. The Nutrition Society. Blackwell Publishing, Oxford, UK.
8. Sundararaj P. and Siddhu A. (2006). Qualitative tests and quantitative procedures in Biochemistry- A Practical Manual. Third edition. Elite Publishers, New Delhi.
9. AOAC (1997). Official Methods of analysis. 16th edition. Association of official Analytical Chemists.

FN 541 BASIC RESEARCH METHODOLOGY 2-0-0-2

Research Methodology- Meaning, objectives and Significance of research. Types of research, research approaches and scientific methods. [2]

Research process and criteria of good research

Definition and identification of a research problem- Selection of research problem, Justification, development of hypothesis, basic assumptions. Limitations and delimitations of the problem, Methods of data collection [4]

Research design- Meaning and needs, Different research designs- exploratory, descriptive and diagnostic (epidemiology and clinical trials). Pilot studies. Qualitative vs quantitative research [5]

Sampling design- Steps in sampling design, Criteria for selecting a sampling procedure, Different types of sampling techniques- Merits and demerits of sampling [5]

Basic principles and regulations in humans and animal research. [3]

Report writing – Significance of report writing, Different steps in writing report, Types of reports, Mechanics of writing reports and precautions to be taken while writing research reports [7]

Text Book:

1. Kothari C.R. (2004) Research Methodology, Methods & Techniques, 2nd ed. New Age International Publishers.

References:

2. Best J.W. and Kahn J.V. (1992) Research in Education.6th ed. New Delhi, Prentice Hall of India Pvt. Ltd,
3. Goode W.J. and Hatt P.K. (1981) Methods in Social Research, McGraw Hill International Editions, Sociology Series.
4. Kerlinger F.N. (1983) Foundations of Educational Research. 2nd ed.
5. Marjory L. Joseph, William D Joseph (1996) Research Fundamentals in Home Economics / Human Ecology. Plycon Press.
6. WHO (2001) Health Research Methodology – A Guide for Training in Research Methods.
7. Stennberg R. J. (1991) The Psychologist's Companion: A Guide to Scientific Writing for students and Researchers. Cambridge: CUP.
8. Scrimhshaw N.S. and Gleason G.R. (2009) Rapid Assessment Procedures, Qualitative Methodologies for Planning and Evaluation of Health Related Programmes. International Nutrition Foundation for Developing Countries, Boston.

BC 522 NUTRITIONAL BIOCHEMISTRY 3-0-0-3

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements. [5]

Specific dynamic action of proteins.

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions. [10]

Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper. [5]

Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins. [5]

Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein-calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing. [10]

Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. [2]

Obesity – Definition, Genetic and environmental factors leading to obesity [2]

Text Book:

1. Devlin T M. (2002) Text Book of biochemistry with Clinical Correlations 5th ed. John Wiley and Sons.

References:

2. Berg J M, Tymoczko J L and Stryer L. (2002) Biochemistry 5th ed. W.H. Freeman.
3. Horton R. H., Moran L. A., Ochs R. S., Rawn J. D. and Scrimgeour.(2002) Principles of Biochemistry 3rd ed. Prentice Hall.
4. Murray R.K., Granner D.K., Kayes P.A. and Rodwell V.W.(2003) Harper's Illustrated Biochemistry. 26th ed. McGraw-Hill. Asia.
5. Voet D. and Voet J.G. (2004) Biochemistry. 3rd ed. John Wiley and Sons.

FN 512 FOOD PACKAGING AND QUALITY CONTROL 3-0-0-3

[6]

Packaging- Concepts, Definition, Significance, Classification.
Packaging-development, Unit/Retail.
Packaging of food(s)- fresh and processed, general characteristics & food

preservation.

Primary Packaging Media- Properties and applications

a) Paper boards, metals, plastics, wood & plywood, glass, flexible etc.

b) Labels, caps & closures & wads, adhesives, inks & lacquers, cushioning materials, reinforcements etc.

Testing & evaluation of packing media – retail packs (including shelf life evaluation) and transport packages. [9]

Packaging systems and methods for food products- vacuum packaging, gas flush. Packaging, CAP & MAP, Aseptic & retort packing, Bag-in Box etc.

Food products- General classification and packing types, varieties and trends.

Storage, handling and distribution of packages (foods) – including palletisation & Containerizetion.

Food marketing and role of packaging.

Packaging Aesthetic & graphic design.

.

Packaging – Laws & Regulations - FDA, PFA, Packaging commodity Rules, Weight & Measures Act etc [3]

Introduction to quality assurance and food safety assurance. Current concepts of quality control.

Quality assurance programme: Quality plan, documentation of records, product standards Product and purchase specifications, process control and HACCP hygiene and housekeeping, corrective action, quality and programme and total quality process.

Quality costs: Measurement and analysis.

[10]

Product Evaluation: [11]

- Sampling for product evaluation and line control.
- Statistical quality and process control.
- Specifications and food standards. International, national-Mandatory, Voluntary.
- Sample Preparation.
- Reporting results and reliability of analysis.
- Tests for specific raw food ingeredients and processed. Foods including additives:
  a) Proximate principles
  b) Nurient analysis
  c) Quality parameters and test of adulterants.

Consumer protection.

Text Book

1. Joshi, V.K. and Pandey, A. Ed. (2009). Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.

References

2. Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford. Crueger, W. and Crueger A. 1984.
3. Knorr, D. 1982. Food Biotechnology. Marcel Dekker, New York.
4. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
5. Pomeranz, Y. and MeLoan, C.E. (1996): Food Analysis: Theory and Practice, CBS Publishers and Distributor, New Delhi.

FN 522 WOMEN NUTRITION AND HEALTH 3-0-0-3

Role of women in National Development.

Women in Family and Community

- Demographic Changes, menarche, marrige, fertility, morbidity, mortality, life-expactancy, sec ratio, aging and wodowhood, female-headed families.

Women and Work

- Environmental stress, production activities, nutrition, health and gender, living conditions, occupational health, health facilities.

Women's nutritional requirements and food needs.

Women and Society

- Women's role, their resoures and contribution to family and community and effect on nutritional status.
- Effect of urbanisation on women.
- Impact of economic policies, industrializzation, and globlization on women.

Women and Health

- Health facilities
- Disease patterns and Reproductive health
- Gender and health
- Health seeking behaviour
- Women- pregnancy and lactation

Safe motherhood

Care of at-risk mothers

Family planning

Women and aging- Special concerns in developed and developing societies: Menopause, osteoporosis, chronic degenerative diseases, neurological problems.

Women and AIDS

Women and Nutrition

- Situation of women in global, national and local context. Improving the nutritional and health status. Intervantions throughout the life cycle.

Policies and Legislations

- CEDAW (Convention on elimination of all forms of Discrimination Against Women), Women's Right to Life and Health (WRLH).

Empowerment of Women-Role of Education and various national schemes

Text Book:

1. Gopalan, C. and Kaur, S (Eds) (1989): Women and Nutrition in India, Nutrition Foundation of India

References

2. ACC/SCN Policy Discussion papers.
3. Wallace, H.M. and Giri,K. (1990): Health care of women and children in developing countries, Third party Publishing Co., Oakland, California.
4. UNICEF: The Urban Poor and Household Food Security, UNICEF
5. NGO committee on UNICEF (1997): Women and children in Urban Poverty-What Way Out?
6. Census Reports, Government of India.
7. UNICEF-State of the world children.
8. International Nutrition Foundation-Micronutrient Initiative (2010): preventing Iron Deficiency in Women and Children; Technical Consensus on Key issues.

MB 514 FOOD TECHNOLOGY 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of [10]

fermented food products,
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation: [10]
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).

Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens, Campylobacter jejuni, Helicobacter pylori* [10]

Packaging and Quality Control: [9]
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane.
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

Text Book:

1. Prescott L.M., Harley J.P., Klein D.A. (2008) Microbiology. 6th ed. WMC Brown Publishers

References

2. Banwart G.J. (1987) Basic Food Microbiology. CBS Publishers and Distributors.
3. Frazier W.C., Westoff D.C. (1998) Food Microbiology. 4th ed. Tata McGrawHill Publishing Co. Ltd.
4. Garbutt John (1997) Essentials of Food Microbiology. Arnold

London.
5. Jay J.M., Loessner D.A., Martin J. (2005) Modern Food Microbiology. 7th ed. Springer
6. Pelczar M.J., Chan E.C.S., Krieg N. (1993) Microbiology. 5th ed. Tata McGraw-Hill Publishing Co. Ltd.

FN 532 NUTRITION FOR HEALTH AND FITNESS 3-0-0-3

Definition, components and assessment criteria of age: Specific fitness and health status. [8]

Holisitic approache to the management of fitness and health: Enrgy input and output. Diet and exercise. Effect of specific nutrient on work eperformance and physical fitness. Nutrition, exercise, physical fitness and health inter-relationship

Review of fifferent energy system for endurance and power activity: Fuel and nutrients to support physical activity. Shifts in carbohydrates and fat metabolism. Mobilization of fat stores during exercise. [6]

Nutrition in sports: Sports specific requirments. Dient manipulation. Pre-game and post game meals. Assessment of different nutragenic aids and commercial supplements. Diets for persons with high enrgy requirments, stress, fractures and injury.

Water and electrolytesbalances: Losses and their replenishment during excerse and sports events, effects of dehydration, sports drinks. [7]

Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer**.**

Nutrition and exercise regimes for management of obesity: Critical review of various dietary regimes for weight and fat reduction. Prevention of weight cycling. [8]

Definign nutriitonal goals.guidelines approporiate to health, fitness and prevention and management of the above chronic degenerative disorders.

Nutrition and exercise regimes for pre-post-natal fitness: Alternative systmes for health and fitness lile ayurveda, yoga, meditation, vegetarianism and traditional diets. [10]

Text Book:

1. Mahan L.K. & Ecott-Stump S. (2000): Krause's Food, Nutrition and diet Therapy, 10th Edition, W.B. Saunders Ltd.

References:

2. Sizer F. & Whitney E. (2000): Nutrition-Concepts and controversies, 8th Edition, Wadsworth Thomson Learning.
3. Whitney E.N. & Rolfes .R. (1999): Understanding Nutrition, 8th

Edition, West/Wadsworth, An Internation Thomson Publishing Co.
4. Parizkova J. Nutrion, Physical activity and health in early life, Ed. Wolinsky, I., CRC press.
5. Ira Wolinsky (Ed) (1998): Nutriton in Exercise and sports, 3rd Edition,CRC Press

FN 542 NEUTRACEUTICALS AND FUNCTIONAL FOODS 3-0-0-3

Nutraceuticals: Use of neutraceuticals in traditional health sciences. Their role in preventing /controlling diseases.	[4]
Definition, Classification, food and non food sources, mechanism of action. Role of omega-3,fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds as neutraceuticals.	[8]
Prebiotics and probiotics: Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes.	[9]
Functional foods Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods.	[8]
Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India.	[10]

Text Book:

1. Geoffrey P. Webb. (2006). Dietary supplements and functional foods. Blackwell Publishing.

References:

2. Losso, J.N. (2007). Angi-angiogenic functional and medicinal foods. Press.
3. Cupp, J and Tracy, TS. (2003). Dietary supplements: Toxicology and C Pharmacology. Humana Press.
4. Manson, P. (2001). Dietary supplements (2nd Ed) Pharmaceutical Press.
5. Campbell, JE and Summers, JL. (2004). Dietary Supplement Labeling Compliance .
6. Shi, J.(2007). Functional Food Ingredients and Nutraceuticals:

Processing Technologies. Taylor & Francis Publ. CRC Press.
7. Goldberg, I (1994). Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall.
8. Robert E.C. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

FN 562 FOOD AND NUTRITION LABORATORY -I 0-0-4-2

Practical exercises related to BC 522, MB 514 and FN 542

FN 641 FOOD SERVICE MANAGEMENT 3-0-0-3

UNIT-I [9]

Food service Institutions- Definition and importance, various types of food service institutions like hospitals, school meals, hostels, industrial canteens, commercial hotel/ canteens etc. Institutions catering to different types of handicapped personnel.

UNIT-II [5]

Theories about approaches to food service management -
Developing objectives and goals- Definition and importance, types of goals Policies, procedures and rules.

UNIT-III [5]

Principles and procedures of management- Managerial roles and responsibilities, the manager and leadership quality. Tools of management – organization chart, types, structure, function; work improvement techniques

UNIT-IV [6]

Personnel management – recruitment, training, placement, promotion, personnel records, work appraisals

UNIT-V [5]

Material management – Principles of quantity food purchase- selection, buying and accounting of different foods. Inventory management- assessing requirements, receiving and release of stocks. Record maintenance.
Quantity food preparation and service- Factors in menu planning for large groups, systems for maintaining quality in food preparation and service. Kitchen control and maintenance of kitchen records

UNIT-VI [4]

Financial management – Budgeting, costing and cost control, accounting

UNIT-VII [5]

Marketing and advertising, Changing food trends and marketing-influencing factors: Life style changes: economic, socio-cultural, psychological influences and marketing influences, Compatibilities/Challenges in Food Storage and its commercialization, Means of Marketing, National and International measurements

Text Book

1. Sethi, M. (2005): Institution Food Management New Age International Publishers.
2. Taneja S and Gupta SL (2001) Entrepreneurship development, Galgotia Publishing

Reference

3. Bessie, W.B. and Levelle, W. (1988): Food Service in Institutions 6th Edition Revised By Hargar FV, Shuggart SG, &Palgne Palacio June,

Macmillian Publishing Company New York.
4. Kazarian, E. A. (1977): Food Service facilities Planning 3rd Edition Von Nostrand Reinhold New York
5. Kotas Richard and Jayawardardene. C (1994) Profitable Food and Beverage Management Hodder& Stoughton Publications
6. Kotler Philip Marketing management (2001) Millennium Edition Prentice Hall of India

FN 611 PUBLIC HEALTH AND NUTRITION **3-1-0-4**

UNIT-I [9]

Concept of public nutrition - Relationship between health and nutrition, role of public nutritionists in the health care delivery system. Population dynamics- Demographic transition, population structure, population policy, fertility behaviour, nutrition and quality of life interrelationship. Nutritional status -methods for assessing nutritional status – Indirect methods – demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR) - Direct – anthropometry, biochemical, clinical, dietary and functional methods of assessments.

UNIT-II [4]

Nutrition during life span – pregnancy, lactation, infancy, preschool age, school going and adolescents, adults and old age.

UNIT-III [9]

Assessment and surveillance of nutritional status in emergency affected populations- Scope for malnutrition assessment, indicators and simple screening methods. Organization for nutritional surveillance. Nutritional relief and rehabilitation- Assessment of food needs, food distribution strategy, targeting food aid, mass and supplementary feeding, special foods/rations for nutritional relief, organization for mass feeding/food distribution, transportation and storage, feeding centers, sanitation and hygiene and public nutrition approach to tackle nutritional and health problems in emergencies, ethical considerations.

UNIT-IV [8]

Approaches and strategies for improving nutritional status and health - Programmatic options – their advantages and demerits. Intervention Programmes – Health based interventions, Food – based interventions including fortification and genetic improvement of foods, supplementary feeding. Malnutrition and Health economics - Its impact on productivity and national development. Cost management.

UNIT-V [9]

Information Education Communication approaches to improve health and nutrition: Concepts – Scope- Elements- Models of communication - Communication Process - Approaches and Barriers to communication, Communication for Extension Education and Development - Introduction to IEC Aims and Objectives, Importance

of IEC, relevance to programmes - Nutrition education for behaviour change – Rationale, Planning Execution and evaluation of Department of Food Science and Technology.

Text books

1. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.

Reference

2. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
3. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Bamji, M.S., Rao, P.N., Reddy, V (Eds) (2003): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

FN 621 INSTITUTIONAL FOOD ADMINISTRATION 3-1-0-4

UNIT-I [3]

Review of different types of institutional food service operations, canteens, hotels, restaurants and hospitals.

UNIT-II [7]

Meal planning, Food preparation and Service: Basic factors in successful institutional meal planning, considerations with regard to religion, region, availability of food and season, food habits, personnel, equipment, physical plant and financial resources. Procedures involved in constructions of recipes in large scale cooking. Processes of food preparation in large quantities. Type of food service in different institutions: Formal and informal food service.

UNIT-III [4]

Management: Definition, functions, tools of management-organization chart, job description, job specification, work sheet. Work improvement and work simplification.

UNIT-IV [8]

Personnel Management: Personnel and leadership qualifications for food service administrator, responsibilities and importance of good human relationship in organization. Criteria for selection of staff personnel, employment conditions, employee-training, role of employee unions, welfare provisions for labour.

UNIT-V [9]

Management of Resources: Budget, records and book keeping. Food cost control and Labour cost control: Factors affecting cost-menu, types of service, methods of purchasing, serving and pricing, maintenance of standard portions, waste, and meals for employee, wages. Physical plant: Its location, floor plans, space allowances for food preparation activities, storage units, service units and washing units.

UNIT-VI [8]

Importance of food standards, criteria for good quality products, hazards of adulteration and poor quality, quality control, specifications for quality in food products, food laws regarding quality and adulteration.

Labour laws regarding health and safety of employees, health examination, sanitary working conditions, labour regulations, welfare policies.

Text Book

1. West BB, Wood, L. Harger, V.F. and Shugert, G.S. 1977, Food Service in Institutions. John Wiley and Sons, NewYork
2. Sethi, M and Malhan, S. 1993. Catering Management – An integral approach, Wiliey Eastern Limited, New Delhi.

Reference

3. R. Kinton und V. Ceserani 2000. The theory of catering. Aufl., Seiten, Abb., Tab. Verlag Edward Arnold Ltd, London 1
4. Weiss H. and Edith. 2000. Catering Handbook /9780471284277; Publisher: Wiley
5. Mizer and Porter, 2010. Food Preparation for the professionals. Eich Drummond. New York: John Wiley & Sons, Inc
6. Crusius, V.C. 2001: Quantity Food Management. Minneapolis, Minn. Burgess, (c)1981

FN 631 CLINICAL AND THERAPEUTIC NUTRITION **3-1-0-4**

UNIT-I [6]

Nutritional screening and assessment of nutritional satus of hospitalized and outdoor patients.identification of high risk patiets. Assessment of patient needs based interpretation of patient data-clinical, biochmecial, biophysical, personal etc. Newer trends in delivery of nutritional care and dietary counselling

UNIT-I [10]

Diet nutrient and drug interaction. Effect of drugs on ingestion, digestion, absorption and metabolism of nutrients, effect of foods, nutrients and nutritional status on drug dosage and efficacy.

Nutritional support-recent advances in techniques and feeding substrates

UNIT-I [18]

Etiopathophysiology, metabolic and clinical aberrations, complications, prevention and recent advances in the medical nutritional management of:

Weight imbalances

Cardio vascular disorders

Diabetes mellitus and other metabolic disorders

GI tract disorders

Liver and gall bladder, pancreatic disorders

Renal disorder

Stress and trauma

Cancer

Neurological disorders

Musculo-skeletal disorders

Immuno-deficiency disorder
Genetic disorders
Infection and AIDS
Respiratory problems

UNIT-I [5]

Childhood problems/disorders including inborn errors of metabolism and their nutritional management.

Text Book

1. Mahan, L.K. and Escott-Stump, S. (2000): Krause's Food Nutrition and DietTherapy, 10th Edition, W-13 Saunders Ltd.
2. Shills, M.E., Olson, J.A, Shike, M and Ross, A.C. (2003): Modern Nutrition in Health and Disease, 9th Edition, A. Vaiiiams and Willdns.

Reference

3. Williams, S.R. (2003): Nutrition and Diet Therapy, 7th Edition, Times Mirror/Mosby Collage Publishing.
4. Chandra, R.K. (eds) (2002): Nutrition and Immunology, ARTS Biomedical. St. John's Newfoundland.
5. Sareen, S, James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition, Thomson Wordsworth Publication, USA.

MB 641 INDUSTRIAL MICROBIOLOGY AND FERMENTATION TECHNOLOGY 3-0-0-3

UNIT-I [9]

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feedback repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods.

UNIT-I [6]

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications.

UNIT-I [7]

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment.

UNIT-I

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (β-lactam, aminoglycosides). [12]

UNIT-I [5]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids.

Text Book

1. Crueger and Crueger (2003): Biotechnology: a textbook of industrial microbiology, 2nd Edition. Panima publications.
2. Stanbury, P.F. and Whitaker, A. (2016): Principles of fermentation technology. Pergamon press.

Reference

3. Taylor and Francis (2007): Fermentation microbiology and biotechnology. El-mansi. 2nd Edition.
4. Scragg (1991) :Bioreactors in Biotechnology: A Practical approach. Latest Ed.
5. Mansi, E. T., Bryce, C. A, Demain, A. L. and Allman A. R. (2011):Fermentation Microbiology& Biotechnology. 3rd Edition.

FN 651 Food and Nutrition Laboratory-II 0-0-4-2

Practical exercises related to FN 611, FN 621 and FN 631

***BC 531 Biomolecules 3-0-0-3**

	Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.**		[5]
	Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway		[8]
	Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis.		[7]

	Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $–NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids. Classification of enzymes, Michelis Menten equation Km value, Linweaver-Burk equation.		[8]
	Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions.		[6]
	Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes.		[5]

*in place of BC 511 of M.Sc Biotechnology, Microbiology and F&N and CH 561 of M.Sc Chemistry

Mody University of Science & Technology

M.Sc. Forensic Science
Session 2019-2020

Curriculum Structure

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 501	Criminology, Criminal Law, Police Administration	2	1	-	3	3	25	25	50
	FS 511	Introduction to Forensic Science & Crime Scene Investigation (CSI)	2	-	-	2	3	25	25	50
	FS 521	Forensic Physics and Trace Evidences	2	1	-	3	3	25	25	50
	FS 531	Introduction to Digital Forensics	2	1	-	3	3	25	25	50
	FS 541	Forensic Ballistics	2	1	-	3	3	25	25	50
	FS 551	Statistics & Research Methodology	2	-	-	2	3	25	25	50
	FS 561	Forensic Practical I (CSI, Trace, DF, Ballistics)	-	-	8	4	4	25	25	50
		Foreign Language I	3	-	-	3	3	25	25	50
		Sub Total	**15**	**4**	**8**	**23**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS 502	Elements of Forensic Medicine, Odontology	2	1	-	3	3	25	25	50
	FS 512	Instrumentation in Forensic Sciences (Chemical, Physical & Biological)	3	1	-	4	3	25	25	50
	FS 522	Introduction to Questioned Document Examination	2	-	-	2	3	25	25	50
	FS 532	Introduction to Forensic Chemistry, Toxicology & Pharmacology	2	-	-	2	3	25	25	50
	FS 542	Introduction to Forensic Biotechnology	2	-	-	2	3	25	25	50
	FS 552	Disaster Management and Victim Identification	2	1		3	3	25	25	50
	FS 562	Forensic Practical II (Instrumentation, Odontology)	-	-	6	3	3	25	25	50
		Foreign Language II	3	-	-	3	3	25	25	50
		Sub Total	**16**	**3**	**6**	**22**				

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS 601	Fingerprinting and Forensic Photography	2	1		3	3	25	25	50
	FS 611	Applied Cognitive Psychology	2	1		3	3	25	25	50
	FS 621	Speech Analysis and Multimedia Forensics	2	1		3	3	25	25	50
	FS 631	Forensic Practical III (Fingerprinting, Photography, Multimedia Forensics)			6	3	4	25	25	50
	Elective A, or, **Specialization A: FORENSIC CHEMISTRY AND TOXICOLOGY**									
	FS 641	Advanced Forensic Chemistry	2			2	3	25	25	50
	FS 651	Advanced Forensic Pharmacology & Toxicology	2			2	3	25	25	50
	FS 661	Forensic Practical IV A(Chemistry, Pharmacology, Toxicology)			8	4	4	25	25	50
	Elective B, or, **Specialization B: FORENSIC BIOTECHNOLOGY and DNA PROFILING**									
	FS 671	Advanced Forensic Biology & Anthropology	2			2	3	25	25	50
	FS 681	Advanced Forensic Serology & DNA Profiling	2			2	3	25	25	50
	FS 691	Forensic Practical IV B(Forensic Biotechnology)			8	4	4	25	25	50
	Elective C **Specialization C: QUESTIONED DOCUMENT EXAMINATION**									
	FS 603	Advanced Questioned Documents Examination	2			2	3	25	25	50
	FS 613	Digital Image Processing	2			2	3	25	25	50
	FS 623	Forensic Practical IV C(QD and DIP)			8	4	4	25	25	50
		Sub Total	**10**	**3**	**14**	**20**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours
			L	T	P		
Spring Semester	FS 620	DISSERTATION				20	
		Sub Total				**20**	

‡ *Refer to the Foreign Languages Section*

M.Sc. Forensic Science
Two-Year Program
Academic Curriculum (2017 – 18 onwards)

FIRST SEMESTER

CRIMINOLOGY, CRIMINAL LAW & POLICE ADMINISTERATION

FS 501 **2-1-0-3**

Course Contents:
Unit I: Introduction to Criminology [7] Criminology: Definition, Nature and Scope. Criminal Action and Criminal Behavior, Introduction of Victimology, Causes of crime: Social, Economic, Psychological, Political, Culture, and Geographical and their prevention, Juvenile Delinquency, Role of the Correctional Institutions.
Unit II: Theories of Criminology [8] Theory of Criminology: Theory of Criminology - Differential Association Theory, Self Concept and Containment theory, Labeling theory, Barrier Theory
Unit III: Type of Offences and Indian Courts structure [10] Criminal Offences, Nature and types, Framing of Charges, Terrorism, SexualOffences, White collar crime, Courts: Structure and types- criminal courts, Juvenile Courts.
Unit IV: Criminal Law [7] Criminal Law: Definition, Scope and development, Sections of I.P.C, Cr.PC related to Crime, Law of Evidences and Criminal Justice System in India: structural and functional process; Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b) Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), CrPC Sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176; IEA Sections: sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159.
Unit V: Police Administration system [7] Police duties and responsibilities, Structure of Police in India, role of Police in society, Police Investigation, Interrogation and Interviewing of criminals, maintenance of Law and order, Custodial crimes and death, Police and human rights.

Text:

1. Rama Ahuja: Social Problems in India

References:

1. Ahmad Siddique: Criminology Problems & perspectives.
2. Batuk Lal: Law of Evidence
3. Rao, S. Venugopal: Police Administration.

4. Nath, Trilok: Indian Police.
5. Mishra. S.C. : Police Administration in India
6. Government of India, Ministry of Home Affairs: Reports of National Police Commission
7. Sutherland and Cassey: Criminology

INTRODUCTION TO FORENSIC SCIENCE and CRIME SCENE INVESTIGATION

FS 511 **2-0-0-2**

Course Contents:
Unit I: Crime Scene Management [9] Definition and causation of crime, Types of crime scene, Crime scene survey, protection of crime scene, searching of physical evidences, Recording, documentation and presentation in the court, processing and reconstruction of the crime scene.
Unit II: Introduction to Forensic Science and Quality Management (ISO/IEC 17025)] [8] Introduction and History of Forensic Science, Basic principles and significance, Utilization of Forensic Science, Forensic Scientist at the scene of crime, Structure of Forensic Labs, General requirements for the competence of testing and calibration laboratories - Introduction, Scope, Management requirements: Organization, Quality System, Document Control, Service to the clients, Complaints, Corrective and preventive actions, Control of records, Internal Audits etc.
Unit III: Investigation and Interrogation [4] Law related to interrogation, interviewing of the criminals; methods used by the police in getting information from the criminal; the ethical issues related to the same; Examination in the Court, Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; Direct examination, re-examination and cross – examination of prosecution lawyer and defense lawyer.
Unit IV: Divisions and Scope of Forensic Investigations [3] Mobile Lab, CSI and its relevance, Toxicology, Forensic Chemistry, Arson, Explosives, NDPS, Scope, Serology, Forensic Biotechnology, Scope, DNA Profiling, Questioned Documents, Digital Forensics, Forensic Ballistics, Forensic Physics

Text:

- James, S.H., and Nordby, J.J., (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003

References:

8. Nabar, B. S., Forensic Sciene in Crime Investigation, Asian Law House, 2001.
9. Allison, R. , Investigation of Crime Scene, Global vision Publishing House, 2008.
10. Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.
11. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science - An Introduction to Criminalistics, McGraw Hill, New York, 1983.

12. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

FORENSIC PHYSICS and TRACE EVIDENCES

FS 521 **2-1-0-3**

Course Contents
Unit I:SOIL [7] Physical Evidence and Role of Probability**;** Formation and types of soil, composition of soil, particle size distribution, microscopic examination, density gradient analysis, interpretation of soil evidence, Discussion on important case studies related to soil evidence.
Unit II: GLASS [8] Types of glass and their composition, Forensic examination of glass fractures, determination of direction of impact: cone fracture, rib marks, hackle marks, colour and fluorescence, physical matching, refractive index, and interpretation of glass evidence.
Unit III: PAINT [7] Types of paint and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis, solubility test, pyrolysis chromatographic techniques, IR spectroscopy and X-ray diffraction, interpretation of paint evidence.
Unit IV: TOOL MARKS & RESTORATION OF ERASED / OBLITERATED MARKS [7] Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks . Method of making-cast, punch, engrave; methods of obliteration, method of restoration.
Unit V: SPEAKER IDENTIFICATION AND TAPE AUTHENTICATION [10] Vocal anatomy, Speech signal processing and pattern recognition – basic factors of sound in speech, acoustic characteristics of speech signal, Fourier analysis, analysis of audio-video signal for authenticity, Introduction to the techniques of pattern recognition and comparison.

Text

1. R. Saferstein, Forensic Science Handbook, Vols. I, II, (Ed), Prentice Hall, Eaglewood Cliffs, NJ; 1988.

References

1. B. Caddy, Forensic Examination of glass and paints analysis and interpretation, ISBN 078405749 2001.
2. Bengold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons, USA, 1999.

3. Bengold and Nelson Morgan,, Speech and Audio signal processing, John Wiley and sons, USA, 1999.
4. C.E. O 'Hara and J.W. Osterburg, An Introduction to Criminalistic, Indiana University Press, Blomington, 1972.
5. Denis Shaw, Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
6. F.W. Sears, M.W Zemansky, and H.D. Young, University Physics, Sixth Ed., Narosa, 1995.
7. Jenkins and White, Fundamentals of Optics, Mc Graw Hill, Fourth Ed, 1976.
8. Nickolls, L.C., Scientific Investigation of Crime, Bulterwest, London, 1956.

INTRODUCTION TO DIGITAL FORENSICS

FS 531 **2-1-0-3**

Course Content:

Unit 1: Cyber Crime in India [7]
Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.

Unit 2: Basics of Computers [8]
Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations

Unit 3: Incident Response Management [7]
Introduction to Incident Response Process, Preparing for Incident Response, detection of an Incident, IRM life cycle-preparation, Identification, Detection, Containment, Eradication, Recovery, lessons learnt, Investigations of Cyber Crime cases as per IRM cycles, opinion formatting for cyber-crime cases, court testimonies, case studies.

Unit 4: File Forensics [8]
Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.

Unit 5: Forensic Tools and Processing of Electronic Evidence [9]
Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images

Text:

13. Bernad Jahne: Digital Image processing, Springer Verlag (1993)

References:

1. James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
2. Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.
3. Tessarolo, A.A. and Marignani, A., Forensic Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.

FORENSIC BALLISTICS

FS 541 **2-1-0-3**

Course Contents:
Unit I: Introduction to Ballistics [10] Firearms, Indian Arms Act, Characteristic features of the firearms, various types of modern firearms, classification of firearms on different basis, bore characteristics.
Unit II: Ammunition (Cartridges and Bullets) [8] Definition, Classification and constructional features of different types of ammunitions (cartridges), types of primers and priming composition, propellants and their compositions, Various types of bullets and their compositional aspects, latest trends in their manufacturing and design, smooth bore and improvised ammunition.
Unit III: Arms and Ammunition Linkage (Cartridge Case and fired bullets) [7] Principles and practice of identification of firearms, different types of marks produced (class and individual characteristics) during firing process on cartridge case -firing pin marks, breech face marks, chamber marks, extractor and ejector marks, Different types of marks produced during firing process on bullet-number/direction of lands and grooves, width of lands and depth of grooves, angle and pitch of rifling, striation marks on lands and grooves, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics
Unit IV: Determination of Range of Firing [8] Ejecta, burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different methods employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system
Unit V: Explosives &Explosion Scene Investigation [6] Explosive Act, nature and classification, composition and characteristics of explosives, pyrotechnics, IEDs, Explosion process and affects, types of hazard, effect of blast wave on structures, human etc.Specific approach to scene of explosion, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residues in the laboratory

Text:

1. Gary J. Ordog, Management of Gunshot Wounds; Elsevier, New York, 1983.

References:

1. Brain J. Heard; Hand book of Firearms and Ballistics; John Willey, England, 1997.
2. Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence; Stackpole Books, Harrisburg, PA, 1977.
3. D.A. Skoog, D.M. West and F.J. Holler; Analytical Chemistry: An Introduction; Saunders College Publishing, Philadephia, USA, (1994)
4. Dettean, J D; Kirk's Fire Investigation, 5th Ed, Prentice Hall, Eaglewood Cliffs, N.J (2002)
5. Working Procedure Manual: Chemistry, Explosives and Narcotics, BPR&D Pub (2000)

STATISTICS & RESEARCH METHODOLOGY

FS 551 **2-0-0-2**

Course Contents:
Unit I: Introduction to Research [7] Research– its definition and objectives, Types of Research, Research process, defining the research problem, research design.
Unit II: Sampling [8] Principles, methods: census and sample survey, sample design. Types of sampling, rationale for using a particular sampling procedure.
Unit III: Tools of Data Collection [7] Observation, interview schedule, questionnaire, Survey. case study methods
Unit IV: Statistics [8] Introduction, Descriptive Statistics: Frequency distribution, class intervals, graphical presentation: bar diagram, histogram, pie chart; Measures of Central Tendency: mean, median, mode; measures of dispersion: variance and std. deviation.
Unit V: Parametric and Nonparametric Statistics [9] Methods of correlation, skewness and Kurtosis variance, Types of correlation (Pearson r& Rho); Tests of significance. Level of significance, one sample, two samples and k-samples, Kruskall-Wallis ANOVA.

Text:

1. Creswell, John W. (2013). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. London: Sage

References:

2. Flick, Uwe (2009). An introduction to qualitative research. London:Sage.
3. Goertz, Gary & James Mahoney (2012). A tale of two cultures: qualitative and quantitative research in the social sciences.N.J. :Princeton University Press.
4. Hart, Chris (1998). Doing a literature review: releasing the social science research imagination. London: Sage.
5. Healey, J. F. (1993). Statistics: A Tool for Social Research.Belmont, CA: Wadsworth Publishing Company.
6. Scott, John (2000). Social Network Analysis: A handbook, London: Sage.
7. Yin, Robert (2009). Case study research: design and methods. London: Sage.

FORENSIC PRACTICAL-I

FS 561 **0-0-4-4**

14. Examination of physical properties of Soil.
15. Examination of physical properties of Glass.
16. Examination of physical properties of paints.

17. Physical examination of threads.
18. Comparison of different cloth pieces from crime scene.
19. Identification of fibers through chemical and instrumental analysis.
20. Sketching of the Indoor Crime scene (Indoor and Outdoor)
21. Sketching of the Indoor Crime scene
22. Photography of the Indoor crime scene
23. Photography of the Indoor crime scene
24. Collection, packaging and forwarding of trace evidences by Druggist Fold method.
25. Collection and preservation of various physical evidences (Fingerprint, blood, saliva, fiber, hair etc.).

SECOND SEMESTER

ELEMENTS OF FORENSIC MEDICINE, ODONTOLOGY

FS 502 **2-1-0-3**

Course Contents
Unit I: Introduction to Forensic Medicine [7] Definition of forensic medicine, Cause, manner and characteristics of death. Autopsy, Post mortem changes.
Unit II: Wounds and its medico legal significance [8] Basic injury production and healing mechanisms, Mechanical injuries (Abrasions, Bruises, Lacerations, Incised and stab wounds) and their medico legal significance.
Unit III: Causes and Manner of death [7] Deaths due to Asphyxia, Deaths due to fire, electrocution. Various Sexual offences including amendment in IPC
Unit IV: Forensic Odontology – I [8] Definition and Scope of Forensic Odontology, Types of dentition, Basic structure of human teeth, types of teeth & their morphology, and determination of age from teeth using various methods, dental anomalies and their role in Personal Identification.
Unit V: Forensic Odontology – II [9] Bite marks: Types & forensic importance .Collection and preservation of samples, analysis of Bite marks, presentation of bite mark evidences in court of law. Role of Forensic Odontology in mass disaster victim identification.

Text:

1. Modi's Medical Jurisprudence and Toxicology,23rd Edition, by K. Mathiharan & Amrit K. Patnaik, Third reprint, 2009, LexisNexis, Butterworth, New Delhi

References:

2. Essentials of forensic medicine, Dr. K. S. Narayan Reddy.
3. Forensic Medicine and toxicology, JB Mukherjee, Vol I & II.
4. Forensic Dentistry, Paul. G. Stimson & Curtis. A. Mertz, CRC
5. Forensic Odontology, Pramod .K. Dayal
6. Keith Simpson's , Forensic Medicine
7. Gleister's Medical Jurispridence and Toxicology, Churchill Livingstone Dental Anatomy Atlas, Whitaker

INSTRUMENTATION IN FORENSIC SCIENCE
(CHEMICAL, PHYSICAL and BIOLOGICAL)

FS 512 **3-1-0-4**

Course Contents:

Unit I: Chromatographic Techniques [10]

General principles, Paper chromatography, column chromatography, TLC, Adsorption chromatography, Partition chromatography, Gas chromatography, Gas- liquid chromatography, Ion-exchange chromatography, Exclusion (permeation) chromatography, Affinity chromatography, HPLC, HPTLC, Capillary Chromatography, Interfacing GC with IR spectrometry; High performance liquid chromatography, Electrospray ionization mass spectrometry Computer aided Analysis -Introduction, Computer organization - Hardware, Circuits for interfacing computers to Instruments, Computer Organization - software, Data representation, The Automated Laboratory.

Unit II: Spectroscopy [15]

Ultra violet and visible spectrophotometry: Types of sources and stability, wavelength selection, filters-cells and sampling devices, detectors, resolution, qualitative and quantitative methods for detection; Fluorescence and phosphorescence spectrophotometry: Types of sources, structural factors, instrumentation, comparison of luminescence and UV-visible absorption methods;
Atomic absorption spectrometry: Instrumentation and techniques, interference in AAS, background correction methods, quantitative analysis; Atomic emission spectrometry: Instrumentation and techniques, arc/spark emission, ICP-AES, comparison of ICP vs AAS methods, quantitative analysis, applications;
X-ray spectroscopy: X-ray absorption and fluorescence methods, X-ray diffraction, Auger emission spectroscopy (AES), electron spectroscopy for chemical analysis (ESCA);
Infrared spectrophotometry: Dispersive and Fourier Transform spectrophotometry, sample handling, quantitative analysis and interpretation of IR spectra;
Raman spectroscopy: Instrumentation, sample handling and illumination, structural analysis, polarization measurements and Dispersive & FT analysis; Radiochemical techniques: Basic principles and theory, introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis (NAA)

Unit III: Microscopy and Centrifugation Techniques [15]

Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges
Microscopy: Basic principles, Simple and Compound microscope, Comparison microscope, Phase contrast Microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Infra red Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM)

Unit II: Mass Spectrometry [8]

Sample flow, Ionization methods, Mass Analyzer, Vaccum Systems, Data handling, Correlation of mass spectra and molecular structure, Fourier transform mass spectrometry, Tandem mass spectrometry, Inductively coupled plasma MS (ICP-MS), Ion Microprobe Mass Analyzer (IMMA), HR GCMS, LCMS, Secondary Mass Spectrometry, Laser Mass spectrometry, Fast Atom bombardment and liquid secondary Ion Mass spectrometry

Text:

26. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).

References:

1. Lindsay S; High Performance Liquid Chromatography, Wiley & Sons NY (1992)
2. Handbook of TLC, 2nd Ed, Marcel Dekker; NY (1995)

3. Jarris, KE, A.L. Gray etal, Handbook of Inductively Coupled Plasma Mass Spectrometry, Glasgow Blockie, (1992)
4. Maclaffrty F.W. & F. Turecek; Interpretation of Mass spectra, 4th Ed., Mill Valley, CA Univ Science Books, (1993)
5. Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993)
6. Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.
7. N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.

INTRODUCTION TO QUESTIONED DOCUMENTS EXAMINATION

FS 522 **2-0-0-2**

Unit I: Introduction [6]

Nature and problems of document examination, classification of documents, procurement of standard admitted/ specimen writings, handling and marking of documents, preliminary examination of documents, Basis of handwriting identification – individuality of handwriting, natural variations, process of comparison, various types of documents – genuine and forged documents, holographic documents, various writing features and their estimation, general characteristics of handwriting, individual characteristic of handwriting, basic tools needed for forensic documents examination and their use.

Unit II: Author Determination [7]

Disguised writing and anonymous letters - identification of writer, Examination of signatures – characteristics of genuine and forged signatures, Examination of alterations, erasers, overwriting, additions and obliterations, Decipherment of secret, indented and charred documents, Examination of seal impression and other mechanical impressions.

Unit III: Examination of Photocopies [6]

Examination of black & white, colour Xeroxed copies, carbon copies, fax messages Forgeries and their detection - Various types of forgeries and their detection, Examination of built up documents – determination of sequence of strokes, Physical matching of documents, Identification of type writings– identification of typist, identification of printed matter – Various types of printing of security documents, Printing of currency notes, examination of counterfeit currency notes, passports, visa, stamp papers, postal stamps etc.

Unit IV: Determination of Age [7]

Determination of age of documents by examination of signatures – Paper, ink and writing/signatures etc. Examination of computer printout, identification of dot-matrix, ink-jet and laser printers, electronic typewriter, credit cards, Forensic stylistics, forensic linguistics, e- documents, digital signatures, An introduction to computer forensics, opinion writing, reasons for opinion.

Text:

27. Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London.

References:

1. Osborn, A. S. (1998). Classes of Questioned Documents. Questioned Documents, 2nd edition, First Indian reprint, Universal law publishing co. Pvt. Ltd., New Delhi.
2. Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group.

3. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
4. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
5. Cossidy, M.J., Footwear Identification, Royal Canadian Mounted Police, Ontario, Canada, 1980.
6. Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
7. Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
8. Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
9. Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
10. Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.
11. Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
12. Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.

INTRODUCTION TO FORENSIC CHEMISTRY, TOXICOLOGY and PHARMACOLOGY

FS 532 **2-0-0-2**

Course Contents
Unit I: Introduction to Forensic Chemistry [5] Forensic Chemistry: Introduction, types of cases/exhibits, preliminary screening, presumptive test (colour and spot test), inorganic analysis, micro – chemical methods of analysis, Analysis of petroleum products.
Unit I: Toxicology of alcohol &Examination of Alcoholic Beverages [5] The fate of alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, Examination of alcoholic beverages; country made liquor, illicit liquor.Analysis of blood for alcohol.
Unit III: Drugs of Abuse [5] Introduction, classification of drugs of abuse, drugs of abuse in sports and doping, narcotics drugs and psychotropic substances, designers drugs and their forensic examination, Drugs and Cosmetic Act, Excise Act, NDPS Act.
Unit IV: Introduction to Toxicology [5] Definition, Law relating to poison, Classification of poisons. Action of poisons & factors modifying its action, routes of administration of poisons.
Unit V: Forensic Pharmacology [6] Pharmacology and toxicology of Psychotropic Drugs: Sedatives, Stimulants, Opiates and drugs of abuse. Extraction, Isolation of drugs from viscera, tissues and body fluids.

Text:

1. Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.

References:

1. A Burger; Medicinal Chemistry, Vol. II, Wiley Interscience, New York; (1970)
2. A.I Vogel; Textbook of Practical Organic Chemistry including Qualitative Organic Analysis; ELBS, Essex (1971)
3. Boudreau, JE et al – Arson & Arson Investigation, Survey & Assessment National Institute of Law Enforcement, U.S Deppt of Justice, US Govt. Printing Press (1977)
4. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
5. Gleason, M.N. et.al, Clinical Toxicology of Commercial products, Williams and Williams, Baltimore,

INTRODUCTION TO FORENSIC BIOTECHNOLOGY

FS 542 **2-0-0-2**

Course Contents
Unit 1:HAIR & FIBER [6] Structure of hair and its biochemical properties, Phases of hair growth, types of hair. Differences between animal and human hair, Forensic examination of different types of hairs. Different Types of fibers and their identification.
Unit 2 : INTRODUCTION TO BOTANICAL EVIDENCES & DIATOMS [5] Different botanical evidences of forensic significance: seeds, pollens etc .Diatoms: Classification, basic structure and morphology, forensic significance of diatoms.
Unit 3: INTRODUCTION TO FORENSIC ANTHROPOLOGY [5] Definition and scope of forensic anthropology, Human skeletal system and Types of bones. Estimation of age from skull and long bones, site and side determination. Estimation of Stature from skeletal remains. Determination of sex from skull, mandible and pelvis.
Unit 4:INTRODUCTION TO FORENSIC SEROLOGY [5] Definition and scope of forensic serology. Nature, composition and functions of blood and other fluids. Collection, preservation and packing of Biological fluids. Introduction to ABO, Rh, MN systems, Lectins – their forensic significance, Determination of secretor/ non secretor status. Antigens- Antibody reactions.
Unit 5:INTRODUCTION TO DNA PROFILING [5] Introduction to DNA , DNA biochemistry, Nuclear DNA and Mitochondrial DNA,. Significance of DNA profiling, Fundamental concepts and techniques applied in specific DNA tests, Scientific principles of forensic DNA typing. FTA cards, DNA extraction/isolation from different samples.

Text:

28. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References:

29. Pandey, B. P., Plant Anatomy; S. Chand, New Delhi, 1998.
30. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
31. Byrd, J. H. & Castner, J. L., Forensic Entomology, The Utility of Arthorpods in legal Investigation, CRC Press, USA, 2000.
32. Catts, E.P & Haskell N.H., Entomology and death: A procedural guide, Joyce's Print Shop, 1990.
33. Mauersberger, Herbert R., & Mathews, Textile Fibres – Their physical, Microscopic and chemical properties, John Wiley, New York, 1954.
34. Smith; DGV; A manual of Forensic Entomology Ithaca New York Camstock Univ. Press, USA, (1986)
35. Glaister's Book of Hairs Seta: Hair
36. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.

DISASTER MANAGEMENT and VICTIM IDENTIFICATION

FS 552 **2-1-0-3**

Unit 1: Understanding Disasters [10]

Meaning, nature, characteristics and types of Disasters, Causes and effects, Disaster:
A Global View, Disaster Profile of India, The Disaster Management cycle, Geological and Mountain Area Disasters-Earthquakes, Volcanic Eruption, Landslides, Snow Avalanches; Wind and Water Related Natural Disaster-Floods and Flash Floods, Droughts, Cyclones, Tsunamis; Man Made Disasters-Understanding Man-Made Disasters, Fires and Forest Fires, Nuclear, Biological and Chemical disaster and Road Accidents.

Unit 2: Roles & Responsibilities of Different Agencies and Govt. [10]

Roll of Information, Education, Communication & Training, Role and Responsibilities of Central, State, District and local administration, Role and Responsibilities of Armed Forces, Police, Para Military Forces, Role and Responsibilities of International Agencies, NGO's, Community Based Org. (CBO's).

Unit 3: Technologies for Disaster Management [10]

Role of IT in Disaster Preparedness, Remote Sensing, GIS and GPS, Use and Application of Emerging Technologies, Application of Modern Technologies for the Emergency communication, Application and use of ICST for different disasters, Human Behaviour and Response: Psychological Response and Psychological Rehabilitation, Trauma and Stress Management, Rumour and Panic Management, Medical and Health Response to Different Disasters, Role of Information and Communication Technology in Response Management.

Unit 4: Relief Measures and Victim Identification [9]

Minimum Standard of Relief, Relief Management- essential components, Funding Relief- short term and long term, Disaster Site Management, Recovery, Victim Identification and Biometrics, Bite Marks, methodologies, DNA Analysis and techniques, Ear prints, methodologies and analysis, Lip Prints, Fingerprints from dead bodies.

Text:

1. Sharma, R.K. & Sharma, G. (2005) (ed) Natural Disaster, APH Publishing Corporation, New Delhi.

References:

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
3. Central Water Commission, 1987, Flood Atlas of India, CWC, New Delhi.
4. Central Water Commission, 1989, Manual of Flood Forecasting, New Delhi.
5. Government of India, 1997, Vulnerability Atlas of India, New Delhi.
6. Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.

FORENSIC PRACTICALS II

FS 562 **0-0-3-3**

1. Dental patterns and Recognition
2. Identification of individual teeth based on the morphological features.
3. Estimation of age from the teeth.
4. Living subject
5. Maxilla & mandible
6. Comparison and Identification of Individuals from bite marks
7. Autopsy
8. UV-Visible Spectrophotometer-working, sample preparation, analyzing graphs
9. IR Spectrophotometer- working, sample preparation, analyzing graphs
10. TLC of Ink Samples
11. Paper Chromatography

THIRD SEMESTER

FINGERPRINTING and FORENSIC PHOTOGRAPHY

Course Code: FS 601 **Credit Units: 2-1-0-3**

Course Contents
Unit I: Introduction to Photography [7] Introduction to forensic photography; Required equipments for photography – Camera, lens, shutter, depth of field, film; Importance of Forensic photography in a crime scene investigation.
Unit II: Types of Photography & Photo Prints [8] History and Development of Photography. Basic principles and techniques of Black & White and colour photography. Developing techniques and methods of photography, Different kinds of developers and fixers, modern developments in photography, linkage of cameras and film negatives.
Unit III: Introduction and Classification of fingerprints [7] Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation; Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints
Unit IV: Classification Systems and AFIS [8] Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC; AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications
Unit V: Fingerprint Developmental Techniques [9] Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.

Text:

37. Redsicker, D. R., The Practical methodology of Forensic Photography, CRC Press, London, 1994.
38. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

References:

1. Henry Horeustein; Colour Photography -A working Manual, Little Brown Co. Boston (1995)
2. B.H.E. Jacobson, Ray GG Attridge; The Manual of Photography, Focal Press, London (1988)
3. Jahne B; Digital Image Processing, Heidelberg Springer (1996)
4. H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press (2002)
5. David R. Redsicker; The Practical Methodology of Forensic Photography- 2nd Ed. CRC Press LLC (2001)
6. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

7. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.

APPLIED COGNITIVE PSYCHOLOGY

FS 611 **2-1-0-3**

Unit 1: Cognitive Neuroscience [13]

Introduction, Philosophical antecedents, Emergence of Cognitive psychology, Approaches and key issues, Organization of Nervous system: Cognition in the Brain, Sensation, to representation, Theoretical approaches to perception, Deficits in perception. Attention and consciousness.

Unit 2: Memory [10]

Models, Processes, Practical Applications of Cognitive Psychology in improving memory processes, Representations and manipulation of Knowledge in: Images and Propositions: Spatial cognition and Cognitive Map.

Unit 3: Language [8]

Nature and Acquisition: Bilingualism and Multilingualism Reading: Bottom-up and Top-down processes, Comprehension, Neuropsychology of Language. Problem-solving and Creativity: Practical applications of cognitive psychology. Decision-making and reasoning: Deductive reasoning and inductive reasoning,

Unit 4: Intelligence [8]

Information possessing and intelligence, alternative approaches to Intelligence. Computer Simulation, improving intelligence.

Text:

1. Durso, F. T. (2007). Handbook of Applied Cognition (2nd Ed). New West Sussex : Wiley & Sons.

References

1. Esgate, A. et al. (2005). An Introduction to Applied Cognitive Psychology. Psychology Press: New York.
2. Sternberg, R. J. (Ed.) (2000). Handbook of intelligence. New York: Cambridge University Press.
3. Sternberg, R. J. (2009). Applied Cognitive Psychology: Perceiving Learning and Remembering. Australia:
4. Cengage Learning

SPEECH ANALYSIS and MULTIMEDIA FORENSICS

FS 621 **2-1-0-3**

Unit I: Speech [10]

Speech Anatomy, Mechanism of speech Production, Acoustic Properties of Vocal Tract, Uniqueness in person's voice, interspeaker and intraspeaker variation; Articulation- Manner & Place of Articulation, Phonemes, Vowel, Consonant and Glides; Phonetics in Speaker Identification, IPA (The International Phonetic Alphabets), Forensic Phonetics, Effect of context, Supra segmental (Prosodic features). Audio-enhancement, Sound Recording/Playback Devices: Analog Tape recorders, Digital recorder, Microphone types, Digital audio formats. Apex Court Judgments on Speaker Identification. Court presentation of report based on speaker identification.

Unit II: DSP [10]

Digital Signal Processing, A to D Conversion- Sampling, Quantization, Digital Audio Formats, Pulse Code Modulation, Coding and Decoding, Computer Representation of Speech Speaker Recognition: Principles of speaker recognition/identification, Methods on Speaker Recognition. Various approaches in Forensic Speaker Identification, Interpretation of result, Statistical interpretation of probability scale, Objective/Subjective methods, discriminating tests, closed test, open test, likelihood ratio calculation, Concept of test and error in Speaker Identification. Introduction to Pattern Recognition, Pattern Recognition application in Automatic Speaker Identification and Verification System, Different algorithm of automatic speaker identification.

Unit III: Audio Evidence [10]

Audio Evidence Examination: Handling of audio recording evidences, Procedure for preparation of working copies, Phonetic transcription, Analysis of linguistic & phonetic characteristics, Temporal measurement, Text-dependent and text-independent speaker recognition. Instrumental Analysis of speech sample: Verbatim, Clue words, IPA marking, CSL & Linear predictive coding technique, Fourier transformation, Examination using SPID, Vocal behaviors, alcohol speech relationships. Authentication of recorded audio: Type of alterations, Auditory Examination by Critical Listening. Waveform analysis, Speech Spectrographic analysis, Magnetic developing, Optical Method.

Unit IV: Video Evidence [9]

Introduction to video technology: Video standards, Recording formats- Analog and Digital, Introduction to video devices, Linear and Non-linear editing, Concept of video film production, Graphics and animation technique. Image perception, Colour space & representation, Storage, Image processing application. Introduction to image enhancement, Image restoration, Concept of digital water marking, Image compression, Retrieval of video files, Integrity of images, Facial image recognition. Forensic analysis of audio/video in video recording: Authentication of video recording, Visual examination technique on video frame sequence, Video image analysis- object, costumes, Facial image recognition from video frame image, Video signal analysis.

Text:

1. Philip Rose; Forensic Speaker Identification, Taylor and Francis, Forensic Science Series, ondon (2002)

References:

1. Arthur R Weeks Jr; Fundamentals of Electronic Image. SPIE Press, (2003)
2. Bengold & Nelson Moryson; Speech and Audio signal processing, John Wiley & Sons, USA (1999)
3. D.B. Fry; The Physics of Speech, Cambridge University Press. (2004)
4. David Cheshire; The Complete Book of Video Techniques Subjects Equipment, Dorling Kindersley, London (1992)
5. Des Lyver & Graham Swainson; Basics of Video Production, 2nd Ed. Focal Press (1999)
6. Dwight Bolinger et. al.; Aspects of Language, Third Edition, Harcourt Brace Jovanovich College Publishers, USA. (1981)
7. Gloria J. Borden et. al. Speech Science Primer (Physiology, Acoustics and perception of Speech), 6th Ed, a Wolters Kluwer Company, USA. (2011)
8. Harry Hollien; Forensic Voice Identification, Academic Press, London. (2001)
9. Harry Hollien; The Acoustics of Crime- The New Science of Forensic Phonetics, Plenum Press, New York and London (1990)
10. Husrev Taha Sencar, Nasir Memon; Digital Image Forensics: There is More to a Picture than Meets the Eye. Springer (2013)
11. John C. Russ; Forensic Uses of Digital Imaging CRC Press, (2001)
12. Martin Uren; BKSTS Illustrated Dictionary of Moving Image Technology, 4th Ed, CRC Press, (2013)
13. Oscar Tosi; Voice Identification-Theory of Legal Applications, University Park Press, Baltimore (1979)
14. O'Shaughnessy, Douglas; Speech Communication, Hyderabad Universities Press (2001)
15. Patricia Ashby; Speech Sounds, 2nd Ed. Routledge, London and New York (2005)
16. Randy Crane; A Simplified Approach to Image Processing, Prentice Hall. (1996)

17. Simon J. Godsill; Digital Audio Restoration, Springer, (1998)
18. Gary H. Anderson; Video Editing and Post-Production- A Professional Guide, 4th Ed,Focal Press, (1998)

FORENSIC PRACTICAL III

FS 631 **0-0-3-3**

1. Taking Photographs
2. Photography of Outdoor Crime Scene
3. Indoor photography including the laboratory
4. Presentation of Evidence through Photograph and charts.
5. Photography of documents and fingerprints (Transmitted light/Oblique light/U.V. Light Photography).
6. Taking of fingerprints on fingerprint chart.
7. Development of latent Finger Prints using powder methods.
8. Examination and comparison of security documents, fake currency and stamp papers.
9. Development of latent finger prints by Chemical methods and photography.
10. Development of latent finger prints by physical methods and photography.
11. Comparison of fingerprints, palm prints along on the basis of ridge characteristics and ridge details.
12. Recording of speech samples using tape recorder & digital recorders and measures for keeping it in the safe custody.
13. Speaker wise segregation of speech sample of recorded conversation spoken between two speakers.
14. Transfer of audio file from a digital media to other media using standard software and authentication of recorded speech.
15. Comparison of linguistic and phonetic features of audio recording voice samples of two speakers
16. Spectrographic analysis of voice samples of two speakers using voice spectrograph and comparison of their spectrographic features.
17. Video analysis and detection of tampered video files using Video analyzing tool.

ELECTIVES

Specialization A: Forensic Chemistry and Toxicology

ADVANCED FORENSIC CHEMISTRY

FS 641 **2-0-0-2**

Course Contents:
Unit I: Arson [5] Arson: Chemistry and Behavior of fire, origin and cause and their methods of investigation and evaluation of clue material, analysis of arson exhibits by various methods: Management of Arson cases.
Unit II: Motor Vehicle Fires [5] Causes, investigation, collection, preservation, packaging and analysis of evidences
Unit III: Analysis of Petroleum Products, Organic and Inorganic Substances [5] Examination of petroleum products: distillation and fractionation, various fractions and their commercial uses, standard methods of analysis of petroleum products for adulteration, Forensic analysis of organic and inorganic Industrial products, chemical fertilizers, insecticide, metallic and non-metallic products, consumer items.

Unit IV: Expert Witness [5] The role of Chemist as an expert witness. Presentation of the report in the court, Cross-examination of the expert
Unit V: Explosives [6] Classification, composition and characteristics of explosives, pyrotechnics, IEDs, systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, Explosives Act.

Text:

1. James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

References:

1. Carper, K. (ed.), Forensic Engineering, 2nd Edn. CRC Press, Bocarida, Florida, 2001.
2. Field, J., and Carper, K., Construction Failure, 2nd Edn. John Wiley and Sons, New York, 1996.
3. SAE Handbook, Vol. 4, On-Hghway and Off-Highway Machinery, Society of Auto mobile Engineers, 2000

ADVANCED FORENSIC PHARMACOLOGY & TOXICOLOGY

FS 651 **2-0-0-2**

Course Contents:
Unit I: Pharmacology-I [5] Sites and mechanisms of action of drugs, Dose-effect relationships; agonists, partial agonists and antagonists. Factor that modify drug actions; side effects, overdose, idyosincratic and allergic reactions; teratogenesis and foetal toxicity. Drug interactions.
Unit II: Pharmacology-II [5] The movement of drug molecules across cell membranes, the blood-brain barrier and the placental filter. Routes of administration and drug adsorption. Binding to plasma proteins. Drug distribution, metabolism and elimination. Drug bioavailability and half-life.
Unit III: Toxicology and Isolation techniques of toxins [5] Definition of Toxicology, Principle of Toxicology, Isolation of Toxic substances from viscera and other relevant materials. The role of drug recognition expert.
Unit IV: Different Toxins-I [5] Nature, administration, sign & symptoms, Fatal dose, postmortem findings, Detection and medicolegal aspects of- **a) Metallic poisons** Arsenic, Mercury **b) Vegetable poisons** Abrus Precatorius, Calotropis Gigantia,Castor ,Oleander, Aconite.
Unit V: Different Toxins-II [6] • **Insecticides** Organophosphorous compounds, Organochloro Compounds and Carbamates

- **Volatile Poisons** Methyl alcohol, Chloroform,
- **Asphyxiants** Cyanide, Carbon monoxide
- **Animal Poisons** Snake venom, Cantharide, Insect bite.

Text:

1. Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986

References:

39. Text book of pharmacology, Lawrence
40. A. Stolemen, Progress in Chemical Toxicology: Acad. Press, New York, 1963.
41. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
42. Gleason, M.N. et.al, Clinical Toxicology of Commercial products, Williams and Williams, Baltimore, USA, 1969.
43. Modi, Jaishing P, Textbook of Medical Jurisprudence & Toxicology, M.M. Tripathi Pub.2001.
44. Working Procedure Manual – Toxicology, BPR&D Publication, 2000

FORENSIC PRACTICAL IV A

(Chemistry, Pharmacology, Toxicology)

FS 661 **0-0-4-4**

45. Isolation techniques of different toxic substances.
46. TLC of insecticides, Barbiturates and other drugs.
47. Analysis of volatile and non-volatile poisons.
48. Analysis of vegetable poisons.
49. Spot test of nitrates, nitrites, carbonates, sulphates, sulphites, chlorates.
50. Spot test of mercury, iron, copper, Aluminum and cadmium and zinc and other metallic poisons

Specialization B: Forensic Biotechnology and DNA Profiling

ADVANCED FORENSIC BIOLOGY & ANTHROPOLOGY

FS 671 **2-0-0-2**

Course Contents
Unit I: Introduction to Wild Life Forensics [5] Introduction to wildlife forensics, Examination of pug marks, horn, skin, fur, hair, nail and teeth. Identification of some endangered species of plants and animals.. Wildlife life protection Act.
Unit II: Forensic Entomology & Forensic microbiology [5] Collection of insects, Shipment of collected insects, Identification of insect and its stage of growth. Determination of the postmortem interval or "time since death" in homicide investigations, forensic entomotoxicology. Introduction to forensic microbiology
Unit III: Forensic Anthropology [5]

Somatometry, osteometry & Craniometry. Identification of individuals from skeletal remains, Collection, Handling, preservation of skeletal remains of forensic science and report writing.
Unit IV: Forensic Taphonomy, Forensic Radiology [5] Forensic Taphonomy. Fire modification of bones .Assessment of antemortem and postmortem skeletal trauma. Artefacts in the skeletal remains. Application of radiology in forensic anthropology
Unit V:, Super Imposition &Facial Reconstruction [6] .Superimposition techniques. Facial reconstruction; three dimensional and computer assisted facial reconstruction

Text:

51. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References:

1. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
2. Byrd, J. H. & Castner, J. L., Forensic Entomology, The Utility of Arthorpods in legal Investigation, CRC Press, USA, 2000.
3. Encyclopedia of Forensic Sciences, Volume, I, II, II & IV, Edited By Jay A. Siegel, Geoffrey C. Knupfer & PekkaSaukko,AcamicPress,2000
   A laboratory manual on Biological Anthropology, Anthropometry, Indera P. Singh, M.K. Bhasin,: Kamla Raj Enterprises,1989
4. Advances in Forensic Taphonomy: Method, Theory, and Archaeological Perspectives ,William D. Haglund , Marcella H. Sorg, CRC Press; 1 edition, 2001
5. Brogdon's Forensic Radiology, Second Edition, Edited by Michael J. Thali, Mark D. Viner, B.G. Brogdon, Published November 22nd 2010 by CRC Press – 654 pages

ADVANCED FORENSIC SEROLOGY & DNA PROFILING

FS 681 **2-0-0-2**

Course Contents
Unit 1:Forensic Characterization of Blood Catalytic tests & crystal tests, Spectrophotometric method, chromatographic method, immunological methods, electrophoresis methods. Typing of blood antigens from dried stains. Lattes test, Absorption Elution, Absorption Inhibition, Mixed agglutination
Unit 2: Forensic Characterization Body Fluids Forensic characterization of semen, saliva, urine, faeces, milk and other biological fluids. Their identification and examination.
Unit 3: Determination of Species of Origin Determination of species origin. Extraction of species specific antigens from blood stains, and other body fluids .Tube technique (Precipitin test/Ring test), Diffusion methods; single diffusion, double diffusion,

and crossed-over electrophoresis, rocket electrophoresis.
Unit 4: Serogenetic Markers Introduction to isozymes and Polymorphic proteins. Typing of isozymes, like Phospho Glucomutase (PGM), Glyoxylase I(GLO), Esterase D(EsD), Adenylate Kinase (AK) .Typing of polymorphic serum proteins like Haptoglobin(Hp) &Transferrin (Tf) Introduction to Human Leucocyte Antigen. HLA Classification, HLA typing, Mol.based HLA typing.
Unit 5: DNA Profiling RFLP analysis, analysis of STR, SNP and Mitochondrial DNA, YSTRs, PCR amplifications, FTA cards, DNA chips. Forensic applications of DNA profiling, limitations of DNA profiling

Text:

1. Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

References

1. Biology Methods manual, Metropolitan Police Forensic Science Laboratory, London, 1978.
2. Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
3. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2nd Edn) CRC Press, Boca Raton, Florida, 1999.
5. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
6. Blood grouping on man R.R. Race and Sanger. Blackwell Scientific Publications, Oxford, England. 1950.
7. Boorman K, Dodd B, Lincoln P. Blood group serology: Theory and Techniques: Practical Applications. 5th ed.

FORENSIC PRACTICAL IV B

FS 691 **0-0-4-4**

52. Determination of species of origin from blood &other biological evidences using precipitin test
53. Extraction /Isolation of Diatoms from water/soil, tissues &Identification
54. Identification of bones based on its morphology and anatomical planes
55. Sex Determination from Skull, Mandible, Pelvis & long bones
56. Presumptive and Confirmatory tests for blood
57. Examination and Identification body fluids
58. Microscopic Examination of Hair for the determination of species
59. Gel-Immuno Diffusion tests for species origin
60. Blood grouping from dried stains by Absorption Inhibition or Absorption Elution
61. Craniometry & Osteometry
62. Somatometry & Somatoscopy
63. Stature estimation from bones
64. Age Estimation from Skull, Mandible, Long bones

65. Sexing from Barr Bodies
66. Isolation of DNA from various sources-plants, bacteria and blood
67. PCR
68. RFLP and DNA Sequencing
69. DNA Estimation through Spectroscopic Methods
70. ImmunoElectrophoresis
71. Radial Immuno diffusion
72. ELISA
73. Double Diffusion Assay
74. Quantification of RNA

Specialization C: Questioned Document Examination

ADVANCED QUESTIONED DOCUMENT EXAMINATION

FS 603 **2-0-0-2**

Unit I: Graphology and Psychological Autopsy [5]

Police Psychology, Victimology, Criminal Profiling, Cognitive Psychology and Applications, Uses, Graphology: Introduction, Writing Systems, Graphology Learning Systems, Criminal Profiling through Handwriting, Lie Detection through Handwriting, Behavioral Estimations through Handwriting

Unit II: Stylistics and Linguistics [5]

Writing Systems, Historical Linguistics, Field Linguistics, Linguistic Phonetics, Phonology, Morphology, The Lexicon, Syntax, Generative Grammar, Functional Linguistics, Typology, An Introduction to Formal Semantics, Pragmatics: Language and Communication, Discourse Analysis, Linguistics and Literature, First Language Acquisition, Linguistics and Second Language Acquisition, Multilingualism, Natural Sign Languages, Sociolinguistics, Neurolinguistics, Computational Linguistics, Applied Linguistics, Educational Linguistics, Linguistics and Reading, Clinical Linguistics

Module III: Automated Signature/Handwriting Recognition Systems [5]

Introduction, Latest Trends in Automated System Development, Image Acquisition, Image Processing, Feature Quantification, Feature Extraction, Feature Processing, Comparison, Behavioral Biometrics, Introduction, Verification and Identification, Basic working of Biometric Matching, Accuracy, False Match Rate, False Non-match Rate, Failure to Enroll Rate.

Module IV: Advanced Detections of Forgeries [5]

Handwriting comparisons using Individual Characteristics, Fractured/cut edge comparisons (paper, tape, postage stamps, dryer sheets), Plastic bag comparisons, Printing process examinations (document authentication/typewriting classification), Charred and liquid soaked document preservation, Indented writing examinations, Alternate light source examinations (ink discrimination, alterations, enhancements), Office machine artifact comparisons; Database queries (Anonymous Letter File, Automated Counterfeit Identification Database, Bank Robbery Note File, Testimony in legal proceedings

Module V: Art Forgery [3]

Introduction, History, Artist Forgers, Dealer Forgers, Examination, Carbon Dating, White Lead Dating, X-Ray based Techniques, Dendrochronology, Stable Isotope Analysis, Thermo-luminescence, Craquelure, Digital Authentication, Morellian Analysis, Atomic Absorption Spectrophotometry, Inductively Coupled Plasma, Mass Spectrometry, Wavelet Decomposition, Photographic Forgery, Victorian Waifs, The Rospigliosi Cup Case Study, Etruscan Terracotta Warriors Case Study, Flower Portrait, Michelangelo's "Cupid" Case Study, Samson Ceramics, Getty Kouros, Copying vs. Forging, Pastiche, Association Research into Crimes against Art, Racketeer Influenced and Corrupt Organizations Act, Postal Fraud, Archaeological Forgery, Archaeoraptor, Neutron Activation Analysis

Module VI: Electronic Document Analysis [3]

Data and Evidence Recovery, Computer and cyber forensic basics, Cell Phones / Mobile Forensics, Bluetooth, Computer Ethics and Application Programs, Data and Evidence Recovery- Formatted Partition Recovery, Data Recovery Tools, Data Recovery Procedures and Ethics, Fine Transfer Protocol (FTP), Preserve and safely handle original media, Recover Internet Usage Data, Recover Swap Files/Temporary Files / Cache Files

Text:

1. Roy A Huber, A.M. Headrick; Handwriting Identification- Facts and Fundamental, CRC Press (1999)

References:

1. Rev ED, Ordway Hilton; Scientific Examination of Questioned Documents, Elsevier, NY (1982)
2. Albert S. Osborn; Questioned Documents, 2nd Ed., Universal Law Pub., Delhi (1998)
3. Albert S Osborn; The Problem of Proof, 2nd Ed., Universal Law Pub. Delhi (1998)
4. Charles C. Thomas; I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates Springfield, Illinois, USA (1971)
5. Wilson R. Harrison; Suspect Documents Their Scientific Examination, Universal Law Pub. Delhi Indian Reprint (2001)
6. Hard less H.R; Disputed Documents, Handwriting and Thumbs – Print Identification, profusely illustrated, Law Book, Allahabad (1988)
7. Morris Ron N; Forensic Handwriting Identification, Acad Press, London (2001)
8. Kurtz Sheila; Grapholypes a new Plant on Handwriting Analysis, Crown Pub. Inc., USA (1983) w.e.f. 2005-2006
9. Lerinson Jay; Questioned Documents, Acad Press, London (2001)
10. Mcmenamin, Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington, D.C. (2002)
11. Ellen David; Questioned Documents- Scientific Examination, Taylor & Francis, Washington (1997)
12. Andrea McNichol, Jeffrey A, Nelson; Handwriting Analysis-Putting It to Work for You, Jaico Books, Delhi (1994)
13. Vacca John R; Computer Forensics, Computer Crime Scene Investigation, Firewall Medial, An imprint of Laxmi Pub. (2002)
14. Casey Eoghan; Handbook of Computer Crime Investigation, Forensic Tools & Technology, Academic Press (2002)

DIGITAL IMAGE PROCESSING

FS 613 **2-0-0-2**

Unit I: Introduction and Fundamentals [5]

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain; Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit II: Image Enhancement in Frequency Domain [5]

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering.

Unit III: Image Restoration [5]

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Unit IV: Registration and Segmentation [5]

Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements. Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit V: Feature Extraction [6]

Representation, Topological Attributes, Geometric Attributes, Boundary-based Description, Region-based Description and Relationship. Object Recognition; Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

Text:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.

References:

1. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
2. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ

FORENSIC PRACTICAL IV C

FS 623 **0-0-4-4**

1. Image enhancement
2. Image compression
3. Color image processing
4. Image segmentation
5. Image morphology
6. Image Restoration
7. Edge detection
8. Comparison of forged (disputed) signature with the specimen signatures.
9. Comparison of disguised (disputed) signature with specimen signatures.
10. Examination and comparison of disputed anonymous letter with specimen of suspect/suspects.
11. Identification of altered/added/obliterated/erased/handwriting on cheques and deeds.

FOURTH SEMESTER
DISSERTATION: RESEARCH WORK BASED PROJECT

FS 620 **Credits: 20**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curriculae where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

75. A short account of the activities that were undertaken as part of the project;

76. A statement about the extent to which the project has achieved its stated objectives;

77. A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;

78. Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;

79. Any problems that have arisen and may be useful to document for future reference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

Title or Cover Page

The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.

Acknowledgement(s)

Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.

Abstract

A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.

Conclusion(s) & Recommendations

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:

1. Did the research project meet its aims (check back to introduction for stated aims)?
2. What are the main findings of the research?
3. Are there any recommendations?
4. Do you have any conclusion on the research process itself?

Implications for Future Research

This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.

Appendices

The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References

References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples:

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect* , **8** (suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

The Layout Guidelines for the Project File & Project Report:

1. A4 size Paper
2. Font: Arial (10 points) or Times New Roman (12 points)
3. Line spacing: 1.5
4. Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following ***assessment objectives:***

1. Range of Research Methods used to obtain information
2. Execution of Research
3. Data Analysis (Analyze Quantitative/ Qualitative information)
4. Quality Control
5. Conclusions

Assessment Scheme:
Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.

Mody University of Science & Technology

MSc Maths

Session 2019-2020

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M. Sc. Mathematics

(Session 2016-2017 Onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20

Objectives: The proposed PG programme in Mathematics is a highly interesting and promising with broader opportunity for absorption in teaching, research and industry for students. The M.Sc. Mathematics programme offers core fundamental skills in Mathematics which incorporate the ideas of applied mathematical knowledge as well as provide platform to the student's regarding research oriented programmes in various interdisciplinary areas of mathematics.

Scope: The programme will generate interest of students towards fundamental mathematical research and will be able to qualify eligibility test for various fellowships.. Student will be able to select various options for higher studies like doctoral programmes in Computational numerical analysis, Advanced graph and pebbling theory, Algebraic and numerical topology, Approximation theory, Optimization techniques , Economics Fluid dynamics, Financial mathematics, Theory of computation and artificial intelligence, Mathematical modeling and simulation etc. Further, they have scope for absorption in research Labs in India like BARC, IISc, TIFR, IITs, ISRO, DRDO etc. as well as may get opportunity for doctoral or post doctoral research in India and abroad.

Input Qualification:

Bachelor's Degree in Science from any recognized university with Mathematics as a core subject for three years/six semesters, with 50% of aggregate marks and adequate proficiency in English.

Evaluation Procedure: All the Rules and Regulations as a provided in the Ordinance and regulations of the Undergraduate/postgraduate programmes of Mody University shall be followed. The first batch of this programme is proposed to be admitted in the session 2016-2017.

	M.Sc. Mathematics									
	Two-Year Programme									
	Academic Curriculum(Session 2016-2017 onwards)									
	First Year									
Autumn Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 511	Computer Based Advanced Numerical Analysis	3	1	-	4	3	25	25	50
	MS 521	Discrete Mathematics	3	1	-	4	3	25	25	50
	MS 531	General Topology	3	1	-	4	3	25	25	50
	MS 541	Operations Research	3	1	-	4	3	25	25	50
	MS 551	Statistics and Probability -I	3	1	-	4	3	25	25	50
	MS 561	Ordinary Differential Equations	3	1	-	4	3	25	25	50
		Sub Total	**18**	**6**	**-**	**24**				
		Foreign Language-I** (Non-Credit)	3	-	-	3	3	25	25	50
Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 512	Advanced Abstract Algebra	3	1	-	4	3	25	25	50
	MS 522	Complex Analysis and Integral Transform	3	1	-	4	3	25	25	50
	MS 532	Mathematical Modeling and Simulation	3	1	-	4	3	25	25	50
	MS 542	Partial Differential Equations	3	1	-	4	3	25	25	50
	MS 552	Statistics and Probability - II	3	1	-	4	3	25	25	50
	MS 562	Modeling and Simulation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**5**	**4**	**22**				
		Foreign Language-II **(Non-Credit)	3	-	-	3	3	25	25	50

** Refer to Foreign Language Section.

M.Sc.(Mathematics)

Two-Year Programme (2016- 17 and onwards)

Second Year

Autumn Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 611	Advanced Linear Algebra	3	1	-	4	3	25	25	50
MS 621	Advanced Graph Theory and Combinatorics	3	1	-	4	3	25	25	50
MS 631	Real Analysis and Measure Theory	3	1	-	4	3	25	25	50
MS 641	Special Functions and Integral Equations	3	1	-	4	3	25	25	50
	Elective-I	3	1	-	4	3	25	25	50
	Sub Total	**15**	**5**	**-**	**20**				

Spring Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 612	Functional Analysis	3	1	-	4	3	25	25	50
MS 622	Inequality and Continued Fractions	3	1	-	4	3	25	25	50
MS 632	Basics of MATLAB	-	-	4	2	4	100		
	Elective-II	3	1	-	4	3	25	25	50
MS 642	Dissertation	-	-	-	8		100		
	Sub Total	**9**	**3**	**4**	**22**				

Total Credits: 88 (I Year +II year)

Elective- I	**Elective- II**
MS 651 Magneto Hydrodynamics	MS 652 Viscous Fluid Dynamics
MS 661 Sequence and Series	MS 662 Summability and Approximation Theory
MS 671 Tensor Analysis	MS 672 Mechanics and Calculus of Variations
MS 681 Reliability Theories	MS 682 Fourier Analysis
MS 691 Advanced Number Theory	MS 692 Differential Geometry

* CW (Course work): It would include attendance, assignments, class /quiz test.

Note: Combinations of electives are: MS 651 & MS 652; MS 661 & MS 662; MS 671 & MS 672; MS 681 & MS 682; MS 691 & MS 692.

(Above II year is taken from AC 30, syllabus in AC 30 minutes)

MS 511 Computer Based Advanced Numerical Analysis 3-1-0-4

1. Algebraic and Transcendental Equations: General iterative methods, Newton-Raphson method for finding multiple roots, system of non linear equations, convergence of Newton-Raphson method, Graeffe's root squaring method, Muller's method , Bairstow iterative method. **[08]**

2. System of Linear Equations: Existence of solution, ill-conditioned system, Gauss elimination with pivoting, Gauss-Jordan method, triangular factorization method, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. **[08]**

3. Boundary Value and Eigen Value Problems: Solution of Eigen values problems by power method, Jacobi method, finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method. **[08]**

4. Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations. **[09]**

5. Difference Equations and Curve Fitting: Homogeneous difference equations with constant coefficients, particular solutions of a difference equations, curve fitting and regression, least square method, fitting of straight line and second order polynomials. **[06]**

Text Books:

1. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
2. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.
3. Jain M.K. and Iyenger S.R.K.(2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.

MS 521 **Discrete Mathematics** **3-1-0-4**

1. Relation and Function: Definition of set, different forms, properties and operations, principle of inclusion and exclusion, partition of a set, definition and types of a relation, composition, properties, graphical representation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice, different forms, properties, definition and kinds of a function, composition and properties of functions, recursively defined functions. **[10]**

2. Logics and Proofs: Propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, notion of a proof and methods for constructing proofs, normal forms (disjunctive and conjunctive), proof methods and strategy, statements of Fermat's last theorem, the $(3x + 1)$ conjecture and Godel's incompleteness theorem, program correctness. **[10]**

3. Induction and Counting: Mathematical induction, strong induction and well-ordering, recursive definitions and structural induction, recursive algorithms, basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

4. Graphs and Finite Automata: Graph and digraphs,, Konigsberg bridge problem, finite and infinite graphs, incidence and degree, isolated vertex, pendant vertex, and null graph, isomorphism, sub graphs, walk, path and circuits, connected graphs, disconnected graphs and components, Euler graphs, operation on graphs, Hamiltonian paths and circuits, traveling salesman problem, types and properties of tree, matrix representation of graphs; deterministic and non-deterministic finite automata, transition table and transition diagram, Mealy and Moore machines, minimization of finite automation. **[10]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International.

Reference Books:

1. Tremblay(1997), Discrete Mathematical Structures with Application to Computer Science, 35th reprint 2008,Mc Graw Hill Education,
2. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd ed., Mc Graw Hill Education, New Delhi.
3. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.

MS 531 **General Topology** **3-1-0-4**

1. Metric and Topological Spaces: Definition and examples of metric spaces, open sets, closed sets, convergence, completeness and Baire's theorem, continuous mappings, spaces of continuous functions, Euclidean and unitary spaces, definition and examples of topological spaces, elementary concepts, open bases and open subbases, weak topologies, function algebras. **[08]**

2. Compactness: Compact spaces, products of spaces, Tychonoff's theorem and locally compact spaces, compactness for metric spaces, Ascoli's theorem. **[08]**

3. Separation: T_1 – spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohn's lemma and the Tietze extension theorem, Urysohn's imbedding theorem, Stone – Cech compactification. **[08]**

4. Connectedness: Connected spaces, the component of spaces, totally disconnected spaces, locally connected spaces. **[08]**

5. Approximation: Weierstrass approximation theorem, Stone-Weierstrass theorems locally compact Hausdrorff spaces, extended Stone-Weierstrass theorems. **[07]**

Text Books:

1. George F. Simmons (2015), Topology and Modern Analysis, reprint ed., McGraw Hill Education, New Delhi
2. Sharma J. N. and Vashistha A. R.(2010), Topology, 37th ed., Krishna Prakashan Media, Meerut.
3. Adams (2008), Introduction to Topology: Pure and Applied, 3rd reprint ed., Pearson.

Reference Books:

1. Cain L.(2012), Introduction to General Topology,1st impression. Pearson.
2. Armstrong (2014), Basic Topology, reprint ed., CBS Publication.
3. Seymour Lipschutz(1965), Schaum's Outline of Theory and Problems of General Topology, 1st ed.,McGraw Hill Education.

MS 541 **Operations Research**

3-1-0-4

1. Linear Programming: Dual simplex method, parametric linear programming, game theory, two person zero sum game, game with mixed strategies, graphical solution, solution by linear programming. **[10]**

2. Inventory and Replacement Models: Deterministic models purchase and manufacturing models, probabilistic models, replacement of items that deteriorate and whose maintenance and repair costs increases with time. **[10]**

3. Job Sequencing and Queuing Theory: N jobs two machines, N jobs three machines, two jobs N machines; elements of a queuing system, Kendall's notation, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞) models. **[10]**

4. Dynamic Programming and PERT-CPM: Bellman's principal, employment smoothing problem, cargo loading problem; project planning and scheduling using PERT-CPM. **[09]**

Text Books:

1. Gupta Prem Kumar and Hira D.S.(2007), Operations Research,4th ed., S. Chand & Company Ltd., New Delhi.
2. Kanti Swarup, Gupta P.K. and Man Mohan (2006), Operations Research, 3rd ed., Sultan Chand & Sons, New Delhi.
3. Hillier F.S. and Lieberman G.J. (2005), Introduction to Operations Research, 8th ed., McGraw Hill, New Delhi.

Reference Books:

1. Taha H.A. (2010),Operations Research-An Introduction, 9th ed., Macmillan Publishing Co., Inc., New York.
2. Hadly G.(1964), Nonlinear and Dynamic Programming , 2nd ed., Addison-Wesley, Reading Mass.

MS 551 **Statistics and Probability - I** **3-1-0-4**

1. Introductory Ideas: Recapitulation of basic probability theory, law of addition and multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[06]**

2. Random Variables: Theorems on random variables, distribution function, properties of distribution, discrete random variable, probability mass function (pmf), discrete distribution function, continuous random variable, probability density function (pdf), cumulative distribution function(cdf), moments, covariance, moments generating function, two-dimensional random variables (discrete and continuous), transformation of random variables. **[12]**

3. Distributions: Discrete-binomial, Poisson, geometric, uniform distributions, continuous-uniform, exponential, gamma, weibull, normal distributions. **[12]**

4. Correlation and Regression: Simple and partial correlations, linear and non-linear regressions, regression coefficients, properties, angle between two lines of regression, standard error of estimate rank, regression curve correlation. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
4. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
4. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

1. Second Order Differential Equations: Review of the general solution of the second order homogeneous differential equations, use of a known solution to find another solution, homogeneous equations with constant coefficients, method of undetermined coefficient and method of variation of parameters. **[08]**

2. Non-Linear Ordinary Differential Equations: Two dimensional autonomous systems and phase space analysis- critical points, proper and improper nodes, spiral points and saddle points, definition of stability, Lyapunov function, stable, unstable and center subspaces, Riccati's equation-general solution and the solution when one, two or three particular solutions are known. **[10]**

3. Total Differential Equations: Different forms and solutions, necessary and sufficient condition, geometrical meaning of equation containing three and four variables, total differential equations of second degree. **[07]**

4. Power Series Solutions: Review of power series, series solutions of first order equations (Taylor series method), second order linear equations, solution near a regular singular point (method of Forbenius) for different cases, particular integral and the point at infinity. **[08]**

5. Existence and Uniqueness of Initial Value Problems: The existence and uniqueness of solutions, method of successive approximations, Picard's theorem, solution of initial-value problems by Picard method. **[06]**

Text Books:

1. Deo S. C., Lakshmikantham and Raghvendra V.(2000), Text book of Ordinary Differential Equations, 2nd ed.,Tata Mc-Graw Hill.
2. Dennis G. Zill, Michael R Cullen (2009), Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.
3. M. Rama Mohana Rao (1980), Ordinary Differential Equations: Theory and Applications, 2nd ed., Affiliated East-West Press Pvt. Ltd., New Delhi.

Reference Books:

1. Birkhoff and Rota G., G.C. (1978) , Ordinary Differential Equations , 4th ed., John Wiley and Sons Inc., NY.
2. Boyce, W.E. and Diprima, R.C.(1986), Elementary Differential Equations and Boundary Value Problems ,4th ed., John Wiley and Sons Inc., NY.
3. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations , 18th ed.,S. Chand Limited.

MS 512 **Advanced Abstract Algebra** **3-1-0-4**

1. Groups: Introduction and preliminaries (equivalence relation, integers modulo n), group definition and basic axioms, examples (dihedral, symmetric, matrix, quaternion groups), subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, centralizers and normalizers, nilpotent groups, direct products. **[10]**

2. Homomorphism and Group Actions: Definition and examples, isomorphism theorems, groups acting on themselves by left multiplication (Cayley's theorem), groups acting on themselves by conjugation (the class equation), automorphisms, Sylow p-groups and Sylow theorem. **[10]**

3. Ring: Basic definitions, examples (polynomial rings, matrix rings, group rings), ideals, ring homomorphism, integral domains and fields, maximal and prime ideals, Euclidean domain, principal ideal domains, unique factorization domains, polynomial rings over fields, introduction to modules (vector space as a special case). **[10]**

4. Field: Basic theory of field extensions, algebraic extensions, splitting fields and algebraic closures, separable and inseparable extensions, finite fields, field automorphisms, fundamental theorem of Galois theory, Galois groups of polynomials, cyclotomic extension. **[09]**

Text Books:

1. Fraleigh J. B. (2003), Abstract Algebra, 7th Edition, Pearson.
2. Dummit and Foote(1991), Abstract Algebra,3rd ed., John Wiley & Sons, Inc.
3. Khanna and Bhambri (2009), A Course in Abstract Algebra , 3rd ed., Vikas Publishing.
4. Herstein I. N.(1996), Topics in Algebra, 3rd Edition, Wiley India.

Reference Books:

1. Thomas W. Hungerford (2012), AbstractAlgebra, 4th Edition, Springer.
2. Vashistha, Modern Algebra(2011), 4th ed., Krishna Prakashan Mandir, Meerut.
3. Artin(2012), Algebra, 7th Edition, PHI.

MS 522 **Complex Analysis and Integral Transform** **3-1-0-4**

1. Basics of Complex Analysis: Complex numbers, complex function and its derivative, basic transcendental functions, power series of functions, integration in the complex plane, residues and their use in integration. **[10]**

2. Laplace Transforms and Stability of Systems: Laplace transform and their inversion, introduction of stability, Nyquist stability criterion, generalized functions, Laplace transforms and stability. **[10]**

3. Mellin Transform: Definition and properties of Mellin transform, evaluation of Mellin transform complex variable method and applications. **[09]**

4. Hankel Transform: Elementary properties, inversion theorem, transform of derivatives of functions, transform of elementary functions, Parseval's relation, relation between Fourier and Hankel transforms, use of Hankel transform in the solution of partial differential equations, dual integral equations and mixed boundary value problems. **[10]**

Text Books:

1. David Wunsch A.(2009), Complex Variables with Applications, 3rd Edition, Pearson.
2. H.K. Pathak(2004), Complex Analysis , 3rd ed., Shiksha Sahitya Prakashan, Meerut.
3. Gupta and Vashistha(2010), Integral Transform,4th ed., Krishna publication Media, Meerut.
4. Ian N. Sneddon(1972), The Use of Integral transforms by, 2nd Printing Edition, McGraw Hill.

Reference Books:

1. Ahlfors(1987), Complex Analysis,3rd ed., McGraw Hill Education.
2. Rudin(2006), Real and Complex Analysis,2nd reprint , McGraw Hill Education.
3. Andrews & Shivamoggi(2007) , Integral Transforms for Engineers,3rd ed., PHI Learning.

MS 532 **Mathematical Modeling and Simulation** **3-1-0-4**

1. Introduction to Simulation and Modeling: System concepts and theories, attributes and types of systems, discrete and continuous, deterministic and stochastic, open and closed, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, developing system dynamic equations - first order (+ve, -ve) systems, pure second order (+ve, -ve) systems and general feedback systems, simulation of equations for different systems. **[14]**

2. Random Numbers and Random Variates: Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods. **[10]**

3. Discrete Event Simulation: Concepts, event scheduling versus time advance scheduling, list processing. **[05]**

4. Verification and Validation of Simulation Models: Introduction, input modeling, identifying the distribution of data, parameter estimation, goodness of fit tests, model building, , verification calibration and validation of models, output analysis- measures of performance and their estimation. **[10]**

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2013), Discrete- Event System Simulation , 5th ed.,, Pearson, 2013.
2. Averill M. Law(2006), Simulation Modeling and Analysis, 4th ed., McGraw Hill Education.
3. V.P. Singh (2009), System Modeling and Simulation, 3rd ed., New Age International Publishers.
4. Frank L. Severance (2009) System Modeling and Simulation: An Introduction , 4th ed., Wiley.

Reference Books:

1. Taha(2012), Operations Research: An Introduction, 15th Indian reprint, PHI.
2. Geoffrey Gordon (2012), System Simulation, 2nd ed.,, PHI.
3. J.N. Kapoor (1994), Mathematical Modeling, 2nd ed.,Wiley Eastern Limited, Fourth reprint.

MS 542 **Partial Differential Equations** **3-1-0-4**

1. Second Order Partial Differential Equations: Preliminaries of partial differential equations, review of the classification of second order partial differential equations to hyperbolic, elliptic and parabolic forms, reduction of linear and quasi-linear equations in two independent variables to their canonical forms, characteristic curves. **[06]**

2. Laplace equation: Solution by method of separation of variables, mean value property, weak and strong maximum principle, Poisson's formula, Dirichlet's principle, solution of Laplace equation in cylindrical and spherical polar coordinates. **[06]**

3. Heat Equation: Solution by method of separation of variables, initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results. **[06]**

4. Wave Equation: Solution by method of separation of variables, uniqueness, D'Alembert's method, solution by spherical means and Riemann method of solution. **[06]**

5. Green's Functions: Introduction, Green's function for Laplace equation, method of images, eigenfunction method, Green's function for the wave and diffusion equations, Helmholtz theorem. **[08]**

6. Laplace and Fourier Transforms: Basics of Laplace transform solutions of diffusion and wave equations, basics of Fourier transform solution of diffusion, wave and Laplace equations. **[07]**

Text Books:

1. Sankara Rao K. (2003), Introduction to Partial Differential Equations , 4th ed., PHI Pvt. Ltd.
2. Asmar(2010), Partial Differential Equations and Boundary Value Problems with Fourier series, 2nd ed., Pearson.
3. Sundarapandian(2012), Ordinary and Partial Differential Equations, 3rd ed.,McGraw Hill Education, New Delhi.
4. Bhamra (2013), Partial Differential Equations: An Introductory Treatment with Applications ,4th ed., PHI Learning.

Reference Books:

1. Raisinghaniya M.D. (2008) , Ordinary and Partial Differential Equations , 3rd ed.,S. Chand Limited.
2. Zauderer(E. 1989), Partial Differential Equations of Applied Mathematics , 2nd ed., John Wiley and Sons, New York.
3. L Debnath(2007), Nonlinear PDE's for Scientists and Engineers , Birkhauser, Boston.
4. Sneddon I.N. (1957) , Elements of Partial Differential Equations, 2nd ed., McGraw Hill Book Company.

MS 552 **Statistics and Probability -II** **3-1-0-4**

1. Tests of Hypotheses: Simple hypothesis versus simple alternative, composite hypotheses, sampling from the normal distribution, tests on the mean and variance, tests on several means and variances, Chi-square tests, tests of hypotheses and confidence intervals, sequential tests of hypotheses. **[10]**

2. **Sampling and Sampling Distributions:** Sampling-inductive inference, populations and samples, distribution of samples, statistics and sample moments, sample mean and variance, law of large numbers, central limit theorem and its applications, sampling from the normal distributions, role of the normal distribution in statistics, sample mean, Chi-square distribution, F distribution, student's t distribution. **[10]**

3. Random Processes: Basics of random process, random process concept, continuous and discrete, statistics of random process, classification of random process, stationary and evolutionary random processes, cross-correlation, Markov process and Markov chain, binomial, Poisson, normal, Ergodic, random telegraph , sine wave random processes. **[11]**

4. Time Series Analysis: Introduction, characteristics movements in a time series, time series models, measurement of trends, secular trend, seasonal movements, cyclical movement, irregular movements, long cycles and applications. **[08]**

Text Books:

5. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
6. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
7. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
8. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

5. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
6. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
7. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
8. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

MS 562 **Modeling and Simulation Laboratory** **0-0-4-2**

Modeling and Simulation Laboratory related to Course Code MS 532 (Mathematical Modeling and Simulation).

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MS 611 **Advanced Linear Algebra** **3-1-0-4**

1. Vector Spaces and Linear Equations: Fields, vector spaces, subspaces, bases, dimension, span, coordinates, row reduced echelon matrices, invertible matrices, row and column space, system of linear equations, direct sum, determinants. **[08]**

2. Linear Transformations: Definition of linear transformations, kernel, range, rank-nullity theorem, algebra of linear transformations, representation of transformations by matrices, eigenvalues, eigenvectors, diagonalization, invariant subspaces, invertibility and isomorphisms, linear functional, transpose of a linear transformation, dual spaces. **[08]**

3. Inner Product Space and Norms: Definition of an inner product and its properties, (including the Cauchy Schwartz inequality), orthogonality, Gram-Schmidt orthogonalization process, orthogonal projections, minimization problem (least squares), adjoints. **[08]**

4. Operators on Inner Product Spaces: Unitary and orthogonal operators and their matrices, normal and self-adjoint operators, bilinear and quadratic forms on inner product spaces, spectral theory. **[08]**

5. Rational and Jordan Forms: Cyclic subspaces and annihiliators, Jordon canonical form, minimal polynomial, block matrices and matrix factorization, SVD and pseudoinverse. **[07]**

Text Books:

1. Friedbeg, Insel, Spence (2011) Linear Algebra, 4th Edition, PHI.
2. David C. L. (2002) Linear Algebra and its Applications, 3rd Edition, Pearson.

Reference Books:

1. Kumaresan S. (2000) Linear Algebra: A Geometric Approach, PHI.

2. Charles. W. C. (2012) Linear Algebra: An Introductory Approach, 3rd Edition, Springer.
3. RomanS. (2008) Advanced Linear Algebra, 3rd Edition, Springer.
4. Cheney, Kincaid (2012) Linear Algebra: Theory and Applications, 2nd Edition, Jones and Bartlet.

MA 621 Advanced Graph Theory and Combinatorics 3-1-0-4

1.Preliminaries: Graphs(undirected and directed), sub graphs, degree-sum formula, graphic sequences, matrix representations of a graph, path and circuits, bipartite graphs, graph isomorphism, decomposition,Euler graph and its properties,operations on graphs, Hamiltonian paths and circuits, traveling –salesman problem. **[08]**

2. Trees, Cut-Sets and Cut-Vertices: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's and Prim's algorithms, cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism. **[08]**

3. Planarity, Matching, Coloring and Covering: Combinatorial versus geometric graphs, geometric and combinatorial duals of a graph, planar embeddings, Euler's formula, triangulation, Kuratowski's theorem, dual graphs, factors and matching (in bipartite and non-bipartite graphs), Hall's matching theorem, chromatic number, chromating partitioning, chromatic polynomial, matching, coverings, the four color problem. **[08]**

4.Pebbling on Graph: Pebbling on undirected graph with properties, pebbling number, cover pebbling, the staching theorem, pebbling on directed graph with properties, pebbling on isomorphic graphs, pebbling of cyclic graph, alternating wheel graph, alternating fan graph and alternating complete graph with their properties, extension of graph pebbling. **[08]**

5. Advance Counting Techniques: Recurrence relations, solving linear recurrence relations, divide-and-conquer algorithms and recurrence relations, generating function, inclusion-exclusion with applications. **[07]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science,

PHI.
2. Chartland G., Zhang P. (2006)Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. Yerger C.R.(2005) Extensions of Graph Pebbling, Thesis.
4. Ore O. (1991) Theory of Graphs, Volume 38, American Mathematical Society, Colloquium Publications.
5. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.
6. Kenneth H R. (2007) Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7thEdition, Mc Graw Hill Education.

MS 631 **Real Analysis and Measure Theory** **3-1-0-4**

1. Metric Spaces: Review of the real number system (supremum, infimum, field, order and completeness axioms, extended real number system, basic notions of sets, relation and functions), finite, countable and uncountable sets, open and closed sets, adherent and accumulation points, Bolzano-Weistrass theorem, Heine-Borel covering theorem, compactness in R^n and in general metric spaces, connectedness. **[08]**

2. Limits and Continuity: Convergent sequences, Cauchy sequences, complete metric spaces, limit of a function, continuous functions, uniform continuity, convergence of series, rearrangements, Abel's and Dirichlet's theorem, sequence of functions, point wise and uniform convergence, sequential compactness, Ascoli-Arzela theorem, real power series, Weistrass theorem. **[08]**

3. Differentiation and Riemann Integration: Algebra of derivatives, the chain rule, differentiation of monotone functions (leading to the mean value theorem and intermediate value theorem), upper and lower integrals, oscillations, integrality of continuous functions, fundamental theorem of calculus, interchange of limit and integration operations, vector valued differentiation and integration. **[08]**

4. Measure Theory: Indicator functions, fields and σ-fields, definition and fundamental properties of a non-negative measure, measurable sets, measure zero sets, positive Borel measures,Lebesgue measure,algebra of measurable functions, almost everywhere convergence, convergence in measure. **[08]**

5. Integration Theory on General Measure Spaces: The Lebesgue integral, Fatou's Lemma, the monotone and dominated convergence theorems, continuous functions with compact support, Tonelli and Fubini's theorems, comparison of proper and improper Lebesgue and Riemann integrals. **[07]**

Text Books:

1. Rudin W.(1976)Principles of Mathematical Analysis, 3rd Edition, TMH.
2. Bartle R. G., Donald R. S. (2011)Introduction to Analysis, 2nd Edition, Wiley and Sons.

Reference Books:

1. Royden H.L. (2017)Real Analysis , 2nd Edition, PHI
2. Apostle (1997)Mathematical Analysis , 2nd Edition, Narosa Publishing House,
3. Carothers N. L. (2000) Real Analysis, 2nd Edition, Cambridge University Press.
4. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.

MS 641 **Special Functions and Integral Equations** **3-1-0-4**

1. Hypergeometric Functions: Definition, convergence, gamma and beta functions, Gauss hypergeometric function and its properties, series solution of Gauss hypergeometric equation, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, Kummer's confluent hyper geometric function and its properties, integral representation. **[10]**

2.Bessel and Legendre Functions: Definition, connection with hypergeometric function, differential and pure recurrence relations, generating function, integral representation, orthogonal properties. **[10]**

3.Linear Integral Equations: Definition and classification, conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions, solution of homogeneous and general Fredholm integral equations of second kind with separable kernels. **[10]**

4.Solution of Integral Equations: Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations, Resolvent kernel and its results, conditions of uniform convergence and uniqueness of series solution, solution of Volterra integral equations of second kind with convolution type kernels by Laplace transform. **[09]**

Text Books:

1. Kanwal R.P. (1971)Linear Integral Equations: Theory and Techniques,Academic Press, New York.
2. Miller LieW. Jr. (1968)Theory and Special Functions,Academic Press, New York and London.

Reference Books:

1. Rainville E.D. (1960) Special Functions, Macmillan Company, New York.
2. Wazwaz A. M. (2011)Linear and Non Linear Integral Equations: Methods and Applications,Higher Education Press, Springer.
3. Banerjee P.K., Goyal M.C. (2003) Special Functions and Calculus of Variations, Ramesh Book Depot. Jaipur, India.
4. Swarup S., Singh S. J. (2014) Integral Equation, 22nd Edition, Krishna Prakashan Meerut.

MS 612 **Functional Analysis** **3-1-0-4**

1. General Theory: Introduction of topological vector spaces, separation properties, linear mappings, finite-dimensional spaces, metrization, boundedness and continuity, seminorms and local convexity, quotient spaces, completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

2. Completeness and Compactness: Completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

3.Duality in Banach Spaces and Applications I: The normed dual of a normal space, adjoints, compact operators, continuity theorem, closed subspaces of Lp-spaces, the range of a vector-valued measure, **[10]**

4.Duality in Banach Spaces and Applications II: Generalized Stone-Weierstrass theorem, two interpolation theorems, Kakutani's fixed point theorem, Haar measure on compact groups, uncomplemented subspaces, sum of Poisson kernels, two more fixed point theorems. **[09]**

Text Books:

1. Rudin W. (2006) Functional Analysis, McGraw Hill Education (India).
2. Limaye B.V.(2013)Functional Analysis, 3rd Edition, New Age International.

Reference Books:

3. Somasundaram D. (2014) First Course in Functional Analysis, 1 Edition, Narosa Book Distribution Pvt. Ltd.
4. Corlson, Robert (2006) Concrete Introduction to Real Analysis, Vikas publishing House Pvt. Ltd.
5. Kreyszig E. (2007) Introductory Functional Analysis with Applications John Wiley & Sons.

MS 622 **Inequality and Continued Fractions** **3-1-0-4**

1. Inequalities: Definition and important properties**,** maximum and minimum values of algebraic functions and expressions with and without constraints, some important inequalities, Weirstrass inequality, Schwarz's or Cauchy's inequality,Tchebychef's inequality, important proofs and theorems. **[10]**

2. Continued Fractions I: Definition and different form of continued fractions, simple, infinite or non terminating and terminating continued fractions, continued fractions with positive quotients, conversion of fraction into continued fraction, successive convergent, law of formation of successive convergent of simple continued fraction. **[10]**

3. Continued Fractions II: Difference between the fraction and its convergent, equivalent numbers and periodic continued fractions, some special quadratic surds, recurring continued fraction. **[10]**

4. Continued Fractions III: Different theorems based on odd and even convergent, limits to error in convergent for the continued fraction, series of fractions and approximation. **[09]**

Text Books:

1. Hardy G. H., Littlewood J. E., Polya G. (1952) Inequalities, Cambridge University Press.
2. Hardy G. H., Wrihgt E.M. (1979) An Introduction to Theory of Numbers, 5th Edition, Oxford, University Press.

Reference Books:

1. Niven, Zuckerman H. S., Montgomery H. L. (2004) An Introduction to the Theory of Numbers, 5th Edition, John Wiley and Sons, Inc., New York.
2. Bruce C. B. (2005)Ramanujan's Note Books Volume-1 to 5, Springer.
3. ApostolT. M. (2013)Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi.

MS 632 **Basics of MATLAB** **0-0-4-2**

1. Introduction: MATLAB interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. **[08]**

2. Functions and Files: Elementary mathematical functions, user defined functions, additional functions, working with data files. **[06]**

3. Decision-Making Programs: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[06]**

4. Advanced Plotting and Model Building: *xy* Plotting functions, additional commands and plot types, interactive plotting, function discovery, regression, basic fitting interface, three dimensional plots. **[06]**

Text Books:

1. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.
2. William J. Palm III (2012), A Concise Introduction to MATLAB, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.
2. Stormy A. (Edition 4), MATLAB: A Practical Introduction to Programming and Problem Solving, BH Publication.

MS 651 **Magneto Hydrodynamics** **3-1-0-4**

1. Fundamental Equations of MFD: Electromagnetic field equations(charge conservation equation, constitutive equations, Maxwell's equations, generalized Ohm's law),fluid dynamics field equations(equation of state, equation of motion, equation of energy), MFD approximation, magnetic field equation, magnetic Reynolds number, Alfven's theorem, magnetic energy, electromagnetic stresses, force free magnetic fields. **[10]**

2. Basic Equations of MHD Flow: Boundary conditions, flow between parallel plates, Hartmann flow, Couette flow with velocity and temperature distributions, flowin a tube of rectangular cross section, pipe flow, flow in a annular channel, flow between two rotating coaxial cylinder. **[10]**

3. Boundary Layer Approximation: Two dimensional boundary layer equations for flow over a plane surface for fluids of large electrical conductivity, flow past a semi infinite rigid flate plate in an aligned and transverse magnetic field, two dimensional thermal boundary layer equations for flow over a plane surface, heat transfer in MHD boundary layer flow past a flate plate in an aligned magnetic field. **[10]**

4. Magneto Hydrodynamics Waves: Waves in an infinite fluid of infinite electrical conductivity, Alfven waves, waves in a compressible fluid, waves in the presence of dissipative effects, stationary plane shock waves in absence of magnetic field. **[09]**

Text Books:

1. Cramer R.K., Pai S.I.(1973) Magnetofluid Dynamics for Engineers and Physicists, Scripta Publishing Company, Washington D. C.
2. Charlton P.(1985) Text Book on Fluid Dynamics, CBS Publications, Delhi.

Reference Books:

1. Shereliff J.A. (1965) Magneto Hhydrodynamics, Pergamon Press, London.
2. Rathy R.K. (1976)an Introduction to Fluid Dynamics Oxford and IBH Publishing Company, New Delhi.

MS 652 **Viscous Fluid Dynamics** **3-1-0-4**

1. Fluid Motion: Introduction and continuum hypothesis, constitutive equations for Newtonian fluids, viscosity, Navier Stoke's equation for viscous compressible flow, vorticity and circulation, equation of energy, flow between two concentric rotating cylinders, stagnation point it two dimensional flow, flow due to plane wall suddenly set in motion(Stoke's first problem). **[10]**

2. Temperature Distribution: Physical importance of non-dimensional parameters. Renold's number, Prandtl number, Mach number, Froude Number, Nusselt number , plane couette flow, plane poisseullecouette flow, plane poissuille flow, Haigen poissuille flow in a circular pipe, Stoke's equation of very slow motion, Stoke's stream function, flow past a sphere. **[10]**

3. Laminar Flow: Two dimensionalincompressible boundary layer equation, Blasuis Topfer solution of boundary layer on a flat plate, wedge flow, flow in a convergent channel, flow in the wake of flat plate, two dimensional plane jet flow. **[10]**

4. Boundary Layer Theory: Thermal boundary layer in two dimensional incompressible flows, Crocco's integrals, forced convection in laminar boundary layer on a flat plate, free convection from a heated vertical plate, Karman momentum and kinetic energy integral equations. **[09]**

Text Books:

1. Schliching H., Boundary Layer Theory, McGraw Hill.
2. Pai, S.I, Nostrand D.V. (1956) Viscous Flow Theory, Vol.I, Laminar Flow, Company, New York.

Reference Books:

1. BansalJ.L. (2004)Viscous Fluid Dynamics, Oxford and IBH.
2. Frank M. W. (1991)Viscous Fluid Flow,2nd edition, McGraw Hill.

MS 661 **Sequence and Series** **3-1-0-4**

1. **Real and Complex Numbers:**Introduction, field and order structures, bounded and unbounded sets with supremum and infimum, completeness, absolute value, limit points, closure, countable and uncountable sets,complex number system, triangle inequality, functions of single variable. **[12]**

2. Sequences: Sequences of real and complex numbers, limit points, limits, convergence and non-convergence, Cauchy's general principle of convergence, algebra of sequences, monotonic, point wise convergence, uniform convergence on an interval, tests for convergence, properties, Weierstrass approximation theorem. **[11]**

3.Infinite Series I: Introduction, series of real and complex numbers, positive term series, comparison, Cauchy's root, D'Alembert's ratio, Raabe's, Logarithmic, integral, Gauss's tests, series with arbitrary terms, rearrangement of terms. **[08]**

4.Infinite Series II: Properties of uniform convergent series, power series, properties of functions expressible as power series, Abel's theorem, Taylor's and Lauren's series with convergence. **[08]**

Text Books:

1. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.
2. Rudin W.(1976) Principles of Mathematical Analysis, 3rd Edition, TMH.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trignometric Series, Vol. 1, Cambridge University Press.
3. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.
4. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
5. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 662 **Summability and Approximation Theory** **3-1-0-4**

1. Transformation and Summability Means: Matrix and linear transformation, definition of summability, Norlund means and its regularity condition, Cesaro means (C, 1) means, Cesaro and holders matrices, consistency of methods, examples and related theorems. **[15]**

2.Convergence of Fourier Series: Convergence of Fourier series, Dirichlet's integral, Riemann-Lebesgue theorem, (C, 1) summability of Fourier series, Fejer theorem, Fejer-Lebesgue theorem. **[08]**

3. L_p Space: Definition of L_2space, L_p space, Bessel's inequality, Holders inequality and Minkowski inequality. **[08]**

4.Approximation Theory: Best approximation in normed space, linear operators, Weierstrass's approximation theorem, Stone Weierstrass theorem, Chebyshev polynomials, trigonometric polynomials, error approximation function, Bernstein polynomial. **[08]**

Text Books:

1. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
2. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trigonometric Series, Vol. 1, Cambridge University Press.
3. PetersonG. M (1966) Regular Matrix Transformation, Mc-Graw Hill.
4. Boss J. (2000) Classical and Modern Methods in Summability, Oxford University Press.
5. Mursaleen M. (2014) Applied Summability Methods, Springer.
6. Hrushikesh N., Haskar M, Pai D.V. (2000) Fundamentals of Approximation Theory, Narosa Publishing House.
7. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 671 **Tensor Analysis** **3-1-0-4**

1. Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors. **[10]**

2. The Tensor Concept: Zeroth-order tensors, first-order tensors, second-order tensors, higher-order tensors, transformation of tensors under rotation about a coordinate axis, invariance of tensor equations, curvilinear coordinates, tensors in generalized coordinate systems. **[10]**

3. Tensor Algebra: Addition of tensors, multiplication of tensors, contraction of tensors, symmetry properties of tensors, reduction of tensors to principal axes, invariants of tensors, pseudotensors. **[10]**

4. Vector and Tensor Analysis: Field concept, Gauss, Green And Stokes theorem, scalar fields, vector fields, second-order tensors fields, the operator ∇ and related differential operators. **[09]**

Text Books:

1. Vector and Tensor Analysis by A. I. Borisenko and I. E. Tarapov, Dover, 1979.
2. Introduction to Vector and Tensor Analysis by R. C. Wrede, Dover, 1972.

Reference Books:

1. DavisH. F., SniderA. D. (1995) Introduction to Vector Analysis, 7thEdition, Brown Publishers.
2. Schey H.M. (1997) Div, Grad, Curl and All That: An Informal Text on Vector Calculus, 2nd edition, W.W. Norton.
3. Bourne D.E., KendallP.C. (1977) Vector Analysis and Cartesian Tensors, Nelson.
4. Tensor Calculus by J. L. Synge and A. Schild, Dover, 1978.

MS 672 **Mechanics and Calculus of Variation** **3-1-0-4**

1. Generalized Coordinates: Holonomic and non holonomic systems, Scleronomic and Reonomic systems, generalized potential, Lagrange's equations of first kind, Lagrange's equations of second kind, uniqueness of solution, and energy equation of conservative fields. **[10]**

2. Hamilton's Variables: Donkin's theorem, Hamilton canonical equations, cyclic coordinates, Routh's equation, Poisson's bracket, Poisson's identity, Jacobi- Poisson theorem. **[10]**

3. Calculus of Variations: Motivating problems of calculus of variations, Brachistochrone problem, isoperimetric problem, geodesic, fundamentals lemma of calculus of variations, Euler's equation of one dependent function and its generalization to (i) 'n' dependent functions, (ii) higher order derivatives, conditional extremum under geometric constraints and integral constraints. **[10]**

4. Hamilton-Jacobi Theory: Hamilton's principal, principal of least action, Poincare Cartan integral invariant, Whittaker's equations, Jacobi's equations, statement of Lee Hwa Chung's theorem, Hamilton-Jacobi's equation, Jacobi's theorem, method of separation of variables. Lagrange's bracket and Poisson brackets, invariance of Lagrange's bracket and Poisson brackets under canonical transformations. **[09]**

Text Books

1. Ramsey A.S.(1941)Dynamics Part II, Cambridge University Press.
2. Goldstein H. (2002) Classical Mechanics, 3rd edition, Narosa Publishing House.

Reference Books:

1. Loney S.L. (2016) An Elementary Treatise on Statics, First paperback edition, Cambridge University Press.
2. Louis N. H., Janet D. F.(1999)Analytical Mechanics, Cambridge University Press.
3. Gelfand I M., Fomin S.V., Richard A. S. (2000) Calculus of Variations PHI.
4. Tiwari R.N., Takhur B.S. (2007) Classical Mechanics: Analytical Dynamics, PHI.

MS 681 **Reliability Theory** **3-1-0-4**

1. Basic Concepts of Reliability: Introduction, reliability and quality, failure and failure modes, causes of failures and unreliability, maintainability and availability, reliability analysis, mathematical models and numerical evaluation, designing for higher reliability, redundancy techniques, equipment hierarchy, reliability and cost. **[07]**

2. Reliability Mathematics: Random experiments and probability, random variables, discrete distribution (Binomial and Poisson) and Continuous distributions (uniform, exponential, Rayleigh, Weibull, gamma, normal, log normal, truncated normal, inverse Gaussian), numerical characteristics of random variables and Laplace transform. **[08]**

3. System Reliability and Hazard Models: Component reliability from test data, mean time to failure, time-dependent hazard models, stress-dependent hazard models, derivation of reliability function using Markov model, treatment of field data, system with components in series and parallel, k-out-of-m systems,non series-parallel systems, system with mixed-mode failures, fault-tree technique. **[08]**

4. System Design and Reliability Redundancy: Component versus unit redundancy, weakest-link technique, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy, maintainability and availability concepts with two-unit parallel system with repair, preventive maintenance. **[08]**

5. Reliability Testing Demonstration and Acceptance: Problem of life testing, estimation of parameters and reliability using standard probability models using complete and censored samples, properties of these estimators, probability plotting and graphical procedures for estimating the parameter and testing validity of model by some standard statistical tests, life test acceptance sampling plans in exponential case, sequential life test in exponential case, accelerated life tests. **[08]**

Text Books:

1. Ebeling C. E. (2015), An Introduction to Reliability and Maintainability Engineering, Eighteenth reprint, McGraw Hill Education.

Reference Books:

1. Balagurusamy E. (2008) Reliability Engineering, Sixth reprint, TMH.
2. Srinath L.S., Reliability Engineering, Fourth Edition, EWP.

MS 682 **Fourier Analysis** **3-1-0-4**

1. Fourier Series: Recapitulation about piecewise continuous functions, odd and even functions, periodic and non-periodic functions, orthogonal and orthonormal functions, orthonormal sets, Dirichlet's conditions, Fourier series, change of interval, Fourier cosine series, Fourier sine series, complex form of Fourier series, convergence of Fourier series, generalized Fourier series, practical harmonic analysis,Fourier–Bessel series, Fourier – Legendre series. **[10]**

2. Fourier Integral and Applications: The Fourier integral formula, Dirichlet's integral, Fourier integral theorem, cosine and sine integrals, Eigen value problems on unbounded intervals, superposition of solutions, steady temperature in a semi-infinite strip, temperature in a semi-infinite solid, temperature in an unlimited medium. **[10]**

3.Fourier Transform and Applications I: Definition and properties of Fourier transform, Fourier cosine and sine transforms, complex Fourier transform, convolution theorem, Parseval's identities, finite Fourier transforms, solution of some partial differential equations. **[10]**

4. Fourier Transform and Applications II: Discrete Fourier Transform (DFT), approximation of Fourier coefficients of a periodic function, inverse DFT, properties of DFT, cyclical convolution and convolution theorem for DFT, Parseval's theorem for DFT, matrix form, N-point inverse DFT, fast Fourier transform(FFT). **[09]**

Text Books:

1. Ward Brown J., ChurchillR. V. (2015) Fourier Series and Boundary Value Problems, McGraw Hill Education.
2. Davis H.F. (1989) Fourier series and Orthogonal Functions, Dover Books on Mathematics.

Reference Books:

1. Spiegel (2015) Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series), McGraw Hill Education.
2. Jain R.K., Iyengar S.R.K. (2003) Advanced Engineering Mathematics, Narosa Publishing House.
3. Tolstov G.P. (1976) Fourier series, Dover Books on Mathematics.
4. JamesI.F. (2002) A Student's Guide to Fourier Transform with Applications in Physics and Engineering, 3rd edition, Cambridge.

MS 691 **Advanced Number Theory** **3-1-0-4**

1. Divisibility Theory and Factorization: Prime numbers and their distribution, greatest common divisor and the Euclidian algorithm, linear Diophantine equation, sieve of Eratosthenes, Mersenne primes and perfect numbers, sums of two squares. **[08]**

2. Theory of Congruences: Basic properties of congruences, linear congruences and the Chinese remainder theorem, Fermat's little theorem and pseudoprimes, $\varphi(n)$ (Euler's phi function), Euler generalization of Fermat's theorem, Wilson's theorem. **[08]**

3. Primitive Roots and Quadratic Reciprocity: Multiplicative orders of integers modulo$n$, primitive roots of primes and composites, Legendre and Jacobi symbols, quadratic reciprocity and quadratic congruences with multiple moduli. **[08]**

4. Special Functions and Recent Applications: Fermat numbers, amicable numbers, the Mobius inversion formula, sums of more than two squares, public key cryptosystems, primalty testing and factorization, Diffie-Helman key exchange, finite fields, cyclotomic polynomials, Gaussian integers, continued fractions, Pells equations, valuations, Deedkind domain, the Riemann zeta(ζ) function, modular (quadratic) forms, quadratic number fields. **[15]**

Text Books:

1. BurtonD.M. (2011) Elementary Number Theory, 2nd Edition, Tata Mc Graw Hills.
2. Telang S.G. (1996) Number Theory, 6th Edition, Tata Mc Graw Hills.

Reference Books:

1. Murty V. K. (1998) Contemporary Mathematics (Number Theory), Wald Schmidt AMS Society.
2. Lang S. (1994) Algebraic Number Theory, 2ndEdition, Springer Textbooks.
3. LandauE. (1966)Elementary Number Theory, 2nd Edition, AMS.
4. Frohlich, Taylor, Taylor (1991) Algebraic Number Theory, 2nd Edition, Cambridge University Press.
5. Niven I., Zuckerman (1991) Introduction to Theory of Numbers, 5th Edition Montgomery, Wiley.

MS 692 **Differential Geometry** **3-1-0-4**

1. Space Curves I: Definition of space curves, arc length, natural equation of a line, and intersection of curves, intersection of curve and surface, order of contact, tangent, normal, osculating plane. **[10]**

2. Space Curves II: Principal normal and binormal at a point of a curve, curvature, torsion, Frenet – Serret formulae, plane curves, osculating circle and osculating sphere, fundamental theorem for space curves, helices, evolutes and involutes. **[10]**

3. Surfaces I: Definition of a surface, tangent plane and normal at a point of a surface, surfaces of revolution, conicoids and helicoids, envelopes and developable surfaces, ruled surfaces. **[10]**

4. Surfaces II: First fundamental form(metric), metric potentials, direction coefficients and angle between two curves on a surface, second fundamental form, lines of curvatures, principal curvatures, Meusnier's theorem, Euler's theorem, Dupin's indicatrix, means curvature, Gaussian curvature. **[09]**

Text Books:

1. Hsiung C. C. (1997) A First Course in Differential Geometry, International Press, and Cambridge, MA.
2. Willmore T.J. (1964) An Introduction to Differential Geometry, Oxford University Press,

Reference Books:

1. Carmo M. P. D. (1976) Differential Geometry of Curves and Surfaces, Prentice-Hall, Englewood, NJ.
2. Abate M., Tovena F. (2012) Curves and Surfaces, Springer.
3. PetersA. K. (2010) Differential Geometry of Curves and Surfaces, Ltd., Natick, Mass.
4. Struik D.J. (1988) Lectures on Classical Differential Geometry, 2nd Edition, Addison-Wesley.

Mody University of Science & Technology

M.Sc. Chemistry
Session 2019-2020

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

MASTER OF SCIENCE IN CHEMISTRY
2019-20 Onwards
M. Sc. - Chemistry

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20
M Sc First Year curriculum will be common for ALL specialization

History:

There has been rapid increase in demand of Chemical science professionals. Considering such a requirement, it is proposed to start a new postgraduate programme namely Master of Science in Chemistry with aim of acquiring the knowledge and developing the skills to plan, design and build complex applications which are highly valued in all sectors like pharmaceutical, fertilizer, education, chemical, biotechnology etc.
The first batch of the revised programme in MUST is proposed to be admitted in the session 2019-2020.

Input Qualification:

Bachelor's degree with Chemistry as a subject for three years / six semesters/ B. Sc. Applied Chemistry / B. Sc. Biochemistry / B.Sc. Industrial Chemistry with 50 % of marks.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of Postgraduate Programmes of MUST shall be followed.

M. Sc.-Chemistry
Academic Curriculum (2019-2020 onwards)
First Year-Common to ALL Specialization

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 511	Inorganic Chemistry-I	3	-	-	3	3	25	25	50
	CH 513	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 531	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH 523	Spectroscopy-I	3	-	-	3	3	25	25	50
	CH 551▲/ **BC 531▲▲**	Mathematics for Chemists▲/ **Biomolecules ▲▲**	3	-	-	3	3	25	25	50
	CH 571	Inorganic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 581	Organic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 591	Physical Chemistry Laboratory -I	-	-	4	2	4	25	25	50
		Sub Total	**15**	-	**12**	**21**	-	-	-	-
		Foreign Language –I ‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 512	Inorganic Chemistry-II	3	-	-	3	3	25	25	50
	CH 514	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH 532	Physical Chemistry-II	3	-	-	3	2	25	25	50
	CH 524	Spectroscopy-II	3		-	3	3	25	25	50
	CH 536	**Advanced Applications in Chemistry**	3		-	3	3	25	25	50
	CH 562	Inorganic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 572	Organic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 582	Physical Chemistry Laboratory -II	-	-	4	2	4	25	25	50
		Sub Total	**15**		**16**	**21**	-	-	-	-
		Foreign Language-II‡	3	-	-	3	-	25	25	50

Total Credits 42

▲ *For students without Mathematics in B. Sc.*

▲▲ *For students without Biology in B. Sc.*

‡ *Refer to Foreign Language Section*

M. Sc.-Chemistry
(Specialization in Organic Chemistry)
Two-Year Programme
Academic Curriculum (2019 – 2020 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 611	Photochemical Reactions	3	-	-	3	3	25	25	50
	CH 623	**Enzyme Chemistry**	3	-	-	3	3	25	25	50
	CH 631	Organic Synthesis-I	3	-	-	3	3	25	25	50
	CH 641	Separation Techniques and Data Analysis	3	-	-	3	3	25	25	50
	CH 651	Environmental and Green Chemistry	3	-	-	3	3	25	25	50
	CH 661	Advanced Organic Chemistry Laboratory-I	-	-	4	2	4	25	25	50
	CH 671	Advanced Organic Chemistry Laboratory-II	-	-	4	2	4	25	25	50
	CH 681	Advanced Organic chemistry Laboratory-III	-	-	4	2	4	25	25	50
		Sub Total	**15**	**-**	**12**	**21**	**-**	-	-	-

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 612	Organic Synthesis-II	3	-	-	3	3	25	25	50
	CH 622	Heterocyclic Chemistry	3	-	-	3	3	25	25	50
	CH 632	Chemistry of Natural Products	3	-	-	3	3	25	25	50
	CH 642	Medicinal Chemistry	3	-	-	3	3	25	25	50
	CH 652	Dissertation[#]	-	-	-	10	-	100		
		Sub Total	**12**	**-**	**-**	**22**	**-**	-	-	-

**Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.*

[#]Student will perform project work for a period of 2 months and submit two copies of Dissertation report to the department. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.

COURSE DESCRIPTION
M. Sc. (Chemistry)

CH 511 **Inorganic Chemistry-I** **3-0-0-3**

Stereochemistry and Bonding in Main Group Compounds: Walsh diagrams (tri-atomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. [9]

Metal-Ligand Equilibria in Solution : Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. [8]

Reaction Mechanism of Transition Metal Complexes : Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. [15]

Metal-Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. [7]

Suggested Books:

1. Advanced Inorganic Chemistry; F.A. Cotton and G. Wilkinson, 6th Edn. John Wiley & Sons.
2. Inorganic Chemistry; James E. Huheey, 4th Edn. Addison-Wesley Pub. Co.
3. Physical Methods in Inorganic Chemistry; R. S. Drago, International Edn. East-West Press.
4. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.

CH 513 **Organic Chemistry-I** **3-0-0-3**

Nature of Bonding in Organic Molecules: Delocalized chemical bonding, conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. [6]

Stereochemistry: Conformational analysis of cycloalkanes, Decalines. Chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. [10]

Reaction Mechanism, Structure and Reactivity: Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation. [8]

Aliphatic Nucleophilic Subsitution: The SN2, SN1 mixed SN1 and SN2 and SET mechanism. Neighbouring group participation mechanism by σ and π bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The SN i mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Ambident nucleophile, regioselectivity. [5]

Aliphatic Electrophilic Substitution: Bimolecular mechanisms SE2 and SEi, The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving groups and the solvent polarity on the reactivity. [6]

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction. [4]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, 5th Edition. John Wiley & Sons.
2. A Guide book to Mechanism in Organic Chemistry; Peter Sykes, 6th Edition, Orient Longman Ltd..
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Organic Chemistry; R.T. Morrison and R.N. Boyd, Prentice- Hall of India.

6. Organic Reactions and Their Mechanisms; P.S. Kalsi, New Age International Publication.

CH 531 Physical Chemistry-I 3-0-0-3

Quantum Chemistry:

A. Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

C.Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

D. Molecular Orbital Theory: Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

[15]

Thermodynamics:

A. Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; Partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems, second order phase transitions.

B. Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translational, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics; distribution Law and application to helium.

C. Non Equilibrium Theromodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity

relations, electrokinetic phenomena, diffusion, electric conduction. [15]

Symmetry and group theory in chemistry: Symmetry elements and symmetry operations, definitions of group, subgroups, relation between orders of a finite group and its subgroup, similarity transformation and classes, point groups, Schonflies symbols, representation of groups by matrices(representation for the Cn, Cnv, Cnh, Dnh, etc. groups to be worked out explicity), character of a representation, the great orthogonality theorem (without proof) and its importance, character tables and their use. [9]

Suggested Books:

1. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
2. Chemical Kinetics; K. J. Laidler, Harper & Row.
3. Physical Chemistry; P. W. Atkins, Oxford University Press.
4. Physical Chemistry; I.N. Levine, Tata McGraw Hill Pub. Co. Ltd.
5. Kinetics and Mechanism of Chemical Transformations; J. Raja Ram and J.C. Kuriacose, MacMillan Indian Ltd.
6. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.

CH 523 Spectroscopy-I 3-0-0-3

Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, applications [8]

Vibrational Spectroscopy: Symmetry and shapes of AB2, AB3, AB4, AB5 and AB6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins. [8]

Raman Spectroscopy: Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS). [8]

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. [7]

Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of
(1) Bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin.
(2) Sn^{+2} and Sn^{+4} compounds; nature of M-L bond, coordination number, structure.

(3) Detection of oxidation state and inequivalent MB atoms. [8]

Suggested Books:

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. NMR, NQR, ESR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
3. Physical Methods in Chemistry, R.S. Drago, Saunders College.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
5. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
6. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.

CH 551 **Mathematics for Chemists** **3-0-0-3**

Vectors and Matrix Algebra: A. Vectors: Vectors, dot, cross and triple products etc The gradient, divergence and curl, Vector Calculus.

B. Matrix Algebra: Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

[12]

Differential and Integral Calculus: Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus.Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar).

[8]

Elementary Differential equations: Exact First-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc, second order differential equation and their solutions.

[10]

Permutation and Probability: Permutations and combinations, probability and probability theorems, average, root means square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc) with a general polynomial fit.

[9]

Suggested Books:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemists, Doggett and Suiclific, Longman.
3. Mathematical preparation for Physical chemistry: F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Bararnte, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.

CH 561 **Biology for Chemists** **3-0-0-3**

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP - the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules. [8]

Carbohydrates: Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides; cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway. [8]

Lipid: Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-β-oxidation of fatty acids. [8]

Amino-acids, Peptides and Proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. Force responsible for holding of secondary structures. α- helix, -β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure, Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical / enzymatic / mass spectral, racemization / detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH). [8]

Nucleic Acids: Purine and pyrimidine bases of nucleic acids, base pairing via H -bonding. Structure of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside [7]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 571 Inorganic Chemistry Laboratory - I 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $VO(acac)_2$
b) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
c) $Na[Cr(NH_3)_2(SCN)_4]$
d) $Mn(acac)_3$
e) $K_3[Fe(C_2O_4)_3]$
f) Prussian Blue, Turnbull's Blue

II. Qualitative and Quantitative Analysis; Two metal ions in cationic/ anionic forms.

Rare elements: Tl, W, Se, Mo, Ti, Zr, Ce, Th, V, U, LiInsolubles: Oxides, sulphates and halides

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, ***G.H. Jeffery and J. Mendham, ELBS.***
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experimens, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 581 Organic Chemistry Laboratory - I 0-0-4-2

*Qualitative Analysis****: Separation, purification and identification of compounds of binary mixture (one liquid and one solid / two liquids / two solids) using TLC and Column Chromatography, chemical tests. IR spectra to be used for functional group identification.***

Organic Synthesis:

a) Acetylation: Acetylation of cholesterol and separation of cholesterylacetate by column chromatography.
b) Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol
c) Grignard reaction : Synthesis of triphenylmethanol from benzoic acid
d) Aldol condensation: Dibenzal acetone from benzaldehyde.
e) Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.

CH 591 Physical Chemistry Laboratory - I 0-0-4-2

a) To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
b) To determine the electron polarization and electron polarizability of a liquid refractometrically.
c) To determine the concentration of a given solution of an optically activesubstance by polarimetric measurements.
d) To determine the specific and molar rotation of an optically active substance, like cane sugar at a number of concentrations and hence findthe intrinsic rotation of the substance.
e) To verify the Beer's law for the solution of the potassium permanganate and determine the concentration of the given aqueous solution of unknown concentration of this salt.
f) To determine the equilibrium constant of the given reaction, potentiometrically.
g) To determine the heat of neutralization of hydrochloric acid using a classical calorimeter.
h) To determine the stability constant of a $FeSCN^{2+}$ complex ion keeping ionic strength constant.
i) To determine the solubility of Ca $(IO_3)_2$ in deionized water and in dilute solution of potassium chloride at room temperature. Also evaluate the thermodynamic solubility product.
j) To determine the formula and the stability constant of a metal ion complex (Lead oxalate complex.)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 512 **Inorganic Chemistry-II** **3-0-0-3**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of D_q, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

[10]

Metal π-Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation,important reactions of metal carbonyls; preparation, bonding, structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphene as ligand.

[8]

Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes compounds with metal metal multiple bonds

[5]

Role of metal ions in biological processes: Brief study of various metal ions (Fe, Mo, Cu, Co, Ni, V, Cr, Mn, Zn, Se, B, Na, K and Ca) in biological processes.

[10]

Isopoly and Heteropoly Acids and Salts: Brief study

[6]

Suggested Books:

1. Mechanism of Inorganic Reactions; F. Basalo and R.G. Pearson,Wiley Eastern Ltd.
2. Inorganic Chemistry; D. F. Shriver and P. W. Atkins, ELBS.
3. Advanced Inorganic Chemistry; F. A. Cotton and G. Wilkinson, Edn. John Wiley & Sons.
4. Electronic Absorption Spectroscopy and Related Techniques; D.N. Sathyanarayana, Universities Press (India) Ltd.
5. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.
6. Inorganic Reaction Mechanisms; Martin L. Tobe and John Burgess, Longmans.

CH 514 **Organic Chemistry-II** **3-0-0-3**

Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1 mechanism, Reactivity; effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet - Hauser, and Smiles rearrangments. [5]

Free Radical Reactions: Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction. [7]

Addition to Carbon Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation. [7]

Addition to Carbon-Hetero Multiple bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. [7]

Elimination Reactions: The E2, E1 and E1CB mechanisms and their spectrum. Orientation of the double bond. Mechanism and orientation in pyrolytic elimination. [5]

Pericyclic Reactions: Molecular orbital symmetry, Electrocyclic reactions, cycloaddition reactions and sigmatropic reactions, FMO and PMO approach. Correlation diagram, selection rules. Claisen, Cope and aza-Cope rearrangements, Ene reaction [8]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, John Wiley & Sons.
2. A Guide Book to Mechanism in Organic Chemistry; Peter Sykes, Orient Longman Ltd.
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Mechanism and Theory in Organic Chemistry; S.M. Mukherjee and S.P. Singh, Mac Millan India.

6. Organic Reactions and Their Mechanisms; P. S. Kalsi, New Age International Pub.

CH 532 Physical Chemistry II 3-0-0-3

Surface Chemistry:

A. Adsorption -Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of dropletes (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).

B. Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles. [12]

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures. [8]

Electrochemistry: Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham- Devanathan - Mottwatts, Tobin, Bockris, Devanathan models, Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance. [10]

Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions). [9]

Suggested Books:

1. Modern Electrochemistry; J.O'M. Bockris and A. K. N. Reddy, Plenum Press.
2. Physical Chemistry; P. W. Atkins Oxford University Press.
3. Physical Chemistry; I. N. Levine, Tata McGraw Hill Pub. Co. Ltd.
4. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.
5. Text Book of Polymer Science; F.W. Billmayer, Wiley-Interscience.
6. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
7. Chemical Kinetics; K. J. Laidler, Harper & Row.

CH 524 Spectroscopy-II 3-0-0-3

Ultraviolet and Visible spectroscopy: Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. [7]

Infrared Spectroscopy: Instrumentation and Sample handling.Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. [7]

Nuclear Magnetic Resonance Spectroscopy: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplifications of complex spectranuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE). [8]

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic , alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOSY, DEPT, INEPT, APT and INADEQUATE techniques. [6]

Mass Spectrometry: Introduction ion production EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Example of mass spectral fragmentation of organic compounds with [6]

respect to their structure determination.

Problems: Structure elucidation based on spectroscopic data. [5]

Suggested Books:

1. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J. Martin, Heyden.
2. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
3. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 534 Colloids and Surface Chemistry 3-0-0-3

Introduction: Introduction: Colloid & surface science - small particles, association structures, surfaces, interfaces, interphases and macromolecules, Survey of technologies reliant upon colloid and surface science. [5]

Particulate Dispersions (solids dispersed in fluids): Single particles, Scattering of electromagnetic radiation from matter, Single particles in external fields (gravity, electrical, etc.), Particle sizing (microscopy, scattering (ILS, DLS, x-ray, neutron), sedimentation, centrifugation, chromatography, acoustics, adsorption), Particles in fluids, Particle trajectories' Transport phenomena; Brownian motion, diffusion; Rheology & rheology of dispersions; Particle-particle interactions, potential energy diagrams; Colloid stability - aqueous, non-aqueous; Consequences of colloid stability (dispersal, flocculation, coagulation, phase separation); Measuring colloid stability; Particle-particle interactions: Dispersion forces (Hamaker theory); Solid-liquid interfaces (charging of surfaces, Electrical Double Layer, adsorption); Particle-particle interactions: Electrostatic forces; Analysis of surface charge and surface chemistry (electrokinetics [electrophoresis, streaming; potential, electro-osmosis, sedimentation potential], electroacoustics, surface spectroscopy, ESR); Particle-particle interactions: steric forces & polymer-mediated forces'' Particle-particle interactions: hydrophobic forces, Analysis of particle interactions (rheometry, AFM, CFM, MASIF, SFA); Flocculation & coagulation - Schulze-Hardy rule, inorganic coagulants, polymeric flocculants ; wastewater treatment

[15]

Wetting & Capillarity: Surface and interfacial tension; Phenomena of liquid surfaces - Phenomena of liquids near solid surfaces Wetting, spreading, penetration, film formation, adhesion, detergency and floation; Contact angles, their analysis and interpretation - component analysis; Surface roughness, chemical heterogeneity, contamination; Surface energy methods on planar, particulate, hollow and fiber surfaces; Relation of capillarity to phase diagrams; Adhesion & Contact mechanics.

[10]

Bubbles and Foams (gases dispersed in liquids): Foam stability; Film drainage; Film rupture; Film rheology; Emulsion and pseudo-emulsion films; Phase diagrams; Measuring thin film properties - disjoining pressure, thin film balance, Frothing agents', Foam breaking, Antifoaming agents & mechanisms, Flotation. [9]

Suggested Books:

1. Colloidal Dispersions: Suspensions, Emulsions, and Foams I.D. Morrison and ***S. Ross (2002, Wiley Interscience, NY; ISBN: 0-471-17625-7).***
2. Basic Principle of Colloid Science, D.H. Everett (1988, Royal Society of Chemistry, London, ISBN : 0-85186-443-0)

CH 562 Inorganic Chemistry Laboratory - II 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $[Co(NH_3)_6]$ $[Co(NO_2)_6]$
b) Cis-$[Co(trien)(NO_2)_2]$ $Cl.H_2O$
c) $Hg[Co(SCN)_4]$
d) $[Co(Py)_2Cl_2]$
e) $[Ni(NH_3)_6]Cl_2$
f) $Ni(dmg)_2$
g) $[Cu(NH_3)_4]SO_4H_2O$

II. Qualitative and Quantitative Analysis; Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

III. Chromatography; Separation of cations and anions byPaper Chromatography.
Column Chromatography : Ion exchange

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experiments, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 572 Organic Chemistry Laboratory - II 0-0-4-2

I. Organic Synthesis:

a) Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.
b) Friedel Crafts reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
c) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. The Products may be Characterized by Spectral Techniques
d) Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetateby A.E.E. condensation

II. Quantitative Analysis:

a) Determination of the percentage or number of hydroxyl groups in anorganic compound by acetylation method.
b) Estimation of amines/phenols using bromate bromide solution/oracetylation method.
c) Determination of lodine and Saponification values of an oil sample.
d) Determination of DO, COD and BOD of water sample.
e) To estimate the percentage of sulphur in the given organic sample byMessenger's method
f) To estimate the percentage of nitrogen in the given organic sample by Kjeldahl's method.
g) To estimate a halogen in the given sample by the alkaline reductionmethod (Modified Stepenow method).

Suggested Books:

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

CH 582 Physical Chemistry Laboratory - II 0-0-4-2

a) To determine the molecular weight of a macromolecule by viscometry.

b) To determine the order with respect to Ag(I) in the oxidation of Mn(II) by $S_2O_8^{2-}$ and the rate constant for the uncatalyzed reaction.

c) To determine the formation constant for the $[Ce^{IV}\text{-}H_3PO_2]$ intermediate complex and also the rate constant of its decomposition at $45^{\cdot}$ C.

d) Study the effect of hydrogen ion on the $H_2O_2 - I^-$ reaction and to determine the rate constants K_1 and K_2 of the given rate equation.

e) To determine the equivalent conductivity of an electrolyte at infinite dilutions, and to determine the dissociation constant of an acid at different dilutions.

f) To determine the standard electrode potential of the ferrous ferric system by titrating ferrous ammonium sulphates against potassium dichromate potentiometrically.

g) To determine the surface tension of an organic liquid (Ethyl acetate) at different temperatures by double capillary method and hence test the constancy of parachor.

h) To determine the critical micelle concentration of a soap (sodium laurate, sodium palmitate etc.) by surface tension measurements.

i) To determine the solubility and solubility product of sparingly soluble salts e.g. PbSO4, BaSO4) conductometrically.

j) To determine the strength of the given acid conductometrically using standard alkali solution. Select suitable pair for titration. (SA-SB, SA-WB, WA-SB, WA-WB)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 611 Photochemical Reactions 3-0-0-3

Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. [7]

Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy state; determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. [8]

Photochemistry of Alkene: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. [5]

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. [8]

Photochemistry of Aromatic Compounds: Isomerisations, additions and substitutions. [5]

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction, Singlet molecular Oxygen reaction, Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. [6]

Suggested Books:

1. Fundamentals of photochemistry, K.K. Rohtagi - Mukherjee, Wiley-Eastern.
2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.

CH 621 Bioorganic Chemistry 3-0-0-3

Introduction: Basic considerations, Proximity effects and molecular adaptation. [4]

Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and

enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver - Burk plots, reversible and irreversible inhibition.

[11]

Mechanism of Enzyme Action: Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase A. [6]

Kinds of Reactions Catalysed by Enzymes: Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisation reactions, β-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. [9]

Industrial Applications of Enzymes : Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-Brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. [9]

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

CH 631 Organic Synthesis-I 3-0-0-3

Reagents and reactions: ***Gilman's reagent – Lithium dimethylcuprate, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DDC), 1,3-Dithiane (Umpolungreagent), trimethylsilyliodide, Petersons synthesis, Bakers yeast, Organophosphorus compounds (Wittig reaction), Sulphur ylides, Phase transfer catalysts: Quaternary***

ammonium and Phosphonium salts, Crown ethers. Heck reaction, Suzuki coupling and Mukaiyama reaction. [9]

Oxidation: Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate. [9]

Reduction: Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Epoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis. [8]

Rearrangements: General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil – Benzillic acid. Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. [8]

Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds: General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene, fluorine and undone). [5]

Suggested Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Uni. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier

CH 641 Separation Techniques and Data Analysis 3-0-0-3

Adsorption and partition chromatography:
(a) Definition of terms, techniques and chemical concepts
(b) Column adsorption chromatography
(c)Partition chromatography-column, paper and TLC [8]

High performance liquid chromatography -
Introduction, choice of the system, instrumentation and applications. [5]

Gas liquid chromatography: Introduction, choice of the system, instrumentation, qualitative and quantitative analysis of mixtures. [5]

Gel permeation/size exclusion Chromatography: Introduction, theory and applications. [5]

Ion exchangers: Theory, action of ion-exchange resins, ion exchange chromatography, exchange capacity, ion-exchange resins and liquid ion-exchange resins, applications of cation and anion ion exchangers. [5]

Solvent Extraction: - Introduction, principles, factors that influence solvent extraction, ion association complexes and applications of solvent extraction. [5]

Data analysis: Types of errors, propagation of errors, accuracy and precision, and least- square analysis, average standard deviation. [6]

Suggested Books:

1. Principles of Instrumental Analysis; D.A. Skoog, SaundersCollege Publishing.
2. Instrumental Methods of Chemical Analysis; G.W. Ewing, McGraw Hill Books Co.
3. Modern Methods of Chemical Analysis; R. L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, John Wiley.
4. Analytical Chemistry: Principles; J.H. Kennedy, Saunders Holt.

CH 651 Environmental and Green Chemistry 3-0-0-3

Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in the atmosphere, stratospheric chemistry: The chemistry of ozone layer, The role of chemicals in ozone destruction, The green-house effect and Global warming, El-Nino phenomenon. [8]

Hydrosphere : Complexation in natural water and waste-water, Micro-organism in aquatic chemical reactions, Eutrophication, Re-cycle of waste-water in process industry, Treatment of sewage and reuse of water in industry and agriculture, Microbiology mediated redox reactions and Nitrogen transformation by bacteria. [8]

Lithosphere : The terrestrial environment, Soil formations, soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, waste classification and disposal. [8]

Chemical Toxicology: Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monooxide, nitrogen oxides, sulphur oxides, ozone, PAN, cyanide, pesticides, insecticides and carcinogens. [7]

Green Chemistry: Green chemistry – Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. Microwave induction, ultrasound assisted, green solvents- reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen , citral, urethane, adipic acid and styrene. [8]

Suggested Books:

1. Green Chemistry, P. Anastas, RSC.
2. Environmental Chemistry, S.E. Manahan, Lewis Pub.
3. Environmental Chemistry, Sharma and Kaur, Krishna Pub.
4. Environmental Chemistry, A.K. De, Wiley Eastern
5. Environmental Chemistry, C. Baird, W.H. Freem

CH 661 Advanced Organic Chemistry Laboratory - I 0-0-4-2

I. Qualitative Analysis: Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

II. Multi –step Synthesis of Organic Compounds: The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques. (Any Five)

a) Photochemical reaction Benzophenone - Benzpinacol - Benzpinacolone
b) Beckmann rearrangement : Benzanilide from benzene Benzene - ***Benzophenone - Benzphenone oxime - Benzanilide***
c) Benzilic acid rearrangement : Benzilic acid from benzoin Benzoin - Benzil ***-Benzilic acid.***
d) Synthesis of heterocyclic compounds Skraup synthesis: Preparation of quinoline from aniline Fisher Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine.
e) Enzymatic synthesis; Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ehtyl-3- hydroxybutanoate and determine its optical purity.
f) Biosynthesis of ethanol from sucrose.
g) Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
h) Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethylacetoacetate with an alkyl halide.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R.Tatchell,J.Wiley

CH 671 Advanced Organic Chemistry Laboratory - II 0-0-4-2

Extraction of Organic Compounds from Natural Sources. (Any Five)

a) Isolation of caffeine from tea leaves.
b) Isolation of benzoic acid from tea leaves.
c) Isolation of casein from milk (the students are required to try some typicalcolour reactions of proteins).
d) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf values reported).
e) Isolation of nicotine dipicrate from tobacco.
f) Isolation of cinchonine from cinchona bark.
g) Isolation of piperine from black pepper.
h) Isolation of lycopene from tomatoes.
i) Isolation of β-carotene from carrots.
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
k) Isolation of eugenol from clove.
l) Isolation of (+) limonine from citrus rind.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

CH 681 Advanced Organic Chemistry Laboratory - III 0-0-4-2

I. Separation and identification of the sugars and Amino acids present in the givenmixture by paper chromatography and determination of Rf values

II. Identification of organic compound with the help of spectral datas.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley
3. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J.

Martin, Heyden.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, ***G.C. Bassler adn T.C. Morrill, John Wiley.***
5. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
6. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
7. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 612 Organic Synthesis-II 3-0-0-3

Disconnection Approach: An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis. [8]

Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. [6]

One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis. [6]

Two Group C-C Disconnections: Diels-Alder Reaction, 1,3-difunctionalised compounds, α, β- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation. [6]

Ring Synthesis: Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings. aromatic heterocycles in organic synthesis. [5]

Synthesis of Some Complex Molecules: application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A. [8]

Suggested Books:

1. Designing Organic Synthesis, S.Warren. Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. carruthers,Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O. House, W.A Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

CH 622 Heterocyclic Chemistry 3-0-0-3

Aromatic Heterocycles: Nomenclature, General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. [6]

Non-aromatic Heterocycles: Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1, 3-diaxial interaction. Stereo-electronic effects, anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions. [7]

Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes. [4]

Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofuranes and benzothiophenes. [4]

Meso - ionic Heterocycles: General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. [4]

Six - Membered Heterocycles with one Heteroatom: Synthesis and reactions of pyrilium salts and pyrones and their comparison with pyridinium & thiopyrilium salts and pyridones. Synthesis and reactions of quinolinium and benzopyrylium salts, coumarins and chromones. [6]

Six Membered Heterocycles with Two Heteroatoms: Synthesis and reactions of diazines, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines. [8]

Suggested Books:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Techinal.

5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M.Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

CH 632 Chemistry of Natural Products 3-0-0-3

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Gereniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene. [9]

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-Coniine, Nicotine, Atropine, Quinine and Morphine. [9]

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of Steroids. [9]

Flavonoids and Anthocyanins: Occurrence, nomenclature, biogenesis and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidine, Hirsutidin. [9]

Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll. [3]

Suggested Books:

1. Natural Products : Chemistry and Biological Significance, J. Mann, ***R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.***
2. Organic Chemistry: Vol. 2 1L. Finar, ELBS
3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood AcademicPublishers.
7. New Trends in Natural Product chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic

Publishers.

CH 642 Medicinal Chemistry 3-0-0-3

Structure and activity : Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery. [9]

Antibiotics and antibacterials: Introduction (i) Antibiotic β-Lactam type Penicillins, Cephalosporins (ii) Antitubercular Streptomycin(iii)Broad spectrumantibiotics-Tetracyclines (iv)Anticancer-Dactinomycin (Actinomycin D) (v)Antifungal –polyenes(vi) Antibacterial Ciprofloxacin,Norfloxacin(vii) Antiviral – Acyclovir [9]

Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine. [4]

Non-steroidal Anti-inflammatory Drugs : Diclofenac Sodium, Ibuprofen and Netopam [4]

Antihistaminic and antiasthmatic agents: Terfenadine,Cinnarizine, Salbutamol and Beclomethasone dipropionate [4]

Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurines. Recent development in cancer chemotherapy. Hormone and natural products. [9]

Suggested Books:

1. Medicinal Chemistry; Burger, Wiley Interscience Publications.
2. Principles of Medicinal Chemistry; W. O. Foye Lea & Febiger:Varghese Publishing House
3. The Organic Chemistry of Drug Synthesis; D. Lednicer and L. A.Mitscher Wiley Interscience.

CH 536 Advanced Applications in Chemistry 3-0-0-3

Supramolecules: Basic concept and definition, nature of supramolecular interactions, Host-guest interaction, Cation-binding hosts, Anion-binding hosts and Neutral molecules. Molecular recognition by Crown Ethers, Cyclodextrin, Calixarene. The Art of Building Supermolecules: Fullerenes, Dendrimers, Rotaxanes, Catenanes. Applications of Supramolecular Chemistry: Molecular Devices and Nanotechnology. Biological supramolecular systems. [8]

Nanomaterials: Beginning of nanoscience, Moore's law, Nanomaterials,Properties of nanomaterials, seeing Nano objects, preparation of nanomaterials, From nanoscience to nanotechnology, graphene, & CNT. Application of nanomaterials: Nano cosmetics, Textiles, Nano sensors, drug delivery, Cancer therapy, Tissue engineering, water purification, Nano computers, DPN, MRI, Nano catalysis, nanomaterials and energy. [8]

Green chemistry: Goalsof Green Chemistry. Basic principles of Green Chemistry. Examples of green synthesis/reaction: Green starting materials, Green reagents, Green solvents (super critical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG). Green catalysis, Green synthesis- Real world cases.Future Trends in Green Chemistry: Combinatorial green chemistry, Proliferation of solvent less reactions and Biocatalysts. [7]

Organic Electronic Materials: Advantages of Organic Electronics, electronic structure of materials, electrical properties of materials and optical absorption, electrically conducting polymers, concepts of polarons and solitons, Theory of charge transport and mobility in organic materials, basic electronic devices: organic solar cells, organics thin film transistors, Organic ElectroChemical Transistors (OECTs), Organic Field Effect Transistors (OFETs). Organic semiconductors, organic light-emitting diodes, flexible organic light emitting diode (OLED), memories, organic electronics in sensors and biotechnology. [8]

Computer Applications in Chemistry:Idea and use of word processing software including documents, presentation and graphics. Handling numeric data: spreadsheet software (Excel), simple calculations, statistical analysis, plotting graphs using a spreadsheet.Principles of computational chemistry, Computer-based molecular design, molecular mechanical and quantum mechanical models. Idea and use of scientific software- ChemOffice, ISIS Draw, ArgusLab, MOLDEN, Dalton, and Gaussian. [8]

Suggested Books:

Text Books:

1) Supramolecular Chemistry by J. W. Steed & J. L. Atwood, 2nd Edn John Wiley, 2009

2) J. M. Lehn, Supramolecular Chemistry, VCH, Weinheim, 1995.

3) Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.

4) Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998.

5) Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001

6) NANOWORLD-An introduction to nanoscience and technology by C N R Rao.

Reference Books:

1) Nanoscience and Nanotechnology by T. Pradeep, McGraw Hill Education.

2) Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.

1) Supramolecular Chemistry – Fundamentals and Applications by Kunitake, T. and Ariga, K. Berlin: Springer-Verlag Heidelberg, 2006. 208 p. ISBN 978-3-540-01298-6.

2) Renewables-Based Technology: Sustainability Assessment; Dewulf, J.; Langenhove, H. V., Eds.; John Wiley & Sons, Ltd.: Chichester, UK, 2006.

BC 531 Biomolecules 3-0-0-3

Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [5]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates.Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway [8]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis,Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis. [7]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids.Classification of enzymes, MichelisMenten equation Km value, Linweaver-Burk equation. [8]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [6]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 623 Enzyme Chemistry 3-0-0-3

Introduction: Units of activity, Specific activity of enzymes and methods of enzyme assay, Enzyme specificity, Uni substrate enzyme kinetics, Factors affecting the rate of enzyme catalyzed reaction, Derivation of Michelis-Menten equation, Significance of V_{max} and $K_{m,}$ Enzyme inhibition- type of inhibition, Competitive non Competitive and uncompetitive kinetics.Proximity effects and molecular adaptation. [5]

Enzyme Catalytic Efficiency: Factors associated with catalytic efficiency such as proximity, Orientation-distortion of strain, base nucleophilic catalysis with equation, Protein ligand binding co-operativity, Hill and Sat Chard plot protein sequencing. [6]

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

IndustrialApplicationsofEnzymes: [6]
Techniquesandmethodsofimmobilizationof enzymes, effectofimmobilizationonenzymeactivity,applicationofimmobilizedenzymes, useofenzymes infood anddrinkindustry-Brewing andcheese-making, syrupsfromcorn starch,enzymesastargetsfordrug design.

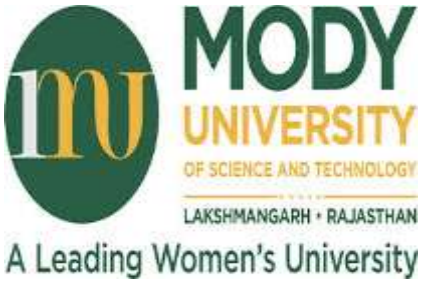
Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

Mody University of Science & Technology

M.Sc. Microbiology
Session 2019-2020

Curriculum Structure



M.Sc.- Microbiology

Two-Year Programme

Academic Curriculum (2019 – 20 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Autumn Semester	MB 511	Bacteriology and Phycology	3	-	-	3	3	25	25	50
	MB 521	Virology and Mycology	3	-	-	3	3	25	25	50
	BC 531	Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 541	Laboratory Course in Study of Microorganisms	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**1**	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW *	MTE	ETE
Spring Semester	MB 512	Microbial Physiology and Metabolism	3	-	-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3	-	-	3	3	25	25	50
	MB 532	Immunology	3	-	-	3	3	25	25	50
	MB 631	Microbial Genetics	3	-		3	3	25	25	50
	MB 542	Seminar	-	-	-	1	-	100		
	MB 524	Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section.

M.Sc.-Microbiology
Two-Year Programme
Academic Curriculum
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	MB 611	Medical Microbiology	3	1	-	4	3	25	25	50
	MB 681	Environmental and Agricultural Microbiology	3	1	-	4	3	25	25	50
	MB 641	Industrial Microbiology and Fermentation Technology	3		-	3	3	25	25	50
	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	MB 651	Medical, Environmental and Agricultural Microbiology Laboratory	-	-	4	2	4	100		
	MB 671	Genetic Engineering and Fermentation Technology Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**3**	**8**	**19**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	MB 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	-	-	**20**				
		Total Credits				**84**				

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra-curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Microbiology)

MB 511 Bacteriology and Phycology 3-0-0-3

General Concepts of Microbiology: History and development of Microbiology as a discipline of science, spontaneous generation vs biogenesis, Koch's postulates Basic features of microscopy-Compound, fluorescence, dark field, phase contrast, SEM and TEM, Staining methods-simple, differential and sample preparation for electron microscopy. [6]

Morphology and Ultrastructure of Bacteria: Basic ultrastructure, morphological types, cell walls of gram positive, gram negative and archeobacteria, cell wall biosynthesis, cytoplasmic membrane-structure, composition and functions, L-forms, Ultrastructure and types of flagella, capsule and its function, pilli. [8]

Cultivation of Bacteria: Aerobic and anaerobic cultivation, Nutrient media-selective and differential, Nutrient types of bacteria, Growth curve and kinetics of growth, Batch culture, fed-batch culture and continuous culture, synchronous growth, Factors affecting growth, Control of bacteria-physical and chemical agents. [10]

Classification: Bacterial classification, Hackle's three kingdom, Whittaker's five kingdom, Eight kingdom classification, Phenetic and phylogenetic classification, Outlines of Bergeys manual, Use of molecular approaches for classification of bacteria. [7]

Algae: General Characteristics, Classification, Nutrition, Reproduction, Algal ecology, Economic importance of Diatoms, Rhodophyta and Green algae. [8]

MB 521 Virology and Mycology 3-0-0-3

General Concepts of Viruses: Discovery of viruses, Distinctive features, Morphology and Ultrastructure, Envelope and its properties, Virus related agents (Viroids and Prions). Classification-General properties, Nomenclature and classification of bacterial, plant and animal viruses. [5]

General Methods of Diagnosis of Viruses: Cultivation methods-embryonated eggs, experimental animals, cell cultures (Primary and secondary), Serological methods- heamagglutination, complement fixation, immunofluoresecnce, ELISA and RIA, infectivity assay (end point method); Role of electron microscopy in study of viruses. [8]

Bacterial and Plant Viruses: Bacteriophage structure- general characteristics, Life cycle- Lytic and Lysogeny, One step growth curve, Regulation of lytic cycle, brief details of M13, Mu, Lambda and T4, Effect of viruses on plant appearance, histology, cytology, Transmission of plant viruses- Vector(insects, nematodes) and without vector, Common diseases of Paddy, Cotton, Tomato and Sugarcane, Life cycles- TMV, CMV and Potato Virus X. [10]

Animal Viruses: Life cycle and pathogenecity of RNA viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota and HIV, Oncogenic viruses, DNA viruses- Pox, Herpes, Adeno, SV 40, Hepatitis viruses, Basic concepts of viral vaccine. [8]

General Concepts of Mycology: General features of fungi, Classification of fungi, Life cycles of *Aspergillus, Saccharomyces, Deuteromycetes,* Mycorrhiza: Ecto, endo and VAM, Lichens- general features, Fungal diseases- Systemic and Sub cutaneous Mycoses, Candidiasis, Dermatomycosis. [8]

BC 511 Chemistry of Biomolecules 3-0-0-3

pH and Buffers: Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Molarity and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance. [4]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates. [5]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. [6]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $–NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. [7]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [5]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Enzymes: Classification of enzymes, Michelis Menten equation, Km value, Linweaver-Burk equation, Kinetics of substrate and enzyme reactions, Isozymes, Effect of different physical and chemical factors, Active sites-nature and determination, Immobilization of enzymes and its application. [7]

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and applications. [6]

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR. [12]

Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary electrophoresis. [6]

Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography. [10]

Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA. [5]

BT 581 Biostatistics 3-0-0-3

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean, median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean [6]

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis [9]

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 541 Laboratory Course in Study of Microorganisms 0-0-4-2

Assignments based on MB 511 and MB 521containing exercises on staining and isolation of different microbial types on the basis of cultural and microscopic methods will be conducted.

BC 541 Biomolecules and Instrumentation laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

MB 512 Microbial Physiology and Metabolism 3-0-0-3

Transport Mechanisms: Basic features of transport- Role of cell membrane in transport, Thermodynamics of transport, Types of transport- passive

diffusion, facilitated diffusion, active transport, group translocation, uniport, symport and antiport, Transport of siderophores. [8]

Respiratory Metabolism: Glucose Metabolism- Reactions and control of Glycolysis, Pentose Phosphate Pathway, Gluconeogenesis, Citric acid cycle, Oxidative and Substrate level phosphorylation, Glyoxylate cycle, Homo and heterolactic fermentation, Pasteur effect. [10]

Photosynthesis: Brief account of photosynthetic and accessory pigments- Chlorophyll, Bacteriochlorophyll, Carotenoids and Phycobiliproteins, Details of Oxygenic and Anoxygenic photosynthesis, Major groups of photosynthetic bacteria, Fixation of CO_2- Calvin cycle, C3 and C4 pathway; Photorespiration. [10]

Nitrogen and Lipid Metabolism: Nitrogen cycle, Assimilation of nitrogen, Biosynthesis of amino acids, Nitrogen fixation- basic concepts, nitrogenase enzyme, Fatty acid oxidation- □-oxidation, Fatty acid biosynthesis. [6]

Sporulation and Morphogenesis: Endospore formation- structure, properties and germination; Dormancy in selected microbes [5]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, [10]
Microbial starters for food fermentations.
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation:
Factors affecting microbial growth in foods- extrinsic and intrinsic,
Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, [10]
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).
Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli* O157:H7, *Listeria monocytogens*, *Campylobacter jejuni*, *Helicobacter pylori* [10]
Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)

Disposal and treatment of food industry waste

BT 592 Bioinformatics , Scientific Communication & Intellectual Property Rights **3-1-0-4**

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management.	6
Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions.	8
Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins.	8
Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index.	3
Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International)	7
Biotechnology and Intellectual Property Rights. Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy	7

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics

and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 Molecular Biology 3-0-0-3

Historical and Introductory Aspects: History of molecular biology; nucleic acids as hereditary material-experimental evidences, structure of DNA; Law of constancy and C-value paradox, Cot curve, DNA denaturation and renaturation kinetics. [5]

DNA Replication: Enzymes and accessory proteins involved in DNA replication, Prokaryotic and eukaryotic DNA replication, Asymmetric and dimeric nature of DNA polymerase III. [5]

Transcription: General principles, Types of RNA polymerases, Promoter Enhancers and Regulatory sequences, RNA polymerases and general transcription factors, Prokaryotic and Eukaryotic transcription General and specific transcription factors, Control of transcription. [8]

Translation: Genetic code, Prokaryotic and Eukaryotic translation, Translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation. [6]

Maturation and Processing of RNA: Methylation, Cutting and trimming of rRNA, Capping, Polyadenylation and Splicing of mRNA, Cutting and modification of tRNA, Degradation system, Catalytic RNA group I and group II intron splicing RNase P. [7]

Regulation of Gene Expression: Operon concept, Catabolite repression, Positive and negative regulation, Inducers and co-repressors, Negative regulation - *E. coli* lac operon, Positive regulation, Regulation by attenuation his and trp operons, Antitermination, Environmental regulation of gene expression- Global regulatory responses - heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP. [8]

MB 532 Immunology 3-0-0-3

Overview of immune response: Historical background, Innate immunity, Adaptive immunity, Innate-adaptive cross-talk, Natural and artificial immunity, Active and Passive immunity, Humoral and Cell-mediated immune response, Early theories of immunity**.** [5]

Cells and Organs of Immune System: Lymphoid organs, Haematopoiesis and differentiation of stem cells into mast cells, Basophils, Eosinophils, Monocytes, Macrophages, Neutrophils, NK cells, B and T lymphocytes (Th and Tc cells)-characteristics, CD markers and biological functions, Development of B-lymphocytes, Immunoglobulin structure and diversity, Development of T lymphocytes, TCR complex and diversity, positive and negative selection. [7]

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co

receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 631 Microbial Genetics 3-0-0-3

Mutations: Basic concepts of mutation, Molecular nature of mutations, Spontaneous mutation, Reverse mutation, Frameshift mutation, Site directed mutagenesis- deletions, insertions, localized point mutation, Mutations by synthetic oligonucleotides, Evolutionary role of mutation. [8]

Gene Transfer: Transformation, Transduction- specialized and generalized, Conjugation- interrupted mating, Transfection. [8]

Vectors: Plasmids, Colicins and col factors, Plasmids as vectors for gene cloning, Transposons and their use in genetic analysis, Mechanisms of antibiotic resistance by transposons. [6]

Bacteriophage Genetics: Life cycle and uses of following phages in microbial genetics- Lytic phages- T4 and T7, Lysogenic phages- P1, M13, ΦX174, fd [9]

Gene Expression: Gene expression in eukaryotes and prokaryotes and its regulation [8]

MB 542 Seminar 0-0-0-1

Student will prepare a presentation on any area of recent research and deliver seminar on it.

MB 524 Microbial Physiology, Food Microbiology and Microbial Genetics Laboratory 0-0-4-2

Assignments based on MB 512 MB 514 and MB 592 containing exercises on microbial physiology, genetics and metabolisms of microorganisms and their role in food production and spoilage will be conducted.

BT 572 Molecular Biology and Immunology Laboratory 0-0-4-2

Assignments based on various techniques involved in BT 542 and MB 532 containing exercises on molecular biology, immunological analysis will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Communication 0-0-2-1

Assignments based on BT 592 containing exercises on NCBI & It's elements, BLAST & It's relatives, Homology searching, Secondary structure prediction, Structure visualization, Phylogenetic analysis etc.

MB 611 Medical Microbiology 3-1-0-4

Normal Flora of Human Body: Skin, Oral cavity, Gastrointestinal tract, Respiratory tract, Urinogenital tract, Concept of opportunistic pathogens. [3]

Infection: Sources of infection for man, Vehicles or reservoirs of infection, Vertical and horizontal transmission of infection, Pathogenesis of infecting microorganisms-Virulence factors (adhesions, enzymes-coagulases, fibrinolysins, mucinases, lipase, proteases, nucleases, collagenase, neuraminidase). Toxins-endotoxins and exotoxins as agents of disease. [5]

Microbial Strategies for Evading Immune Response: Evading phagocytosis, Survival in phagocytes, Immunosuppression, Induction of ineffective antibodies, Antigenic variation, Avoiding induction of immune response. [5]

Bacterial Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of bacterial diseases caused by- *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Vibrio, Yersinia, Mycobacterium, Treponema, Mycoplasma, Campylobacter, Helicobacter, Rickettsiae and Chlamydiae.* [9]

Viral Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of viral diseases- Pox viruses (Small pox), Herpes viruses (HSV, Epstein-barr virus), Adenoviruses, Picorna viruses (Polio, Rhinoviruses), Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, RSV), Arboviruses (Dengue, Yellow fever,), Rhabdoviruses (Rabies), Hepatitis viruses, Rubella, Reovirus, Rotavirus, Viral Haemorrhagic Fevers, HIV, Oncogenic Viruses. [9]

Fungal and Protozoan Diseases: Pathogenesis, laboratory diagnosis and treatment of fungal and protozoan (Malaria, Kala Azar) diseases. [5]

Antimicrobial Agents: Mode of action of important antibacterial, antifungal, antiviral and antiprotozoan agents. [3]

MB 681 Environmental and Agricultural Microbiology 3-1-0-4

Aerobiology: Droplet nuclei, aerosols, Assessment of air quality- solid, liquid impingment, Air borne transmission of microbes [3]

Types of Soils- physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere [3]

Water Microbiology: Fresh water and marine habitats- general characteristics, Types of microbes, Microbial activity, Eutrophication and its effects, Assessment of water quality- water purification, Potability standards. [7]

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles; Role of microbes in biodeterioration- Metal corrosion, Paper; Metal detoxification, Biopesticides. [10]

Microbes in Waste Treatment: Types of wastes- Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and Tertiary treatment), Trickling filter, Biocontactor, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [8]

Nitrogen Fixation: Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic(Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications. [8]

MB 641 Industrial Microbiology and Fermentation Technology 3-0-0-3

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feed back repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [9]

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [6]

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment. [7]

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (□-lactam, aminoglycosides). [12]

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids. [5]

BT 611 Genetic Engineering 3-1-0-4

Introduction: Isolation and purification of nucleic acids, measuring nucleic acid concentration and purity. [2]

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomyces cereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

MB 651 Medical, Environmental and Agricultural Microbiology laboratory 0-0-4-2

Assignments based on MB 611 and MB 621 describing role of microorganisms in disease causing and prevention and their positive and negative role in environment and agriculture will be conducted.

MB 671 Genetic Engineering and Fermentation Technology laboratory 0-0-4-2

Assignments based on MB 641and BT 611 containing exercises on genetic engineering of microorganisms and their role in industrial production of various metabolites like antibiotics, vitamins and enzymes will be conducted.

Mody University of Science & Technology

M.Sc. Biotechnology
Session 2019-2020

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum (2019 –20 onwards)
First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 511	Cytogenetics	3	-	-	3	3	25	25	50
	BT 581	Biostatistics	3	-	-	3	3	25	25	50
	MB 531	General Microbiology	3	-	-	3	3	25	25	50
	BC 531	Biomolecules	3	-	-	3	3	25	25	50
	BC 521	Biophysical Techniques	3	1	-	4	3	25	25	50
	BT 551	Microbiology and Cytogenetics Laboratory	-	-	4	2	4	100		
	BC 541	Biomolecules and Instrumentation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	1	**8**	**20**				
		Foreign Language-I‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 512	Plant Biotechnology	3	-	-	3	3	25	25	50
	BT 522	Animal Biotechnology	3	-	-	3	3	25	25	50
	BT 592	Bioinformatics, Scientific Communication and Intellectual Property Rights	3	1	-	4	3	25	25	50
	BT 534	Molecular Biology	3		-	3	3	25	25	50
	MB 532	Immunology	3		-	3	3	25	25	50
	MB 514	Food Technology	3	-	-	3	3	25	25	50
	BT 552	Seminar	-	-	-	1	-	100		
	BT 514	Plant, Animal Biotechnology and Food Technology Laboratory	-	-	4	2	4	100		
	BT 572	Molecular Biology and Immunology Laboratory	-	-	4	2	4	100		
	BT 524	Laboratory Course in Bioinformatics & Scientific Communication	-	-	2	1	2	100		
		Sub Total	**18**	**1**	**10**	**25**				
		Foreign Language-II‡	3	-	-	3	-	25	25	50

‡ Refer to Foreign Language Section

M.Sc.-Biotechnology
Two-Year Programme
Academic Curriculum
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	BT 611	Genetic Engineering	3	1	-	4	3	25	25	50
	BT 621	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT 641	Bioprocess Engineering	3	1	-	4	3	25	25	50
	CH 623	Enzyme Chemistry	3	-	-	3	3	25	25	50
	BT 661	Genetic Engineering and Environmental Biotechnology Laboratory	-	-	4	2	4	100		
	BT 613	Enzymology and Bioprocess Laboratory	-	-	4	2	4	100		
		Sub Total	**12**	**2**	**8**	**18**				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	BT 612	Dissertation and Viva-Voce#	-	-	-	20	-	100		
		Sub Total	**-**	**-**	**-**	**20**				

Total Credits **83**

Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.;

$Evaluationof proficiency will be based on the participation in co-curricular/extra curricular activities.

#Student will perform dissertation work in a recognized Organization for a period of 4 months and submit two copies of dissertation to the department latest by first week of May. Presentation and viva voce of dissertation will be conducted in second week of May. Dissertation and presentation will carry 50% weightage each

COURSE DESCRIPTION
M. Sc. (Biotechnology)

Biomolecules 3-0-0-3

BT 511 Cytogenetics 3-0-0-3

Cell Diversity: Cell as a basic unit of life, Cell theory, Cell size and shape.	[2]
Cytology: Introduction to cell organelles (Structure and functions), Self-assembly and dynamic structure of cytoskeletal filaments and their cellular regulation, Molecular motors and cell behaviour, Microtubules motors and movement, Cell-cell interactions, Cell adhesion, Tight and gap junction, Plant cell adhesion and plasmodesmeta.	[8]
Energy Metabolism: Chemotropic (mitochondria) and phototropic (chloroplast) energy metabolism of cell, Electron transport chain and proton pump, Evolution of electron transport chain.	[5]
Membrane Biology: Structure, Chemistry and function of biological membrane, Transport across membrane- simple diffusion, facilitated diffusion, active transport, Energetics of transport, Signal transduction mechanism of cell-membrane potential, Action potential, Synaptic transmission, Messengers and receptors of signal transduction mechanism.	[7]
Cellular Oncology: Cell cycle and its control, Molecular mechanism, Check points and cancer.	[6]
Principles of Genetics: Introduction toMendelian and non-Mendelian genetics, Chromosomal theory of inheritance. Extra chromosomal inheritance.	[4]
Linkage: Concept of linkage and crossing over, basic eukaryotic chromosome mapping, recombination of genes, two-point and three-point test cross, tetrad analysis, linkage maps, Interference.	[4]
Mutation: Spontaneous and induced mutations, chromosomal aberrations, Cytological behavior and molecular basis.	[4]
Population Genetics: The Sources of variation, Hardy Weinberg's Law, Genetic drift and change in gene frequency.	[2]

BT 581 Biostatistics

Introduction: Collection of primary and secondary data, Class tabulation of data, Graphs of frequency distribution and Curves, central tendency — mean,median and mode, Mathematical properties mean, Geometric and harmonic Mean

Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures [6]

Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis [9]

Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples [9]

Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve [9]

MB 531 General Microbiology 3-0-0-3

History and Scope of Microbiology: Spontaneous Generation vs. Biogenesis, Contributions of various scientists to the field of microbiology and development of microbiology as a scientific discipline. Avenues for microbiologists. [6]

Classification: Microorganisms and place of microbes in Whittakers' five kingdom classification, Eight kingdom classification, Phenetic and phylogenetic classification. Bergeys' manual for classification of bacteria, Structure and organization of Prokaryotic and Eukaryotic cells. Structure of bacterial cell wall-difference between Gram positive, Gram negative and archaebacteria, Cell membrane, Flagella, Pilli, Capsule, Endospore, Mesosome, Reserve food material. [10]

Microbial Growth: Bacterial growth curve, Factors affecting the microbial growth, One step growth curve of bacteriophages, Concepts of batch culture, Continuous culture, fed batch culture, synchronous growth and measurement of growth. [8]

Recombination in Bacteria and Viruses: Transformation, Conjugation and Transduction. [5]

Methods of Studying microorganisms: Microscopy-light microscopy (bright field, dark field, phase contrast, fluorescent) and electron microscopy (SEM & TEM), Pure culture techniques, Microbiological media (Liquid, solid, semi solid, defined, selective, maintenance, enrichment & differential), Sterilization, Disinfection, Aseptic techniques. [6]

General Properties of Microorganisms: Brief study of characteristics of viruses, algae, protozoa and fungi. Economic importance of microorganisms, Microbes as agents of diseases. [4]

BC 511 Chemistry of Biomolecules

pH and Buffers: Importance of buffers with reference to biologic Isoelectric points, pK values, Morality and Molality, Thermodyna Free energy, Gibbs law, High energy compounds and their importance**.**

Carbohydrates: Structure, Classification and important rea monosaccharides and their derivatives, Synthesis of biologically structural and Storage carbohydrates,

Lipids: Structure and classification of lipids, Fatty acids, Propertie acids, Glycerolipids, Sphingolipids, Cholesterol and their bio Alkaloids, Steroids and Flavonoids- properties and synthesis, Lipids molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- and function.

Proteins: Structural unit of proteins, Classification of amino acids, of amino acids on the basis of $-NH_2$ and –COOH group, Protein stru classification, Ramachandran plots, Stability of proteins, Fol unfolding of proteins, Polypeptide synthesis and sequencing, Protein Structure and function of globular and fibrous proteins.

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classificat stability between purines and pyrimidines, Structure and reactions and pyrimidines and their derivatives, Metabolism of purines and py Protein and nucleic acid interactions.

Vitamins: Role of vitamins in growth and differentiation in huma Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes

Enzymes: Classification of enzymes, MichelisMenten equation, K Linweaver-Burk equation, Kinetics of substrate and enzyme Isozymes, Effect of different physical and chemical factors, Act nature and determination, Immobilization of enzymes and its applicat

BC 521 Biophysical Techniques 3-1-0-4

Basic Principles of Biophysics: Quantum Mechanics, Electronic structure of Atoms, Molecular orbitals and Covalent bond, Molecular interaction, Stereochemistry and chirality, Thermodynamics-Entropy, Enthalpy, Oxidation-Reduction potential, Zero order and first order reactions. [5]

Centrifugation: Principles of centrifugation, Design and care of rotor, Preparative and Analytical centrifuge, Density gradient centrifugation, Safety aspects and [6]

applications.

Spectroscopic Techniques: Ultra violet- visible spectroscopy, Spectrofluorometry, Circular dichorism and Optical rotatory dispersion, Atomic spectroscopy, Raman and Infra-red spectroscopy, Electron spin resonance spectroscopy, Mass spectroscopy, NMR.	[12]
Electrophoretic Techniques: Principle, Electrophoresis of proteins and nucleic acids, Isoelectric-focusing, 2-D electrophoresis, Capillary electrophoresis.	[6]
Chromatographic Techniques: Principles of Chromatography, Chromatography theory and practice, Paper, Thin layer, and Column chromatography, Permeation, Ion exchange, Affinity, Adsorption, Partition, HPLC and Gas chromatography.	[10]
Radioisotope Techniques: Radioactive decay, Interaction of radioactivity with matter, GM counter, Scintillation counter, Quenching and its correction, Autoradiography, Radio-immunoassay and ELISA.	[5]

BT 551 Microbiology and Cytogenetics Laboratory 0-0-4-2

Assignments based on BT 511 and MB 531 containing exercises on study of cell and its various structures and functions and general characteristics of microorganisms will be conducted.

BC 541 Biochemistry and Instrumentation Laboratory 0-0-4-2

Assignments based on BC 511 and BC 521 containing exercises on working and maintenance of instruments and qualitative and quantitative analysis of biomolecules will be conducted.

BC 531 Biomolecules

Basic Concept of Biomolecules: Structure of prokaryotic and eukary intracellular organelles and their functions, comparison of plant a cells. Importance of buffers with reference to biological aspect, points, pK values, Morality and Molality, Thermodynamics law, Fr Gibbs law, High energy compounds and their biological importance.

Carbohydrates: Structure, Classification and important rea monosaccharides and their derivatives, Synthesis of biologically structural and Storage carbohydrates.Carbohydrate metabolism-Kr glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, phosphate pathway

Lipids: Structure and classification of lipids, Fatty acids, Propertie

acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis,Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis.

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids.Classification of enzymes, MichelisMenten equation Km value, Linweaver-Burk equation. [8]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [6]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

BT 512 Plant Biotechnology **3-0-0-3**

Plant Tissue Culture: Historical perspective, Tissue culture media, Totipotency, Organogenesis, Somatic embryogenesis- regulation and application, Artificial seed production, Micropropagation, Somaclonal variation, Androgenesis and its applications in genetics and plant breeding, Germplasm conservation and Cryopreservation. [5]

Protoplast Culture and Somatic Hybridization: Protoplast isolation, Culture and usage, Somatic hybridization-methods and applications, Cybrids and somatic cell genetics	[6]
Agrobiology: *Agrobacterium*-plant interaction, Organization of virulence genes, Ti and Ri plasmids, Opines and their significance, T-DNA transfer mechanism, Disarming the Ti plasmid, *Agrobacterium* based vectors, Binary and shuttle vectors.	[5]
Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co -integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Transgene stability and Gene silencing.	[7]
Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance Plants as Biofactories.	[8]
Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers-RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection.	[8]

BT 522 Animal Biotechnology 3-0-0-3

Introduction: Brief account of animal tissue culture, Brief history and some established normal and transformed cell lines.	[5]
Media formulations: Balanced salt solution, Semi-synthetic and synthetic media, Serum as a media supplement, Serum-free media, Feeder layers, Medium sterilization.	[8]
Cell culture Methods: Disaggregation (mechanical, chemical and enzymatic), Primary culture, Secondary culture, Suspension and monolayer cultures, Immobilized cultures.	[8]
Growth Characteristics of Animal Cells: Growth curve, Growth kinetics, Synchronization of cells, Differentiation of cells, Transformation, Bioreactors.	[8]
Application of Animal Biotechnology: Tissue engineering, Production of monoclonal antibodies, Transgenic animals, Embryo culture and IVF, Gene therapy, Production of interferons and vaccines, Diagnostics.	[10]

BT 592	**Bioinformatics , Scientific Communication & Intellectual Property Rights**	**3-1-0-4**

Introduction to Bioinformatics: Biological Databases**:** Types-GenBank, EMBL, DDBJ, SwissProt and PDB (Data Submission and Retrieval via WWW) and their management.	6
Molecular Phylogenetics: Pattern and mode of substitution, Acquisition and origin of new function, Phylogenetic tree; Distance matrix and maximum Parsimony methods of phylogenetic tree constructions.	8
Data Searches and Pairwise Alignments: Dot Plots, Simple alignments, Gaps, Scoring Matrices; Global and Local Alignments; Database searches (BLAST and FASTA and their relatives); Multiple Sequence alignments; Genome analysis; Homology modeling and Secondary structure prediction of proteins.	8 3
Scientific Literature: Structure, Type (Research article, review article, Short communication, Book review). Abstracting methodology. Concept of Impact factor; Citation Index.	7
Introduction to Intellectual Property Rights, Basic Principles of Patent Law, Types of IPR ,Patent Application procedures (India and International)	7
Biotechnology and Intellectual Property Rights. Biotechnology and the Law-Objective, Evolution, Moral & ethical issues Issues. Protection of Geographical Indications - Objective, Multilateral Treaties, Protection of Traditional Knowledge-Objective, Bio-Prospecting and Bio-Piracy	

Text Book

1. Introduction to Bioinformatics by Teresa K. Attwood, David Parry, Smith 1st Edition
2. Bioinformatics: a practical guide to the analysis of genes and proteins by Baxevanis A., Ouellette F.B.F. (Eds.). John Wiley and Sons, New York (1998) 2nd Edition.
3. Intellectual Property Rights and the Law by Reddy G.B., 2005

Reference Book

4. "BLAST": An Essential Guide to the Basic Local Alignment Search Tool by O'Reilly 2nd Edition.
5. Bioinformatics : Methods and Applications genomics, proteomics and drug discovery by Rastogi S.C., Prentice-hall Of India Pvt Ltd.

BT 534 Molecular Biology 3-0-0-3

Historical and Introductory Aspects: History of molecular biolog acids as hereditary material-experimental evidences, structure of DN constancy and C-value paradox, Cot curve, DNA denaturation and re kinetics.

DNA Replication: Enzymes and accessory proteins involved replication, Prokaryotic and eukaryotic DNA replication, Asymm dimeric nature of DNA polymerase III.

Transcription: General principles, Types of RNA polymerases, Enhancers and Regulatory sequences, RNA polymerases and transcription factors, Prokaryotic and Eukaryotic transcription Ge specific transcription factors, Control of transcription.

Translation: Genetic code, Prokaryotic and Eukaryotic tr Translation machinery, Mechanisms of initiation, elongation and te Regulation of translation.

Maturation and Processing of RNA: Methylation, Cutting and tri rRNA, Capping, Polyadenylation and Splicing of mRNA, Cu modification of tRNA, Degradation system, Catalytic RNA group I a II intron splicing RNase P.

Regulation of Gene Expression: Operon concept, Catabolite r Positive and negative regulation, Inducers and co-repressors, regulation - *E. coli* lac operon, Positive regulation, Regulation by a his and trp operons, Antitermination, Environmental regulation expression- Global regulatory responses - heat shock response, response and regulation by small molecules such as ppGpp and cAM

MB 532 Immunology

Overview of immune response: Historical background, Innate i Adaptive immunity, Innate-adaptive cross-talk, Natural and immunity, Active and Passive immunity, Humoral and Cell-mediate response, Early theories of immunity.

Cells and Organs of Immune System: Lymphoid organs, Haem and differentiation of stem cells into mast cells, Basophils, Eo Monocytes, Macrophages, Neutrophils, NK cells, B and T lympho and Tc cells)-characteristics, CD markers and biological Development of B-lymphocytes, Immunoglobulin structure and Development of T lymphocytes, TCR complex and diversity, pos negative selection.

Antigens: Antigenicity vs. immunogenicity, Characteristics of antigens, Epitopes, Characteristics of B-cell and T-cell epitopes, Haptens, Adjuvants, Isotypes, Allotypes and Idiotypes [3]

Humoral Immune Response: Activation and differentiation of B-lymphocytes, immunoglobulin classes and subclasses, B-cell receptor–co receptor complex, Primary and Secondary response, Affinity maturation, Antigen- antibody interactions, forces involved in Ag-Ab interactions, Antibody affinity and avidity, Primary interactions and secondary interactions, RIA, ELISA, IFA, Flow cytometry, Western blotting, precipitation reactions (in gel and in solution), agglutination reactions, Complement system. [8]

Cell Mediated Immune Response: Development- antigen processing and presentation, Major Histocompatibility Complex- structure, diversity and regulation of expression on cells, Leukocyte trafficking, Activation of T-cells, TCR signaling, Co-stimulatory signals, Effector functions, cytokines- types and biological role, Regulation of cytokine expression, Differentiation into Th1 and Th2 subclasses, Tc-cell mediated target cell killing. [8]

Immune System in Health and Disease: Immunologic tolerance, Autoimmune diseases, Immunodeficiency diseases, Hypersensitivity and allergies, Transplantation Immunology, Tumor immunology, Immunology of infectious diseases, Vaccines- concepts and strategies of development. [6]

MB 514 Food Technology 3-0-0-3

Food and Fermentation Technology: Origin, Scope and development of fermented food products, Microbial starters for food fermentations. Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods. Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods, Single cell protein, Mushroom cultivation [10]

Spoilage and Preservation: Factors affecting microbial growth in foods- extrinsic and intrinsic, Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks, Spoilage detection and characterization. Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives). [10]

Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella*, *Clostridium*, *Escherichia*, *Salmonella*, *Shigella*, *Staphylococcus*, *Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, [10]

*E.coli*O157:H7, *Listeria monocytogens, Campylobacter jejuni, Helicobacter pylori*

Packaging and Quality Control:
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane. [9]
Detection of food pathogens- Culture methods, Rapid detection using PCR
Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

BT 552 Seminar

Student will prepare a presentation on any area of recent research ar seminar on it.

BT 514 Plant, Animal Biotechnology and Food Technology Laboratory

Assignments based on BT 514, BT 512 and BT 522 containing exercises on application of food microbiology and biotechnological techniques in animals and plants will be conducted.

BT 572 Molecular Biology and Immunology Laboratory

Assignments based on various techniques involved in BT 54 532 containing exercises on molecular biology, immunologica will be conducted.

BT 524 Laboratory Course in Bioinformatics & Scientific Commu
Assignments based on BT 592 containing exercises on NC elements, BLAST & It's relatives, Homology searching, S structure prediction, Structure visualization, Phylogenetic ana

BT 611 Genetic Engineering

Introduction: Isolation and purification of nucleic acids, measurir acid concentration and purity.

Enzymes in Molecular Cloning: Principal enzymes used to manipulate DNA *in vitro* with their activities and major applications including Restriction endonucleases, Nucleases, DNA ligases, topoisomerases, Enzymes involved in modifications including DNA methylases, DNA polymerases, kinases, phosphatases and DNA binding proteins (SSB, Rec A). [4]

Cloning and Expression Vectors: Brief study of features and applications of plasmids, phagemids, bacteriophage, lambda vectors, cosmids, high capacity cloning vectors like BACs, PACs and YACs, General considerations for design of expression vectors in prokaryotes. [5]

DNA Cloning Strategies: Criteria for the choice of suitable vectors and host, Modification of DNA ends, Methods of gene transfer to bacterial cells, Preparation of genomic and cDNA libraries, Screening methods for selection of recombinant DNA molecules by direct, indirect methods and by detection of specific proteins. [4]

Analysis of DNA Protein and Protein-Protein Interactions: Electromobility shift assay, Methyl interference assay, Footprinting technique, Dimethyl sulphate protection assay, Entrapment vectors, Yeast two hybrid systems, Phage display, Differential gene expression by microarray. [4]

Polymerase Chain Reaction: Principle and technique, Advances and extensions to basic PCR strategy including RT-PCR, Assymetric PCR, Inverse PCR, Nested PCR, anchored-PCR, overlap extension, DOP-PCR, Applications of PCR. [4]

Manipulation of Gene Expression in Prokaryotes: Production of fusion proteins and heterologous unique proteins in bacteria, Maturation, Transport and stability of eukaryotic proteins in bacteria, Strategies to increase protein production and stability. [5]

Cloning in Systems other than *E. coli*: Cloning in gram positive bacteria, *Saccharomycescereviciae*, Streptomyces, Yeast expression vectors. [4]

Common Genetic Engineering Techniques: Site directed mutagenesis, Sequencing, Probe labeling, Hybridization. [3]

Applications of rDNA Technology: Role of genetic fingerprinting in diagnostics, therapeutic, agricultural applications. [5]

BT 621 Environmental Biotechnology

Agricultural Microbiology: Types of soils-physical and characteristics, microflora, Rhizosphere and Phyllosphere- genera Microbial interactions- Study of positive and negative interactio microbial populations, Biological nitrogen fixation- Symbiotic (R Frankia), Asymbiotic (Azotobacter, Azospirillum), Nitrogenase and Biofertilizers, VAM- brief account and applications, Bio Biopesticides.

Water Microbiology: Assessment of water quality- water pu Potability standards, Major water borne diseases.

Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle microbes, Biodegradation- recalcitrant and xenobiotics, Degra pesticide, Wood and Textiles, Role of microbes in biodeteriorati corrosion, Paper, Metal detoxification.

Waste Treatment: Types of wastes-Solid and Liquid waste, Waste treatments-Physical, Chemical and Biological (Primary, Secondary and Tertiary treatment), Trickling filter, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production. [10]

BT 641 Bioprocess Engineering

Microbial Growth and Product Kinetics: Microbial biomass, Enz metabolites, Batch and Continuous culture, Feed back system, Com batch and continuous culture, Fed batch system and its applications.

Isolation, Preservation and Improvement of Industrially i Microorganisms: Enrichment culture technique, Storage at low te Storage in Liquid nitrogen, Lyophlization, Strain improvement by Feed back inhibition and repression, Strain improvement by mod characteristics of inhibitor metabolite, Isolation of auxotrophic Resistant mutants, Revertant mutants, Use of Recombination me Improvement by modifying properties other than yield.

Sterilization: Design of batch sterilization process, Calculation of I Holding time, Richard's rapid method for design of sterilization, s batch sterilization process, Design of continuous sterilization Sterilization of air, Theory and design of depth filter.

Mass Transfer in Microbial System: Fluid and its properties, Ma co-efficient and its determination, Factor affecting mass transfer c Scale up and scale down.

Downstream Processing: Introduction, Filtration, Product isol extraction– centrifugation, precipitation, cell disruption, lic extraction, chromatography, membrane processes, Drying, Crystalli whole broth processing.

Bioreactor and Control: Basic design of fermenter and contro automatic and manual, off line and on line, Bioreactor– Packed bed, bed, Tickle bed, CSTR, Plug flow reactor, Scale up of bioreactor.

BC 611 Enzymology

Introduction: Units of activity, Specific activity of enzymes and n enzyme assay, Enzyme specificity, Uni substrate enzyme kinetic affecting the rate of enzyme catalyzed reaction, Derivation of Michel equation, Significance of $V_{max}$and $K_{m,}$ Enzyme inhibition- type of Competitive non Competitive and uncompetitive kinetics.

Enzyme Catalytic Efficiency: Factors associated with catalytic such as proximity, Orientation-distortion of strain, base nucleophili with equation, Protein ligand binding co-operativity, Hill and Sat C protein sequencing.

Immobilization: Immobilized enzymes and their industrial applicatio of partition on kinetics and performance with particular emphasis on pH and hydrophobicty.

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics physiological significance, Symmetric and sequential modes for

Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

BT 661 Genetic Engineering and Environmental Biotechnology Laboratory

Assignments based on BT 611 and BT 621 containing exercises c engineering and role of biotechnology in environment will be conduc

BT 613 Enzymology and Bioprocess Laboratory

Assignments based on BC 611 and BT 641containing exercise fermentation process and production of metabolites and role of enzyn biotechnology will be conducted.

***BC 531**

	Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.**		[5]
	Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway		[8]
	Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis, Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis.		[7]
	Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid		[8]

	metabolism-degradation and biosynthesis of amino acids. Classification of enzymes, Michelis Menten equation Km value, Linweaver-Burk equation.		
	Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions.		[6]
	Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes.		[5]

*in place of BC 511 of M.Sc Biotechnology, Microbiology and F&N and CH 561 of M.Sc Chemistry

CH 623 Enzyme Chemistry 3-0-0-3

Introduction: Units of activity, Specific activity of enzymes and methods of enzyme assay, Enzyme specificity, Uni substrate enzyme kinetics, Factors affecting the rate of enzyme catalyzed reaction, Derivation of Michelis-Menten equation, Significance of V_{max} and $K_{m,}$ Enzyme inhibition- type of inhibition, Competitive non Competitive and uncompetitive kinetics.Proximity effects and molecular adaptation. [5]

Enzyme Catalytic Efficiency: Factors associated with catalytic efficiency such as proximity, Orientation-distortion of strain, base nucleophilic catalysis with equation, Protein ligand binding co-operativity, Hill and Sat Chard plot protein sequencing. [6]

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

IndustrialApplicationsofEnzymes: Techniquesandmethodsofimmobilizationof enzymes, effectofimmobilizationonenzymeactivity,applicationofimmobilizedenzymes, useofenzymes infood anddrinkindustry-Brewing andcheese-making, syrupsfromcorn starch,enzymesastargetsfordrug design. [6]

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.

2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

Mody University of Science & Technology

M.Sc. Physics

Session 2019-2020

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc. Physics

Academic Curriculum (2015 – 16 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 511	Mathematical Physics-I	3	1	0	4	3	25	25	50
	PH 521	Classical Mechanics	3	0	0	3	3	25	25	50
	PH 531	Classical Electrodynamics and Plasma Physics	3	1	0	4	3	25	25	50
	PH 541	Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 551	Statistical Physics and Thermodynamics	3	1	0	4	3	25	25	50
	PH 561	General Physics and Optics Laboratory	0	0	4	2	4	100		
	PH 571	Programming Language Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**4**	**8**	**23**	**-**	**-**		
		Foreign Language-I (Non-Credit)‡	3	0	0	3	3	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 512	Mathematical Physics -II	3	1	0	4	3	25	25	50
	PH 522	Atomic & Molecular Physics and Lasers	3	1	0	4	3	25	25	50
	PH 532	Condensed Matter Physics	3	0	0	3	3	25	25	50
	PH 542	Computational Physics	3	0	0	3	3	25	25	50
	PH 552	Elements of Nuclear and Particle Physics	3	0	0	3	3	25	25	50
	PH 562	Computational Physics Laboratory	0	0	4	2	4	100		
	PH 572	Advance Physics Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**2**	**8**	**21**	**-**	**-**		
		Foreign Language-II (Non-Credit)‡	3	0	0	3	3	25	25	50

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 611	Semiconductor Physics and Devices	3	1	0	4	3	25	25	50
	PH 621	Digital Electronics	3	1	0	4	3	25	25	50
	PH 631	Physics of Nano-Materials	3	0	0	3	3	25	25	50
	PH 641	Ancient Indian Science	2	0	0	2	3	25	25	50
	PH 651	Electronics Laboratory	0	0	4	2	4	100		
		Specialized Paper –I	3	1	0	4	3	25	25	50
		Specialized Paper –II	3	1	0	4	3	25	25	50
	Sub Total		**17**	**4**	**4**	**23**	**-**	**-**		

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 612	Advance Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 622	Instrumentation and Characterization Techniques	3	0	0	3	3	25	25	50
		Specialized Paper –III	3	1	0	4	3	25	25	50
		Specialized Paper –IV	3	1	0	4	3	25	25	50
	PH 682	Project	0	0	0	8	-	100		
	Sub Total		**12**	**3**	**0**	**23**	**-**	**-**		

Total Credits = 90

Specializations:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE**	ETE
A	**Nanoscience**								
PH 661	Elements of Nanoscience	3	1	0	4	3	25	25	50
PH 671	Nano-Fabrication Techniques	3	1	0	4	3	25	25	50
PH 632	CNT and Sensor Applications	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
B	**Photonics**								
PH 681	Advance Opto-Electronics	3	1	0	4	3	25	25	50
PH 691	Fiber and Non-linear Optics	3	1	0	4	3	25	25	50
PH 652	Quantum Optics	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
C	**Condensed Matter Physics**								
PH 613	Advance Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 623	Soft Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 662	Material Science	3	1	0	4	3	25	25	50
PH 672	Smart Materials	3	1	0	4	3	25	25	50

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

[#]*Student will perform* ***project work*** *for a period of 2 months and submit two copies of Dissertation report to the Ddepartment. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

Detailed Syllabus (M.Sc. Physics):

PH 511 **Mathematical Physics-I** **3 - 1 - 0 - 4**

1. **Vector Analysis:** Gradient, divergence, Curl and their representations in Orthogonal curvilinear coordinates. [11]

   Linear algebra: Linear vector spaces, linear operators, dual space, ket and bra notation, Hilbert space, Metric space, Function spaces.

   Matrices: The algebra of matrices, Special matrices, Rank of a matrix. Elementary transformations, Elementary matrices, Equivalent matrices, Solution of linear equations. Linear transformations, Change of Basis, Eigenvalues and eigenvectors of matrices, The Cayley-Hamilton theorem, Diagonalisation of matrices.

2. **Tensor Analysis:** Tensor analysis, Coordinate transformations, scalars, Covariant and Contravariant tensors, Addition, Subtraction, Outer product, Inner product and Contraction, Symmetric and antisymmetric tensors, Quotient law, Metric tensor, Conjugate tensor. [8]

3. Partial Order Differential Equations and Special Functions: Separation of variables-ordinary differential equations, singular points, Bessel, Leguerre, Legendre, Hermite equations. Recurrence relations, generating functions and Rodrigues formulae for the Bessel, Leguerre, Legendre and Hermite functions [11]

4. **Greens Functions:** Sturm-Lioville operators and eigen values and eigen functions. Dirac delta functions-properties and representations, Definitions and physical significance of Greens functions, Eigen function expansion of Greens function, Greens function for ordinary differential operators [9]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990.
3. M.D. Greenberg:Advanced Engineering Mathematics, 2nd Edition, PHI, New Jersey, 1998.
4. B.D. Gupta: Mathematical Physics, 3rdedition, Vikas Publishing House, New Delhi. , 2006.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, 8th ed., Wiley, New York, 1999.
2. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
3. Satyaprakash, Mathematical Physics, Sultan Chand & sons, 6th edition, New Delhi, 2004.

PH 521 **Classical Mechanics** **3 - 0 - 0 - 3**

1. **Fundamental Principles and Lagrangian Formulation and Applications:** Newtonian Mechanics: Mechanics of a particle and system of particles, Conservation laws, Constraints, Generalized coordinates, D' Alembert's principle and Lagrange's equation, Hamilton's Variational principle, **Lagrangian Problems:** Double Pendulum, Spherical pendulum, Cylinder rolling down an inclined plane. [8]

2. **Hamiltonian Formulation and Application:** Hamilton's equations, cyclic variables, Principle of least action, **Hamiltonian Problems:** motion of a particle in a central force field, charged particle moving in an electromagnetic field, Equations of motion and first integrals, Kepler's laws, Scattering by central potential, Transformation from center of mass to laboratory frame. [10]

3. **Rigid Body Dynamics and Canonical Transformations:** Rigid body motion – Kinematics - Euler's angles - Angular momentum and kinetic Energy – Moment of inertia tensor - Euler's equations of motion –Canonical transformation and their generators – simple examples, Poisson brackets. [8]

4. **Jacobi Theory and Theory of Small Oscillations :** Hamilton-Jacobi equations – application to Linear Harmonic Oscillator problem - Action Angle variables - Application to Kepler's problem - Oscillatory motion - Theory of small oscillation –Two coupled pendulums, Vibrations of a triatomic molecule. [8]

5. **Relativity:** Reviews of basic ideas of special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence [5]

Text Books:

1. H. Goldstein, C.Poole and J.Safko; Classical Mechanics, Pearson, New Delhi, 3rd ed 2002.
2. N.C.Rana and P.S.Joag; Classical Mechanics, Tata Mc: Graw Hill, New Delhi, 1991.

Reference Books:

1. L. D. Landau E.M. Lifshitz; Mechanics: Volume 1 (Course of Theoretical Physics), Pergamon Press Ltd, 2nd ed. 1969.

PH 531 Classical Electrodynamics and Plasma Physics 3 - 1 - 0 - 4

1. **Electrostatics:** Electric potential, Poisson and Laplace‟sequations.Boundary value problems, Uniqueness theorems, Green‟stheorem.Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion. [6]

2. **Electromagnetic Waves:** Maxwell‟s equations, Boundary conditions, Wave equation and its complex notation, Electromagnetic waves in vacuum, Electromagnetic waves in non-conducting and linear media, Electromagnetic waves in linear conducting media. Poynting theorem, Reflection, refraction and polarization of electromagnetic waves, [6]

3. **Waveguides and Cavities:** Metallic boundary conditions, Electromagnetic waves confined to hallow metallic pipe,TE, TM and TEM modes, TE and TM modes in rectangular waveguides, Bessel‟s function, TE and TM modes in cylindrical waveguides, Dielectric waveguides, TE and TM modes in rectangular and cylindrical Resonant cavities. [6]

4. **Potential, Fields and Radiations:**

   Scalar and vector potentials, Gauge transformation, Coulomb and Lorentz gauge, Retarded potential, Lienard-Wiechert potentials, Fields due to moving charge, Power radiated by an accelerated charge and angular distribution, Bremstrahlung Cerenkov and Synchrotron radiations. [6]

5. **Relativistic Electrodynamics:** Four vectors, Lorentz transformation in terms of Four vectors, Lorentz transformation matrix, Transformation of electromagnetic fields, Field Tensor, Dual field strength tensor, Maxwell's equations in terms of strength tensors, [6]

6. **Plasma Physics:** Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, Motion of charged particles in electric and magnetic fields, Adiabatic Invariants Wave in Plasma: Polarisation, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and Perpendicular to the Magnetic Field Propagation at Finite Angle. [9]

Text Books:

1. David J. Griffith; Introduction to Electrodynamics, PHI Private Limited, 1999
2. John D. Jackson; Classical Electrodynamics, Wiley Eastern Limited, 1998
3. F.F. Chen; Plasma Physics and Controlled Fusion,Springer,2006

Reference Books:

1. Edward C. Jordan and Heith G. Balmain; Electromagnetic Waves and Radiating Systems, PHI, 1991
2. W.K.H. Panofsky and M. Phillips; Classical Electricity and Magnetism, Dover Publications; 2nd Ed., 2005
3. J A Bittencourt; Fundamentals of Plasma Physics, 3rd Ed, Springer, 2004

PH 541 **Quantum Mechanics** **3 - 1 - 0 - 4**

1. Limitations of classical mechanics, development of Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states. Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest‟s theorem, momentum Eigen functions in the coordinate representation, box normalization and Dirac delta function. Coordinate and momentum representations, Schrodinger equation in momentum representation [10]

2. Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, Eigen values and Eigen vectors, Hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations. Matrix representation of operators, change of basis, unitary transformations, quantum dynamics, Schrodinger, Heisenberg and interaction picture. [10]

3. Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method. Angular momentum operator, commutation relations, expression for L2 operator in spherical polar coordinates, Role of L2 operators in central force problem, eigen value problem for L2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator. [10]

4. Generalized angular momentum, raising and lowering operators, matrices for J2, Jx, Jy, Jz operators, Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions. [9]

Text Books:

1. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
2. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

Reference Books:

1. L.I.Schiff; Quantum Mechanics, TMH, 2010.
2. Mathews and Venkatesan; A Textbook of Quantum Mechanics, TMH 1976,
3. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
4. J.J.Sakurai; Modern quantum Mechanics, Addison Wesley; 2 ed., 2010

PH 551 Statistical Physics and Thermodynamics 3 - 1 - 0 - 4

1. **Review: (Elementary Probability Theory & Thermodynamics):** Preliminary concepts, Random walk problem, Binomial distribution, mean values, standard deviation, various moments, Gaussian distribution, Poisson distribution, mean values. Extensive and intensive variables, laws of thermodynamics, thermodynamic potentials, Maxwell relations, applications of thermodynamics to (a) ideal gas, (b) magnetic material, and (c) dielectric material. Laws of thermodynamics [4]

2. **Statistical Description of System of Particles and Statistical Thermodynamics:** State of a system, microstates, ensemble, basic postulates, behavior of density of states, density of state for ideal gas in classical limit. Thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of density of states on external parameters, Statistical calculation of thermodynamic variables [10]

3. **Classical Statistical Mechanics :** Microcanonical ensembles and their Equivalence, Canonical and grand canonical ensembles, partition function, thermodynamic variables in terms of partition function and grand partition function, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem. Maxwell-Boltzmann gas velocity and speed distribution. Chemical potential, Free energy and connection with thermodynamic variables, First and Second order phase transition; phase equilibrium. [10]

4. **Quantum Statistical Mechanics :** Formulation of quantum statistics, Density Matrix, ensembles in quantum statistical mechanics, simple applications of density matrix. The theory of simple gases : Maxwell-Boltzmann, Bose-Einstein, Fermi Dirac gases. Statistics of occupation numbers, Evaluation of partition functions, Ideal gases in the classical limit. [10]

5. **Ideal Bose System :** Thermodynamic behavior of an Ideal Bose gas, Bose-Einstein condensation. Thermodynamics of Black body radiation, Stefan-Boltzmann law, Wien's displacement law. [5]

Text Books:

1. B. B. Laud; Fundamentals of Statistical Mechanics, New Age International, 2007.
2. F. Reif; Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965
3. S. Loknathan&Gambhir; Statistical and Thermal Physics: An Introduction, PHI Learning, 1991.

Reference Books:

1. K. Huang; Statistical Mechanics, 2nded, John Wiley & Sons, 1987.
2. R. K.Pathria, Paul D. Beale, Statistical Mechanics;Butterworth-Heinemann Press, 2011.
3. L. D. Landau and E. M. Lifshitz; Statistical Physics: Volume 5 (Course of Theoretical Physics), 3rded Butterworth-Heinemann Press, 1980.

PH 561 General Physics and Optics Laboratory 0-0-4-2

Experiments based on Mechanics, Optics, Basic Electronics, PH 531.

PH 571 Programming Language Laboratory 0-0-4-2

Programming based on C^{++} related to Physics.

PH 512 Mathematical Physics -II 3 - 1 - 0 - 4

1. **Complex Analysis :**Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula, Taylor's series and Laurent's series expansion, Zeros and singular points, Multivalued functions, Branch Points and Cuts, Riemann Sheets and surfaces, Residues, Cauchy's Residue theorem, Evaluation of definite integrals. [11]

2. **Group Theory:** Definition of groups e.g. matrix groups- transformation groups , Representation of groups: matrix, faithful, Unitary, reducible and irreducible representations' Lie groups and algebras: Definition of Lie groups with examples- O(3), SO(3), SU (2) groups- representation of SU(2), SO(3). [9]

3. **Fourier Series & Transforms**: Integral transforms, Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives [9]

4. **Laplace Transforms:** Convolution Theorems, Momentum representation, Laplace transform, Properties and examples of Laplace Transform, Laplace transforms of derivatives, Use for solving differential equations [10]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. M. R. Spiegel: Theory and Problems of Complex Variables, Schaum's outline series, 6thed., 2008
3. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990,
4. B.D. Gupta: Mathematical Physics, 3rd edition, Vikas Publishing House , New Delhi. , 2006,

Reference Books:

1. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
2. E. Kreyszig: Advanced Engineering Mathematics, 8thed., Wiley, New York, 1999.
3. M.D. Greenberg: Advanced Engineering Mathematics, 2nded., PHI, New Jerrsey, 1998,

PH 522 **Atomic & Molecular Physics and Lasers** **3 - 1 - 0 - 4**

1. Time independent perturbation theory, First order perturbation theory applied to nondegenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic [11]

2. **Pauli's Principle and Shell Structure:** Systems with several electrons and spin functions. [2]

3. **Complex Spectra:** LS-Coupling scheme, normal triplets, basic assumptions of the theory, identification of terms, selection rules, jj- coupling (Qualitative). [2]

4. **Infrared and Raman Spectra:** Rigid rotator, energy levels, spectrum (no derivation of selection rules), Harmonic oscillator: energy levels, eigenfunctions, spectrum, comparison with observed spectrum, Raman effect, Quantum theory of Raman effect, Rotational and Vibrational Raman spectrum. Anharmonic oscillator: energy levels, Infrared and Raman Spectrum, Vibrational frequency and force constants. Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of Dunham coefficients), Symmetry properties of rotational levels, influence of nuclear spin. [12]

5. **Electronic Spectra:** Electronic energy and potential curves, resolution of total energy,Vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronicbands: General relations, branches of a band, band-head formation, Intensity distribution in avibrational band system. [6]

6. **Lasers:** Basic concept and principle of laser, Component of lasers, Einstein's and Gain coefficient, Types of lasers and pumping, Gas laser, YAG laser and chemical laser, Erbium lasers, Fibre lasers, Erbium-doped fibre lasers. Q-Switching:Laser Spiking and relaxation oscillations, Rate equations, TW and PW laser systems, Application of lasers. [6]

Text Books:

1. Kuhn H., Atomic Spectra, Academic Press, 1962
2. Herzberg I G., Molecular Spectra and Molecular Structure Van-Nostrand Rein-hold, 1950

Reference Books:

1. White H.E., Atomic Spectra, Mc-Graw Hill, 1934.
2. C N Banwell and E M McCash, Fundamentals of Molecular Spectroscopy: Tata Mc-Graw Hill, 2008
3. Chandra S., Molecular Spectroscopy, Narosa, 2009.
4. Vishwakarma H. L., Applied Physics, Wiley India Pvt. Ltd., 1st Edition, 2013.

PH 532 **Condensed Matter Physics** **3 - 0 - 0 - 3**

1. **Elastic Constants:** Binding in solids; Stress components, stiffness constant, elastic constants, elastic waves in crystals. [5]

2. **Lattice Dynamics and Thermal Properties:** Rigorous treatment of lattice vibrations, normal modes; Density of states, thermodynamic properties of crystal, anharmonic effects, thermal expansion. [5]

3. **Energy Band Theory**: Electrons in a periodic potential: Bloch theorem, Nearly free electron model; tight binding method; Semiconductor Crystals, Band theory of pure and doped semiconductors; elementary idea of semiconductor superlattices. [8]

4. **Transport Theory:** Electronic transport from classical kinetic theory; Introduction to Boltzmann transport equation; electrical and thermal conductivity of metals; thermoelectric effects; Hall effect and magnetoresistance. [7]

5. **Dielectric Properties of Materials:** Polarization mechanisms, Dielectric function from oscillator strength, Clausius-Mosotti relation; piezo, pyro- and ferro-electricity. [6]

6. **Liquid Crystals:** Thermotropic liquid crystals, Lyotropic liquid crystals, long range order and order parameter, Various phases of liquid crystals, Effects of electric and magnetic field and applications, Physics of liquid crystal devices. [8]

Text Books:

1. Kittel C., Introduction to Solid State Physics, Wiley, New York, 2005.
2. Kittel C., Quantum Theory of Solids, Wiley, New York, 1987.
3. Ziman J., Principles of the Theory of Solids, Cambridge University Press, 1972.

Reference Books:

1. Ibach H. and Luth H., Solid State Physics, Springer Berlin, 3rd ed. 2002.
2. Walter A. Harrison Solid State Theory, Tata McGraw-Hill, New Delhi, 1970.
3. Chandrasekhar S. Liquid Crystals, Cambridge University, 2nd ed. 1992.
4. Sluckin T.J., The Liquid Crystal Phases, Physics & Technology, Contemporary Physics Taylor & Francis, 2000.

PH 542 **Computational Physics** **3 - 0 - 0 - 3**

1. **Errors analysis and curve fittings:** General formula for errors – Errors of observation and measurement, Empirical formula, Graphical method, Method of averages, Least square fitting, curve fitting, parabola, exponential. Least square curve fittings methods for linear and polynomial functions. [7]

2. **Numerical solution of algebraic and transcendental equations:**

   The bisection method, the iteration method, The method of false position, Newton – Raphson method. [7]

   Linear systems of equations: Direct methods, Gauss elimination method, Gauss–Seidel method.

3. **Interpolation:** Finite differences (Forward, backward and central difference), Newton Interpolation formula, Central difference Interpolation formula, Cubic spline interpolation formula, Newton's interpolation formula for unequal intervals. [8]

4. **Numerical Differentiation and Integration:** Newton's forward and backward difference formula for numerical derivatives, Numerical Integration: the trapezoidal rule and Simpson's rule. [7]

5. **Numerical Solutions of Ordinary and Partial Differential Equations:** Taylor's method, modified Euler's method, second and fourth order Runge-Kutta methods, Predictor-Corrector methods. Finite-difference approximation to derivatives, S.O.R. and Jacobi methods for solving Laplace equations, Parabolic equations and Hyperbolic equations. [10]

Text Books:

1. S.S. Sastry; Introductory Methods of Numerical analysis, PHI New Delhi, 3rd Ed, 2003.
2. E. Balagurusamy; Numerical methods, Tata Mc Graw Hill, New Delhi, 2008.

Reference Books:

1. Erwin Kreyszig; Advanced Engineering Mathematics, 10thed, John Wiley and Sons, 2011.
2. W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling ; Numerical Recipes in C, , Cambridge University, 1996.

PH 552 **Elements of Nuclear and Particle Physics** **3 - 0 - 0 - 3**

1. **Nuclear Properties and Models:** General properties of Nuclei: nuclear size, Rutherford scattering, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magnetic dipole moment and electric quadrupole moment. Liquid drop model, Bethe-Weizs¨acker binding energy/mass formula, Fermi model, Shell model. [6]

2. **Nuclear Two-body Problem:** Properties of deuteron, Schr¨odinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces. Experimental n-p scattering data, Partial wave analysis and phase shifts, scattering length, magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Scattering from molecular hydrogen and determination of singlet and triplet scattering lengths, effective range theory, low energy p-p scattering, Nature of nuclear forces: charge independence, charge symmetry and iso-spin invariance of nuclear forces. [10]

3. **α, β and γ Decay:** α-decay, Gamow theory, Barrier penetration, fine structure of α spectrum. alpha decay, neutrino hypothesis β emission and electron capture, Fermi's theory of allowed β decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment, Gamma decay- Multiple transitions in nuclei- Angular momentum and parity selection rules [8]

4. **Nuclear Reactions and Fission:** Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions — Breit Wigner dispersion relation; Compound nucleus formation and break-up, Statistical theory of nuclear reactions and evaporation probability, Optical model; Principle of detailed balance, Transfer reactions, Nuclear fission and fusion. [8]

5. **Elementary Particle Physics:** Elementary particles: Photons, quarks, baryons, mesons, leptons, hadrons, Elementary idea of quark model. Conservation laws in particle reactions, Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula, C, P, T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic Kinematics. [7]

Text Books:

1. B L Cohen; Concepts of Nuclear Physics, Tata-McGraw Hill, 2008
2. Kenneth S. Krane; Introductory Nuclear Physics, Wiley India Pvt., 1988.
3. I.Kaplan;Nuclear Physics; Addison-Wesley, 1955

Reference Books:

1. S S M Wong; Introductory Nuclear Physics, Wiley, 1998.
2. S.B.Patel; Introductory Nuclear Physics, New Age International, 1991.
3. D.C.Tayal; Nuclear Physics, Himalayan Publishing House, 5th Edition, 2014.
4. R. R. Roy and B. P. Nigam; Nuclear Physics: Theory and Experiments, John Wiley & Sons, 1967.

PH 562 Computational Physics Laboratory **0-0-4-2**

Practical exercises based on 542, 512 and computational methods in Physics

PH 572 Advance Physics Laboratory **0-0-4-2**

Practical exercises based on 522, 532, 552 and related experiments.

PH 611 Semiconductor Physics and Devices 3 - 1 - 0 - 4

1. **Network Theorems:** Thevenin's, Norton's theorem and analysis of equivalent Circuits of networks. [9]

   Power Supplies: Half-Wave, Full-Wave and Bridge rectifiers with Capacitive input, Inductance input and PI filters, Shunt regulated power supplies using Zener diodes, Series regulated power supply. I. C. Voltage regulators.

2. **Transistor Amplifiers:** The CE, CB and CC configurations. Class A, Class B and Class C amplifiers. Low-frequency amplifiers. The transistor hybrid model and the h-parameters for a transistor. Conversion formulae for the h-parameters of the different transistor configurations. Analysis of a transistor CE amplifier at low frequencies using h-parameters. The CE amplifier with un-bypassed emitter resistor. The emitter follower at low frequencies. The emitter-coupled differential amplifier and its characteristics. Low frequency power amplifiers. The push-pull and the complementary - symmetry power amplifiers. Transistor biasing, Self-bias and thermal stability. [10]

3. **BJT and FET:** The BJT at high frequencies – the hybrid – model. Analysis of CE amplifier at high frequencies. Single stage CE amplifier and the gain-bandwidth product. Cascaded amplifiers. The emitter follower at high frequencies. The field effect transistor and its small signal model. The CS and CD amplifiers at low frequencies. Biasing the FET. The CS and CD amplifiers at high frequencies. [7]

4. **Feedback:** The Gain of an amplifier with feedback. General characteristics of negative feedback amplifiers. Stability of feedback amplifiers, The Barkhaussen Criteria. Grain and Phase margins. Compensation. Sinusoidal oscillators: RC oscillators – The Phase shift and the Wien's bridge oscillators. LC oscillators. Frequency stability and the crystal oscillators. [7]

5. **Operational Amplifiers:** Characteristics of an ideal operational amplifier. Applications of operational amplifiers – Inverting and Non-inverting amplifiers. Summing circuits, integration and Differentiation. Waveform generators. [6]

Text Books:

1. Maillman and Halkias, Integrated Electronics, Tata McGraw-Hill 1972.
2. V K Mehta; Principal of Electronics S. Chand and Sons 2008.
3. Donald Neamen; Semiconductor Physics and Devices, McGraw-Hill; 4th ed. 2011.

Reference Books:

1. M K Achuthan and K N Bhat; Fundamental of Semiconductor Devices, TMH 2006.
2. Rolf Enderlein, Norman J. M. Horing; Fundamentals of semiconductor physics and devices, World Scientific Pub, 1997.
3. John D. Ryder & Charles M. Thomson; Electronic Circuits & Systems, PHI Publication, 1976.

PH 621 **Digital Electronics** **3 - 1 - 0 - 4**

1. **Binary Number System:** Binary number system and other codes, binary arithmetic series and parallel processing of bites, logic of the addition operation, logic fundamentals, Boolean theorems, synthesis of Boolean functions, Karnaugh diagram. [8]

2. **Basics of Digital Electronics**: Basics and derived gates: OR gate, AND gate, NOT gate, NAND gate, NOR gate, XOR gate, Boolean identities and logic circuits using gates, Boolean algebra- DeMorgans Theorems, Sum of products and product of sums expressions, Minterm, Maxterm, SOP and POS from truth tables. [10]

3. **Combinational and Sequential Circuits:** Parity checker and generator, Half adders, full adders, Binary adders, decoders, multiplexer, demultiplexer, encoders, ROM and applications, Digital comparator, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and applications, A/D and D/A converters; Microprocessor and microcontroller basics. [12]

4. **Digital Circuits with MOS:** MOSFET, MOS invertors- static inverter, dynamic inverter, two phase inverter, MOS NAND gates, NOR gates, complementary MOSFET technology, CMOS inverter, CMOS NOR gates and NAND gates, MOS shift register and RAM. [9]

Text Books:

1. Malvino & Brown:Principle Of Digital Computer Electronics, 3rd Ed., McGraw-Hill, 1992.
2. Morris Mono: Digital logic Design, 4th edition, PHI, 2006.
3. J. Millman and C.C. Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi, 1991.

Reference Books:

1. Mottershed: Electronics fundamentals and application, 8th edition, PHI, 2009.
2. A.P. Malvino and D.P. Leach, Digital Principles and. Applications, 6thed., TMH, 2003.

PH 631 **Physics of Nano-Materials** **3 - 0 - 0 - 3**

1. **Introduction**: An overview of quantum mechanical concepts related to low dimensional systems. [12]

   Concepts related to Electronic Structure: direct lattice, Reciprocal lattice, Brilloujn zones, Diffraction from 2D structures, Free —electron approximation, periodic boundary Conditions, allowed k values, Fermi energy, density of electronic states for electron gas, Energy bands, Electron statistics, carrier concentration and Fermi level, Direct- and Indirect- gap semiconductors, Lattice matching, Effective mass, Variation of energy bands with alloy compositoin and its exploitation for devices.

2. **Hetrostructures and Electron States**: Hetero junctions, Type I and Type II hetero structures, Classification of Quantum confined systems, Electrons and holes in Quantum wells. Surface to volume ratio in quantum confined systems, Electronic wave functions, energy sub bands and density of electronic states in Quantum wells, Quantum wires, and Quantum dots, Effective mass mismatch in hetero structures. Coupling between Quantum wells, Super lattices, Wave functions and Density of States for super lattices, Unit cell for quantum well, for quantum wire and for quantum dot. [12]

   EXCITONS: Excitons in bulk, in Quantum structures and in hetero structures.

3. **Nanoclusters and Nanoparticles**: Introduction, Particle shape and the surface, Collective surface area, Porosity, Spherical cluster approximation, Metal nanoclusters – Magic numbers, Geometric structures, Electronic structure, Bulk to nanotrasition, Magnetic clusters; Semiconducting nanoparticles; Rare-gas and molecular Clusters. [6]

4. **Carbon nanotubes**: Chiral vector, Chiral angle and the Unit cell for the Carbon nanotubes. [5]

5. Bulk Nanostructurs Materials: Solid disordered nanostructures, Nanostructured crystals, photonic crystals. [4]

Text Books:

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio; Quantum Heterostructures: Microelectronics and Optoelectronics, Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens; Introduction to Nanotechnology, Wiley India, 2003.
3. T. Pradeep; Nano: The essentials, Tata McGraw-Hill, New Delhi, 2007.
4. P. Harrison; Quantum Wells, Wires, and Dots: Theoretical and Computational Physics of Semiconductor Nanostructures, Wiley, 2009.

Reference Books:

1. G. Streetman and S. Banerjee; Solid State Electronic Devices, Prentice Hall of India, 6th Edition, 2005.
2. A. Y. Shik ; Quantum Wells: Physics and Electronics of two-dimensional systems, World Scientific, 1997.
3. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao; Introduction to Nanoscience, CRC Press, 2009.

PH 651 Electronics Laboratory 0-0-4-2

Practical exercises based on 611, 621 related to analog and digital electronics.

PH 641 Ancient Indian Science 2 - 0 - 0 - 2

1. **Reference of Science in Vedas** [3]

2. **SAGE Scientists and Their Achievements:** Baudhayan, Aryabhatta,Brahmgupta, Bhaskaracharya , varahamihira, Mahaviracharya, Acharya Kanad, Varahamihira, Nagarjuna, Acharya Bhardwaj, SusrutaAtreya, Acharya Charak, Patanjali. [8]

   Scientists of modern era: C. V. Raman (1888-1970), S. Ramanujan (1887-1920), J. C. Bose (1858-1937), H. J. Bhabha (1909-1966), V. A. Sarabhai (1919-1970), H. G. Khorana (1922-2011), Harish Chandra (1923 - 1983), S. N. Bose (1894 - 1974)), S. S. Bhatnagar (1894 – 1955), Visvesvaraya (1860 –1962)[, MeghnadSaha (1893–1956) etc.

3. **Discoveries in Astronomy and Physics of Ancient India:** Earth's rotation, Gravity, Speed of light, Lunar Eclipse, Planetary motion, Mechanics, Matter, Magnetism and Optics [5]

4. **Vedic Mathematics**: Algebra & Arithmetic, Geometry, Trigonometry [5]

5. **Chemical and Biological advancement of Ancient India**: Chemistry (Distillation, Caustic Alkali, Cell and Explosives), Metallurgy (Crucible, Furnaces, Air Blowers, Metal Powder, Binder), Botany, Medicine and Pharmacology. [5]

Text Books:

1. Pride of India- A Glimpse into India's Scientific Heritage. SamskritaBharati, New Delhi, 2006.
2. Science in Samskrit, SamskritaBharati, New Delhi, 2007.
3. N. K. Jain; Science and Scientists in India. Kalyani India, Delhi, 2001.
4. Awakening Indians to India, All India ChinmayaYuvaVendra, Central Chinmaya Mission Trust, Mumbai, 2003.

Reference Books:

1. N.K. Jain; History of Science and Scientific Methods. Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi, 1990.
2. S. Soni; India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd., New Delhi, 2006.

PH 612 **Advance Quantum Mechanics** **3 - 1 - 0 - 4**

1. Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission,atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein‟s A and b coefficients and their calculations.Approximation methods: W. K. B. method and its application to barrier penetration.Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential. [10]

2. System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule. [11]

3. Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential , Partial wave method, phase shifts and their importance, scattering by a square well; potential and a perfectly rigid sphere, resonance scattering. [6]

4. Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac‟s relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac‟s theory, negative energy states and their qualitative explanations. [12]

Text Books:

1. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
2. L.I.Schiff; Quantum Mechanics, TMH, 2010.

Reference Books:

1. E. Merzbacher, Quantum Mechanics, Wiley and Sons, 1998
2. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
3. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

4. Pauling, Introduction to Quantum Mechanics, Dover Publication 2008.

PH 622 **Instrumentation and Characterization Techniques** **3 - 0 - 0 - 3**

1. **Imaging Techniques:**

Optical microscopy: Use of polarized light microscopy, Phase contrast microcopy, Interference Microscopy, hot stage microscopy - surface morphology. [2]

Scanning electron microscopy: Basic design of the scanning electron microscopy , Modes of operation, Backscattered electrons, secondary electrons, X-rays – typical forms of contrast, Resolution and contrast, Specimen Preparation, application of SEM. [5]

Transmission electron microscopy: Basic principles, Modes of operation, Specimen preparation, Diffraction in imperfect crystals, Dislocations, precipitates, Structure of Grain boundaries and interface. [4]

Force microscopy: Basic concepts-Interaction force, AFM and the optical lever, force curves, measurements and manipulation, feedback control, different modes of operation, contact non-contact and tapping mode, Imaging and manipulation of samples in air or liquid environments-Imaging soft samples, Applications . [6]

Scanning tunneling microscopy: Principle, Instrumentation, importance of STM for nanostructures, surface and molecular manipulation using STM. [4]

2. **Qualitative and Quantitative analysis**

X-Rays powder diffraction: Single crystal diffraction techniques, Determination of accurate lattice parameters, structure analysis , profile analysis, particle size analysis using Scherer formula. [3]

Thermal analysis methods: Principle and Instrumentation of Thermogravimetry, Differential Thermal Analysis and Differential scanning calorimetry. Electron Energy Loss Spectroscopy; Atom probe field ion microscopy-X-Ray Photoelectron Spectroscopy, X-Ray Characterization, EDAX and WDA analysis, EPMA, ZAP corrections. [7]

Spectroscopic techniques: Introduction to Molecular Spectroscopy and Differences-With Atomic Spectroscopy-Infrared (IR) Spectroscopy and Applications- Microwave Spectroscopy-Raman Spectroscopy and CARS Applications-Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique. [8]

Text Books:

1. Cullity, B. D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
2. Loretto, M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.

Reference Books:

3. Rose, R.M., Shepard, L.A. and Wulff, J., The Structure and Properties of Materials, 2nd Ed., Wiley Eastern Ltd, 2005.

PH 661 **Elements of Nanoscience** **3 - 1 - 0 - 4**

1. **History , Scope and Classes of Nanomaterials:** Pre-nanotechnology, origins of concepts of Nano, Basics and basis of Nanotechnology, Generations and Development, Molecular aspects, Top down and Bottom up approaches, fullerenes: properties of fullerenes [8]

2. **Nanomagnetics**: Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics. [12]

   Quasicrystals: Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

3. **Optical and Vibrational Spectroscopy**: spectroscopy of semiconductor; infrared surface spectroscopy, Raman spectroscopy, Brillouin spectroscopy, luminescence (photoluminescence, thermoluminescence), [7]

4. **Biological Materials**: biological buildings blocks, nucleic acids, biological nanostructures. [6]

5. **Nanomachines and Nanodevices**: MEMS, MEMSs, molecular and super molecular switches. [6]

Text Books:

1. S. Shanmugam; Nanotechnology, MJP Publishers, Chennai, 2010.
2. Guozhong Cao; Nanostructures and Nanomaterials, Imperial College Press, London, 2004.
3. Charles P. Poole, Frank J Owens; Introduction to Nanotechnology, Wiley, 2003.
4. T. Pradeep; Nano: The Essentials, TMGH, New Delhi, 2009.

Reference Books:

1. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

PH 671 **Nano-Fabrication Techniques** **3 - 1 - 0 - 4**

1. **Physical and Chemical Methods:** Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE), Sol-Gel Process — Self-assembly – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Photochemical Synthesis - Sonochemical Routes – Reverse Micelles and Micro emulsions - Combustion Method – Template Process - Chemical Vapor Deposition (CVD) – Metal Oxide Chemical Vapor Deposition (MOCVD) [12]

2. **Optical Lithography:** Introduction - Necessity for a clean room- different types of clean rooms-construction and maintenance of a clean room- Lithography -Optical lithography- Optical projection lithography- Multistage scanners resolution- Photomask- Binary mask- Phase shift mask - Attenuated phase shift masks - alternating phase shift masks - Off axis illumination- Optical proximity correction - Sub resolution assist feature enhancement-Optical immersion lithography- Optical interferometric lithography- Holographic lithography. [9]

   Maskless optical projection lithography - Zone plate array lithography-Extreme ultraviolet lithography.

3. **Electron Beam and Ion Beam Lithography:** Scanning electron-beam lithography- maskless EBL- parallel direct-write e-beam systems-electron beam projection lithography - Scattering with angular limitation projection e-beam lithography- Projection reduction exposure with variable axis immersion lenses. [8]

   Focusing ion beam lithography - Ion projection lithography - Projection focused ion multi-beam - Masked ion beam lithography- Masked ion beam direct structuring- atom lithography.

4. **Nanoimprint Lithography and Soft Lithography**: Nanoimprint lithography (NIL)- NIL- hot embossing- UV-NIL- Soft Lithography- Moulding/Replica moulding: Printing with soft stamps- Edge lithography -Dip-Pen Lithography-set up and working principle. [5]

5. **Etching Techniques**: Reactive Ion etching- RIE reactive ion etching- Magnetically enhanced RIE- IBE Ion beam etching- Other etching techniques. [5]

Text Books:

1. Zheng Cui; Nanofabrication-Principles, Capabilities and Limits, Springer, 2008
2. Guozhong Gao; Nanostructures & Nanomaterials: Synthesis, Properties & Applications, , Imperial College Press, 2004.

Reference Books:

1. K. Suzuki and B W Smith, Microlithography: Science and Technology, 2nd Ed., CRC Press, 2007.
2. M.Ratner, D Ratner. Nanotechnology - A Gentle Introduction to the Next Big Idea, Pearson, 2003.
3. Bhushan, B., Handbook of nanotechnology, 2nd Ed., Springer, 2007.

PH 632 CNT and Sensor Applications 3-1-0-4

1. Structure of CNTs

Allotropes of carbon, Buckminsterfullerene, Fullerene-related carbon nanotubes, Single- and double-walled nanotubes, Catalytically produced carbon nanotubes, Bonding in carbon materials, Vector notation for carbon nanotubes, Unit cells of nanotubes, Symmetry classification of nanotubes, Defects in the hexagonal lattice, The layer structure of multiwalled nanotubes, Theory of nanotube capping, multiwalled nanotubes produced by arc-evaporation, multiwalled nanotubes produced by catalysis, experimental studies: single-walled nanotubes General features Electron diffraction of SWNTs, HRTEM of SWNTs, Scanning tunnelling microscope of SWNTs, Neutron diffraction.

[9]

2. Physical properties of CNTs

Electronic properties of graphite, Electronic properties of nanotubes, Band structure of single-walled tubes, Effect of curvature and of tube–tube interactions, Electron transport in nanotubes, Effect of a magnetic field, Correlation between electronic properties and structure of single-walled nanotubes, Quantum conductance, Electronic properties of nanotubes in a magnetic field, Superconductivity, Mechanical properties of carbon nanotubes, Optical properties of nanotubes, Thermal properties of nanotubes.

[8]

3. Chemistry and biology of CNTs

Covalent functionalization, Functionalization of nanotube ends and defects, Functionalization of sidewalls, Non-covalent functionalization, Characterizing chemically functionalized nanotubes, Biological functionalization, Proteins, Nucleic acids, Toxicity of carbon nanotubes.

[6]

4. Synthesis, Purification and processing of CNTs

Production of multiwalled nanotubes by arc-evaporation, Growth mechanisms of multiwalled nanotubes in the arc, Production of multiwalled nanotubes by high-temperature heat treatments, Production of single-walled nanotubes by arc-evaporation, Production of single-walled nanotubes by laser vaporization, Growth mechanisms of SWNTs in the arc and laser methods, Purification of single-walled and multiwalled tubes, Processing of single-walled and multiwalled nanotubes.

[10]

5. Probes and sensors Applications

Nanotube tips for atomic force microscopy, Preparing nanotube tips: mechanical assembly, Preparing nanotube tips: chemical vapour deposition, Imaging using nanotube AFM tips, Gas sensors, Biosensors, Physical sensors.

[6]

Text Books

1. Applied Physics of Carbon Nanotubes: Fundamentals of Theory, Optics and Transport Devices, Rotkin Slava V. , Subramoney Shekhar, Springer (2005)
2. Aligned Carbon Nanotubes: Physics, Concepts, Fabrication and Devices, Zhifeng Ren, Yucheng Lan, Yang Wang, Springer-Verlag Berlin Heidelberg (2013)

3. Carbon Nanotube and Graphene Device Physics, H.-S. Philip Wong, Deji Akinwande , Cambridge University Press (2011)

Reference Books

1. Carbon Nanotubes – Growth and Applications Edited by Mohammad Naraghi Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia (2011)
2. Carbon nanotubes : properties and applications Edited by Michael J O'Connell, CRC Press (2006)
3. Carbon Meta-Nanotubes: Synthesis, Properties and Applications, Edited by Mark Monthioux, Willey (2011)

PH 642 Nanophotonics 3 - 1 - 0 - 4

1. **Photons and electrons:** Isomorphism of Schrodinger and Helmholtz equations, free space propagation. Confinement of photons and electrons. Bloch waves, reciprocal space, and Brrilouin zones Propagation through well and barriers, Cooperative effects for photons and electrons. [8]

2. **Quantum Confinement Effect:** Quantum confinement effects in solids, nanoscale interaction dynamics, quantum wells, quantum wired, quantum dots, quantum rings. Manifestation of quantum confinement: linear and nonlinear optical properties. [10]

3. **Photonic Crystals**: Basics Concepts, Light in periodic nanostructures, Features of Photonic Crystals, photonic bandgaps, Band gap and band structures in 1-D, 2-D and 3-D photonic lattices. Photonic Crystal Sensors, Microstructure Fibers: Photonic crystal fiber, photonic band gap fibers (PBG), band gap guiding, single mode and multi mode, dispersion and nonlinear effect of Photonic crystal devices using crystal fibers. [12]

4. **Plasmonics:** Optical response of metals, plasmons, shell nanoparticles, metal-dielectric shell nanoparticles, Nonlinear optics with surface plasmons, Plasmon waveguides, Applications of Metallic Nanostructures: nanolasers, nanowire lasers, resonant cavity LED, Metamaterials. [9]

Text Books:

1. Paras N Prasad: Nanophotonics, John Wiley & Sons, 1st edition, NJ, 2004.
2. S V. Gaponenko, Introduction to Nanophotonics, 1st ed., Cambridge University Press, NY, 2010.
3. J D Joannopoulos, R.D. Meade and J.N.Winn: Photonic Crystals: Modelling Flow of Light; 2nd ed. , Princeton University Press, NJ, 2008.

Reference Books:

1. Lukas Novotny and Bert Hecht: Principles of Nano Optic,2nd ed., Cambridge Univ. Press, 2012.
2. J MLourtioz, H Benisty; V Berger, Jean-Michel Gerard: Photonic Crystals: Towards Nanoscale Photonic Devices, 2nd ed., Springer, Berlin 2008.

PH 681 **Advance Opto-Electronics** **3 - 1 - 0 - 4**

1. **Optical Properties of Semiconductors:** Basic of semi-conductors, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, External quantum efficiency, double hetero-junction, fabrication of hetero-junction, Solar cells, photo-resistors quantum wells and super lattices. [6]

2. **Optical Sources:** Current Densities and Injection Efficiency, Injection Luminescence and the Light-Emitting Diode, Spectrum of Injection Luminescence, Selection of Materials for LEDs, Internal/External Quantum Efficiency The Hetero-junction, Surface-Emitting LEDs, Edge-Emitting LEDs, Super-luminescent Diodes, LASER as an amplifier of light and necessary conditions for amplification, special properties of LASER- monochromatic, coherent and light power nature, directionality, divergence and attenuation of LASER beam. Study of three level Laser (Ruby LASER), Study of four level laser (He-Ne laser), semiconductor laser and applications of high power, low power continuous wave and pulse lasers [14]

3. **Light Detectors:** Idea of light detectors and their basic types, Optical Absorption Coefficient and Photocurrent, Quantum Efficiency, Responsivity, Long-Wavelength Cut-off, p-i-n-Photodiode, Avalanche photodiodes (APDs) [4]

4. **Opto-electronic Modulator and Display Devices:** Optical polarization, Electro-optic effect, Longitudinal and Transverse Electro-optic modulator, Acousto-optic effect, Raman-Nath Modulator, Bragg Modulator. Display devices, Photoluminescence, cathodo luminescence, EL display, LED display, drive circuitary, plasma panel display, liquid crystals, properties, LCD displays, numeric displays. [9]

5. **Organic Optoelectronic Devices:** Organic Light-Emitting Diodes (OLEDs), Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs Organic photovoltaic diodes (OPVDs), Exciton absorption, Exciton dissociation ,Charge collection Characterization of OPVDs [6]

Text Books:

1. A. YarivOptical Electronics,4thed, Saunders Collage Press, 1991.
2. A. Ghatak&K.Thyagarajan; Optical Electronics, Cambridge University Press, 1989.
3. R. P. Khare; Fiber Optics and Optoelectronics, Oxford University Press, 2004.
4. Wolfgang Brutting;Physics of Organic Semiconductors, Wiley, 2006.

Reference Books:

1. Pallabh Bhattacharya, Semiconductor Optoelectronics Devices, Prentice Hall; 2nd ed. 1996.
2. A. Roger, Essentials of Optoelectronics, Chapman Hall, 1997.
3. Jasprit Singh, Electronic & Optoelectronic properties of Semiconductor, Cambridge University Press, 2007.

PH 691 **Fiber and Non-linear Optics** **3 - 1 - 0 - 4**

1. **Basic Optics :** Basic optical laws, reflection at plane interface, Brewster angel and total internal reflection, Linear and nonlinear medium, Maxwell's equations, Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides, polarization, dielectric susceptibility, first and higher order susceptibilities. [6]

2. **Optical Fiber Waveguides and Sources:** Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays, evanescent field and Goos-Haechen shift, step index and graded index fibers, single and multi-mode fibers. [5]

3. **Transmission Characteristics of Optical Fibers:** Attenuation , material absorption losses in silica fibers, linear and nonlinear scattering losses, fiber bend loss, mid-infrared and far-infrared transmission, intra-modal and inter-modal dispersion, overall fiber dispersion in multimode and single-mode fibers, modal birefringence. [8]

4. **Fabrication Techniques and Connection of Optical Fibers:** Glass fibers, Preparation of optical fibers, Liquid-phase (melting) and Vapour-phase deposition techniques, characteristics of single-mode, multimode, plastic-clad and all-plastic fibers, Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen absorption, fiber alignment and joint loss, fiber splices, Fiber connectors, Fiber couplers, Sources to Fiber Power launching. [8]

5. **Nonlinear Optical Effects in Fiber and Solitons in Optical Fiber Communication:** Refractive index, frequency and intensity dependent refractive index, group velocity dispersion, self-phase modulation, Kerr effect, chirping, stimulated Raman scattering , stimulated Brillouin scattering, self-steepening, self-focusing, self-defocusing, concept of solitons, formation of solitons, Nonlinear Schrödinger equation for solitons, soliton switching, soliton laser, advantages of soliton based communication. [12]

Text Books:

1. AGhatak and K. Thyagarajan; Introduction to fiber optics, Cambridge University press, 6th ed., 2006.
2. K. Thyagarajan and A Ghatak; Fiber Optic Essentials, , Wiley-IEEE Press, 2007.
3. G. Keiser, Optical Fiber Communications, Mc Graw-Hill, 5th ed., 2013.
4. Govind P. Agrawal, Nonlinear Fiber Optics, Academic Press, 2001

Reference Books:

1. John M. Senior; Optical fiber communications: Principles and practice, PHI, 3rded, 2009.
2. B.B. Laud; Lasers and Non-Linear optics, John Wiley & Sons, 1985.
3. Robert W Boyd; Nonlinear fiber optics, Elsevier, 2nd ed., 2006.

PH 652 **Quantum Optics** **3 - 1 - 0 - 4**

1. **Quantized States of Radiation**: Quantization of the radiation field, quantum harmonic oscillator, the zero-point energy. the connection between the positive and negative frequency parts of the electric field operator; states of the quantized radiation field - single mode number states, thermal states, phase states, the minimal uncertainty states; the coherent and squeezed coherent states. [6]

2. **Semi-classical and Quantum Descriptions of a Radiation Field**: Various definitions of a coherent state: the minimal uncertainty states, the states with classical motion, the displacement operator eigen states etc; the Glauber-Sudarshan P-function, the Q-function and other quasi-probability distribution functions and their use in the semi-classical description of a radiation field; Nonclassical aspects like squeeezing and antibunching and examples of nonclassical states and experimental status. Important experiments in Quantum Optics: Photon counting experiments, Intentsity-intensity correlation - Hanbury-Brown and Twiss experiment. [8]

3. **Classical and Quantum Theories of Optical Coherence**: The concept of an analytic signal, elementary description of stochastic processes, correlation functions and coherence functions; Stationary and ergodic processes, Wiener-Khinchin relations etc. Young's double slit experiment to discuss the conditions on the classical coherence functions and quantum coherence functions for various orders of coherence; higher-order correlations functions etc. [8]

4. **Interaction Between Light and a Two-level Atom**: The Jaynes-Cummings model interaction and the corresponding Hamiltonian - its solution and the expression for the population inversion; the experimental developments; the classical and quantum signatures -collapses and revivals. [6]

5. **Quantum Theory of Laser**: Photon rate equations, threshold conditions, laser photon distribution, fluctuations in laser light and laser phase diffusion. [12]

   Special topics: Spontaneous emission, laser cooling, collective and cooperative effects in the light-atom(s) interaction, quantum beats, the role of quantum optics in the problem of quantum entanglement and quantum information.

Text Books:

1. L. Mandel and E. Wolf; Optical coherence and quantum optics, Cambridge, 1995.
2. M Fox; Quantum Optics, An Introduction, Oxford University Press, 2006.

Reference Books:

1. P. Meystre and M. Sargent; Elements Of Quantum Optics 3Ed, Springer (India) Pvt. Ltd., 2006.

PH 613 Advance Condensed Matter Physics 3 - 1 - 0 - 4

1. **Plasmons, Polaritons and Polarons:** Dielectric function of the electron gas, Plasma optics, Dispersion relation for electromagnetic waves, Transverse optical modes in plasma, Longitudinal plasma oscillations, Plasmons, electrostatic screening, Mott metal-insulator transition, Screening and phonons in metals; Polaritons and LST relation, Electron-electron interaction; Electron –phonon interaction (Polarons). [9]

2. **Optical Properties and Raman Effect in Crystals:** Optical reflectance, Kramers-Kronig relations, Excitons, Frenkelexcitons, weakly bound excitons, Raman Effect in crystals, Electron spectroscopy with X-rays, Energy loss of particles in a solid. [8]

3. **Superconductivity:** Superconductors, Meissner effect, heat capacity, energy gap, isotope effect, London penetration depth, coherence length, BCS theory, Flux quantization in a superconducting ring, Josephson tunnelling. [5]

4. **Magnetic Properties of Solids and Magnetic Resonance:** Langevin diamagnetism, quantum theory of paramagnetism, paramagnetic susceptibility of conduction electrons, ferromagnetic, Curie point, temperature dependence and saturation magnetization at absolute zero, Magnons, Curie temperature and susceptibility of Ferrimagnets, Antiferromagnetics and susceptibility below Neel temperature, Ferromagnetic domains, Nuclear magnetic resonance, line width, hyperfine splitting, electron paramagnetic resonance [12]

5. **Imperfections in crystals and diffusion in solids:** Point, line and surface imperfections, Dislocations; Fick's law of diffusion, Fick's second law, Kirkendall effect, Temperature dependence of diffusion coefficient, determination of diffusion coefficient and activation energy [5]

Text Books:

1. Kittel C, Introduction to Solid State Physics, Willey 7th ed. 2005
2. Hayden W., Moffatt W. G. And Wulff J., Structure and properties of materials, Willey Vol. 3rd.
3. Dekker A., Solid State Physics, Prentice-Hall, 1967

Reference Books:

1. Azaroff L. V., Introduction to Solids, Mc-Graw Hills, 2010
2. Vijaya M. S. And Rangrajan G., Material Science, Tata McGraw Hills, 2006
3. J. R. Hook, H. E. Hall., Solid State Physics, Wiley; 2 edition, 1995.
4. Narula and Gupta, Material Science, Tata McGraw Hills, 2007

PH 623 **Soft Condensed Matter Physics** **3 - 1 - 0 - 4**

1. **Introduction and Review of Statistical Mechanics:** Examples of soft materials in industry and biology, Foams as a lead-off example of macro properties derived from micro, Atomic- and molecular-scale forces and bonds, Repulsion, entropy, hydrophobicity. Probabilities; Boltzmann distribution, Helmholtz energy, Equipartition theorem, Example of pulling RNA and measuring stiffness of a network (experiments). [8]

2. **Van der Waals Forces and Fluctuation-induced forces:** Keesom, Debye, and London contributions, Mean-field models of media, Measurements; list of Hamaker constants, relationship to surface tension, Derjaguin approximation; interaction between spherical particles. Osmotic pressure, Depletion attraction, Repulsion between membranes, Tension in a polymer. [7]

3. **Polymer :** Part A: Survey of types of polymers. Ideal-chain and Freely-jointed chain models.

   Part B: Worm-like chain (Kratky-Porod) model. The spectrum of fluctuations and the stiffness of a single polymer. [4]

4. **Friction in Fluids and The Diffusion Equation:** The Langevin Equation of motion of a particle in fluid. Viscosity and a simple model for its value; terminal velocity; sedimentation. The mean-square displacement, Fluctuation-dissipation theorem. A free particle; an ink spot; diffusion to capture, etc. Particle-hopping model; Fick's law; diffusion with drift. Experimental methods: Dynamic light scattering and the correlation function. Measuring interactions: terminal velocity; g(r); Boltzmann method. [10]

5. **Fluid Interfaces**, **Fluid Dynamics and Electrostatics in Solution (3D):** Surface tension, surfactants and Pickering emulsions. Consequences of a surface tension: LaPlace pressure, Jurin's Law, the Rayleigh instability, the Young-Dupre law and wetting, the shape of a meniscus: the equation of capillarity. Forces among interfacial inclusions (the 'Cheerios Effect'). Assembly of particles at liquid interfaces. [10]

   The Navier-Stokes equation for an isotropic fluid. Reynolds Number, laminar flow, Poiseuille flow, lubrication. Poisson-Boltzmann theory and Debye length Inter-particle forces,

Text Books:

1. Richard A.L Jones., Soft Condensed Matter, Oxford University Press, 1st Edition, 2002.
2. Chaikin P. M. and Lubensky T.C. , Principles of Condensed Matter Physics, Cambridge University Press, 1st Edition 2000

Reference Books:

1. Poon W.C.K. , David Andelman, Soft Condensed Matter Physics in Molecular and Cell Biology, CRC Press, Taylor and Francis Group, 2006

PH 662 **Material Science**

3-1-0-4

1. **Introduction**

   Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern Materials.

   [2]

2. **Phase Diagrams and Phase Transition in materials**

   Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system.

   Solid solutions, Phases, Thermodynamics of solutions, Phase rule, Binary phase diagrams, Binary isomorphous systems, Binary eutectic systems, ternary phase diagrams, kinetics of solid reactions. Order disorder phenomenon in binary alloys, long range order, super lattice, short range order.

   [14]

3. **Elastic,Anelastic and viscoelastic behaviour**: Atomic model of elastic behavior- Rubber like elasticity- Anelastic behavior- Viscoelastic behavior, Spring-Dashpot model.

   [5]

4. **Plastic deformation, Creep and Fracture**

   Plastic deformation - Slip - twinning - Critical resolved shear stress - theoretical shear strength of perfect crystal - role of dislocation in plastic deformation - methods of strengthening crystalline materials - strain hardening - grain size - solid solution strengthening - precipitation strengthening - fibre reinforced materials - whiskers - creep - creep curves - mechanism of creep - creep resistant materials, Ductile, Brittle fracture, Fracture toughness, Ductile-Brittle transition, fatigue fracture, Method of protection against fracture.

   [14]

5. **Oxidation and Corrosion**

   Mechanisms of oxidation, Oxidation resistant materials, Principles of corrosion, Protection against corrosion

   [4]

Text Books:

1. Dekker A J, "Solid State Physics", Macmillan and Co., (2000).
2. Raghavan V, “Materials Science and Engineering: A First Course", 5th Edition, Prentice Hall of India Pvt. Ltd., (2004).
3. Narula G K,Narula K S and Gupta V K,”Material Science”4th Ed.Tata McGraw Hill,(1993).

Reference Books:

1. Callister W D, "Materials Science and Engineering: An Introduction", 7th Edition, John Wiley & Sons, Inc., (2007).
2. James F Shackelford, "Introduction to Materials Science for Engineers", 7th Edition,Pearson Prentice Hall, (2009).
3. Van Vlack L H, "Elements of Materials Science and Engineering", 5th Edition, Addison Wesley, New York, (1989).

PH 672 Smart Materials 3 - 1 - 0 - 4

1. **Smart Materials: An Introduction:** States of matter, atomic structure, chemical bond, oxidation and reduction, aldehydesand ketones, amines and amino acids, lipids, carbohydrates, proteins and Enzymes, Biological Cell structure, Bacteria, Viruses, DNA and heredity , chromosomes, Genes, Study of Smart Materials and their integration into novel designs. Classifies according to their Response and Stimuli ability. Describes the effect of crystalline structures in the properties of piezoelectric materials, magnetostrictive materials, shape memory alloys. [10]

2. **Sensing Elements And Transducers:** Mechanical spring devices, Cantilever, Helical spring, Torsion bars or Shaft; Pressure Sensitive Devices, Bourdon tubes, bellows; Passive and active transducers, Theory of strain gauges, measurement of temperature, Thermocouples, RTDs, Thermistors, LVDT, Capacitive transducers, Hall effect transducers. [12]

3. **Chemical, Gas and optical Sensors:** pH, pH electrode, pH measurement, Humidity, Absolute and relative humidity, measurement of humidity, P-i-n and APD photodetectors, Fiber optic sensor, sensors using CNTs [6]

4. **MEMS and NEMS:** An elementary idea of MEMS, NEMSs, molecular and super molecular switches. [7]

5. **Biosensors:** Insulin therapy, Enzyme electrode, bio receptor molusles, Transduction mechanisms in biosensors. [4]

Text Books:

1. Jasprit Singh, Smart Electronic Materials, Cambridge University Press,2005.
2. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
3. Vinod Kumar Khanna, Nano Sensors, CRC Press, 2012.
4. Helmut Budzier, Gerald Gerlach; Thermal Infrared Sensors, John Wiley & Sons, Ltd, 2011.

Reference Books:

1. Jon S. Wilson, Sensor Technology Handbook, Elsevier, 2005.

2. Pavel Ripka, AloisTipek,Modern Sensors, ISTE, 2007.

Mody University of Science & Technology

Ph.D.

(Effective from Academic Year 2019-20)

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

RM20.711 **Research Methodology** **3-0-2-4**

Course Objectives:

1. To equip students with knowledge, abilities and insight in research methodology and related interdisciplinary fields.
2. To plan and design research using scientific and statistical methods.

1. Introduction to Research: Meaning, nature, purpose and motivation; Types of research – exploratory, descriptive, causal, and analytical; Research process; Definition of construct and variables and types of variables; Bases for choosing a topic; Problem definition; Literature review, Identification of research gap; Formulation of objectives; Signification and relevance of research objectives. **[06]**

2. Research Design and Sampling: Research Design - Meaning, need, features, types, important concepts, developing a research plan. **[06]**
Sampling: Census and Sample Survey, implications and types of sampling, process of sample selection, criteria and characteristics of selecting a good sample.

3. Scaling and Methods of Data Collection: Definition and types of scales, construction of measurement scale, errors, test of sound measurement scale. **[06]**
Methods of data collection: Types, sources and methods (Qualitative and Quantitative).

4. Statistical Tools for Data Analysis*: Measures of central tendency – Mean, Median, Mode, Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness, Correlation – Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests – Chi-Square test. **[09]**

5. Application of Computer in Research*: MS office and its application in Research, Use of Internet in Research – Websites, Search Engines, E-journal and E-Library – INFLIBNET. **MS-Excel:** Data representation, application of inbuilt formulas, formulation of equation using BODMAS rule in MS-Excel. **[06]**

6. Foundation of Research and Report Writing*: Significance and technique of interpretation, importance of report writing, types of reports, structure and components, writing research proposal and synopsis, planning phase of report writing (cauterization), Bibliography, Appendices, referencing, Style Manuals – APA style, MLA style, ASA style, Harvard/IEEE etc), plagiarism, journals, citations and indexing, funding agencies, ethics in research, characteristics of a good research report. **[06]**

Remark: 39 Hours for Lecture and 26 Hours for Practical*.

Course Outcome:

1. Develop the ability to understand and analyse the problems and able to connect the problem with practical and present scenario.
2. Develop the ability to think independently as well as scientifically towards for continuous lifelong learning process.
3. Analyse the situation, convert into problem and find its solution.

Suggested Readings

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill.India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics.Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House(Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami, O. R., Ranganatham M. (2011). Methodology of Research in SocialSciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New AgeInternational (P) Publisher. New Delhi
8. Lambert, Joan , Frye, Curtis D. (2016). Microsoft Office 2016 Step By Step. PHI
9. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd. India
10. Sekaran Uma (2003). Research Methods for Business. Wiley India.
11. Zikmund, Babin, Carr, Griffin (2003). Business Research Methods. Cengage Learning,India.

https://www.proschoolonline.com/blog/top-10-data-analytics-tools

BT 761	Forensic Biotechnology	3-0-0-3
Forensic Serology: General Introduction, Collection, preservation and packing of Biological fluids. Forensic applications of Isozymes and Polymorphic proteins. Introduction to Human Leucocyte Antigen, classification and typing		**[6]**
DNA profiling: Nuclear DNA and Mitochondrial DNA Techniques involved: PCR, Sequencing, RFLP analysis, analysis of STR, SNP Significance of DNA profiling DNA extraction/isolation from different samples, FTA cards, Ethical issues		**[7]**
Forensic Toxicology: Brief Idea of Toxins and Drugs, Extraction, separation and Identification		**[4]**
Wild Life Forensics: Collection, Processing and Examination of forensic artefacts: Pug marks, Horn, Skin, Fur, Hair, Nail and Teeth. Extraction of species specific antigens. Introduction to forensic entomology and forensic microbiology, Wild Life Protection Act		**[9]**
Analytical techniques for forensic applications: Spectroscopy: UV-Visible, NMR and Mass Chromatography: Normal and Reverse Phase, Paper and Column (Gel filteration, Ion exchange and Affinity) Electrophoresis: Agarose, PAGE-1D and 2D, IEF Antigens- Antibody reactions. ELISA, Immuno-electrophoresis, RIA, single diffusion, double diffusion, and rocket electrophoresis Microscopy: Simple and Compound microscope, Phase contrast Microscope, Fluorescent Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM) Centrifugation: Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges		**[13]**
Suggested Readings **Text Book** 1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986). 2. Wilson K and Walker J; Principle and Techniques of Biochemistry and Molecular Biology and Practical Biochemistry, Cambridge University Press **Reference Book** 1. Clark, E.G.C. Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986 2. Brown TA; Gene cloning; Willey-Liss Publications, Singapore. 3. Old & Primrose; Principle of Gene Manipulation; Panima Publications, New Delhi 4. Goldsby et al; Kuby Immunology; Freeman and Company, New York.		

Evaluation Pattern

Course Code	Course Title	Contact Hours per Week	Credits	ETE Duration	Weightage (%)

		L	T	P		Hours	CW	MTE	ETE
BT 761	**Forensic Biotechnology**	3	-	-	3	3	100		

Annexure-VIII

Ph.D. Syllabus

BT 711	**Animal Toxicology**	**3-0-0-3**
	Introduction to the subject, History, Terminology, Disciplines. Basic Principles, Dose, Dose Response, Toxic Effects and Testing methods, Risk Assessment, Exposure Standards and Guidelines. Toxicokinetics: Absorption, Distribution, Biotransformation and elimination of toxic agents Environmental Toxicology, Classification of toxicants, Routes of Exposure, Duration and frequency, category of toxic effects, bio-magnification Cellular Toxicology, Introduction, Effects of toxicant on cell structures, DNA damage Cellular Toxicology, Biochemical disturbance, cellular response and repair Mechanism of Toxicity: Introduction, Dose-response Relationship, Receptor Concept Natural Protection Mechanism: Role of cell organelles, Glutathione Metabolism, Antioxidants Antidotal Therapy: Types and Procedures, free radicals Nanotoxicology: Introduction and Interdisciplinary aspects **Suggested Readings:** 1. Landis WG, Sofield RM, Yu MH. Introduction to Environmental Toxicology, Molecular Substructures to Ecological Landscapes, CRC Press 2. Reviews of Environmental Contamination and Toxicology Springer 3. Worth DJH, Howard G J. Fundamental Toxicology Springer	
Course instructor : Dr. R.S.Chundawat		
Evaluation pattern: End Term Examination of 100 marks		

BT 721	**Plant Microbe Interaction**	**3-0-0-3**
	Introduction: Plant and microbe interaction, Plants as a host environment, The effects of microbes on plant physiology such as effects on photosynthesis, respiration, and the translocation of water and nutrients. Plants defense including structural defenses, biochemical defenses, and the hypersensitive response, Biotechnological perspectives of plant-microbe interaction Plant-Bacteria Interaction: Introduction, Abundance and distribution of bacteria in plants, Epiphytic/Endophytic bacteria, Rhizobacteria, Plant growth-	

	promoting rhizobacteria/bacteria (PGPR/PGPB), Pseudomonads *Bacillus* and as PGPR, Bacteria and plant health, Root nodule formation on legumes by *Rhizobium*spp for nitrogen fixation; other nitrogen fixing systems such as in alder/ *Frankia* and *Azolla*/*Anabaena*, Molecular mechanism of plant growth-promotion and biocontrol by bacteria, Microbial response to plants under habitat-imposed stresses (abiotic and biotic), Pathogenic interactions of bacteria with plants Plant-fungal Interaction: Introduction to fungal biology, Abundance and distribution of fungus in plants (Epiphytic/Endophytic), Mycorrhiza: Ecto, endo and VAM, Survey of fungal diseases important in plant pathology, Diagnostics and preventive measures Plant-virus Interaction: Diversity of plant viruses, Plant diseases caused by virus, Life cycles of plant viruses, Diagnostics and preventive measures Plant-nematode Interaction: Root-knot nematode, role of *Meloidogyne*, Plant health and nematode, Diagnostics and preventive measures **Suggested Readings:** 1. Burns and Slater. Experimental Microbial Ecology, Blackwell Scientific Publications, Oxford 2. Alexander M. Microbial Ecology, John Wiley and Sons 3. Atlas RM and Bartha R. Microbial Ecology: Fundamentals and Principles, Benjamin Cummins, USA	
Course instructor : Dr. D.K.Choudhary		
Evaluation pattern: End Term Examination of 100 marks		

BT 731	**Plant Transgenic Biology**	**3-0-0-3**
	Agrobiology: *Agrobacterium*-plant interaction, T-DNA transfer mechanism, *Agrobacterium* based vectors, Binary and shuttle vectors. Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co -integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Gene silencing, Chloroplast transformation Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance, Plants as Bio-factories, Metabolic engineering of plant secondary metabolites pathways of metabolism Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection.	

	Transgenic animal production, Methods of transgene delivery, Integration of foreign genes and their validation, Gene targeting methods and strategies, Expression of mammalian genes into prokaryotic and eukaryotic cell **Suggested Readings:** 1. Henry RJ. Practical Application of Plant Molecular Biology, Chapman and Hall Publishers 2. Glick and Pasternak.Molecular Biotechnology: Principles and application of Recombinant DNA, ASM Press 3. P.K.Gupta: Elements of Biotechnology, Rastogi and Co. Publishers 4. Freshney I. Culture of Animal Cells, Wiley-Liss. 5. Hafez B, Hafez ESE. Reproduction in Farm Animals, Wiley-Blackwell. 6. Houdebine LM. Transgenic Animals: Generation and Use, CRC Press. 7. Decker J and Reischl U. Molecular Diagnosis of infectious diseases, 2nd Edition, Humana Press	
Course instructor: R.K. Gaur		
Evaluation pattern : End Term Examination of 100 marks		
BT 741	**Biocatalysis and Biotransformation**	**3-0-0-3**
	Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc. Stresses related defense enzymes in plants and animals Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc. **Suggested Readings:** 1. Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press 2. Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press 3. Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford	

	4. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.	
Course instructor: Dr. K.P.Sharma		
Evaluation pattern: End Term Examination of 100 marks		

BT 751	**Environmental Biotechnology**	**3-0-0-3**
	Sources, generation, classification & composition of pollutants;effect on living organism;Persistence and biomagnification of xenobiotic molecules. Biological and Chemical methods for detection ofWastes; Need for management of resources. Biodegradation. Acclimation, detoxification activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Methods in determining biodegradability; Contaminant availability for biodegradation. Microbial degradation of aliphatic and aromatic compounds; Microbial degradation of halogenated and sulfonated compounds; Biodegradation of pesticides. Bioremediation, Constraints, advantages and applications; Types of bioremediation, Bioaugmentation and biostimulation; factors affecting	

	bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol. Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, bioreactors; Phytoremediation. Sources of heavy metal pollution; Microbial interactions with inorganic pollutants - Microbial metal resistance; Microbial transformation; Accumulation and concentration of metals; Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills. **Suggested Readings:** 1. Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition,McGraw-Hill, 2000. 2. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999. 3. K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999. 4. Martin Alexander, Biodegradation and Bioremediation, 2nd edition, Academic Press, 1999. 5. M.N.V. Prasad, Kazimierz Strzalka, Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, Kluwer Academic Publishers, Dordrecht Hardbound, 2002. 6. Baker, K.H and Herson, D.S.BioremediationMcGraw Hill, Inc. New York, 1994. 7. M.V.Levin&Gealt, M.A., Biotreatment of Industrial & Hazardous Waste McGraw Hill. Inc. 1993. 8. Martin Alexander, Biodegradation and Bioremediation (2^{nd}editon). Elsevier Science & Technology. 1999. 9. Raina M. Maier, Ian L. Pepper, Environmental Microbiology. Academic Press. 2001.	
Course instructor: Dr. Pankaj Kumar Jain		
Evaluation pattern: End Term Examination of 100 marks		

MS 711 Advanced Computational Methods and MATLAB 3-1-0-4

Algebraic and Transcendental Equations: General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graeffe's root squaring method, Muller's method, Bairstow iterative method. **[7]**

System of Linear Equations and Boundary Value Problems: Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. Finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method **[8]**

Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations. **[8]**

Elements of MATLAB-I: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. **[8]**

Elements of MATLAB-II: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[8]**

Text Books:

1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd.
2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
3. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.
4. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW	MTE	ETE

MS 711	Advanced Computational Methods and MATLAB	3	1	-	4	3	---	---	100

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
1.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
2.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
3.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
4.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**
5.	**Elements of MATLAB:** Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 3. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 4. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.		
Reference Books: 1. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 2. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.		

3. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education.
4. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
6.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
7.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
8.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
9.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**

10. Elements of MATLAB: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 5. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 6. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 7. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 8. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.	
Reference Books: 5. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 6. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited. 7. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education. 8. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.	

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

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Session 2020-2021

Mody University of Science & Technology

Bachelor of Science (Hons) Psychology

(Effective from Academic Year 2020-21)

B.Sc. (Hons) Psychology
Session 2020-2021 onwards

Programme	**Level:**	**No. of Seats:** 20	**Duration: Three Years (Six Semesters)**
Undergraduate			

Affiliation: The proposed programme shall be governed by the Department of Arts, SLAS, MUST, Lakshmangarh.

Programme Educational Objectives: This course aims at developing an understanding of the growing discipline of psychology and promoting skill based education. An important goal is to facilitate self-discovery in the students and ensure their enthusiastic and effective participation in responding to the needs and challenges of society. The course intends to enable students in developing skills and competencies needed for meeting the challenges and needs of the real world effectively.

At the end of the B.Sc. (Hons.)Psychology program, graduates will be able to:

PO1: Understand and apply the basic theories underlying the human behaviour in everydaylife.

PO2: Recognize, understand, appreciate and respect the complexity of socioculturaland internationaldiversity.

PO3: Transfer learning and psychological knowledge to novel contexts andsituations

PO4: Use curricula for personal-development, emotional and self-regulationskills.

PO5: Imbibe ethical skills during psychological testing, assessment andcounseling.

PSO6: Evolve as a person with positive attributes of non-judgement, empathy, kindness, multicultural sensitivity andresponsibility.

PSO7: Acquire the ability to decide on the future course of study and research in thisfield.

Programme Learning Outcomes

[PSO.1]: To understand the foundational principles and theories of humanbehaviour.

[PSO.2]: Recognise and classify the biological and neural bases of mentalprocesses.

[PSO.3]: Understand, analyse and evaluate individual differences based onvarious perspectives and theories of personality andintelligence.

[PSO.4]: Understand the developmental processes involved in various stages: childhood, adolescence, adulthood and oldage.

[PSO.5]: Identify, classify and diagnose different psychological disorders and examine and apply the different treatment programs for various psychologicaldisorders.

[PSO.6]: Demonstrate the uses of psychological tools and tests to examine the variations in human behaviour in clinical, organizational, and educationalsettings.

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Scope: The students secure following bright opportunities in the allied fields after the completion of under graduate programme in Psychology. Various diploma, master's and doctoral programmes are available across the world for the students looking for higher studies in the field of Psychology. The students after their completion of bachelors program in Psychology have a wide range of career opportunities in various areas such as Social psychology, Clinical psychology, Experimental psychology, Occupational psychology, Child psychology, Educational psychology, etc. They can work as Clinical Psychologists / Educational Psychologists / Industrial Psychologists / Counseling Psychologists / Research psychologists / Social Psychologists / Developmental psychologists. Some of the areas where a psychologist can work are Welfare Organizations, Prisons, Child/ Youth Guidance Centres, Research Establishments, Rehabilitation Centres and so on.

Input Qualification

Student should have passed 10+2 with Science stream, from a recognized Board with proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody Universityshall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [5] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation:Year up-gradation of the student will be as per the University ordinance.

Session 2020-2021 onwards										
B.Sc. (Hons) Psychology			**Year: First**							
	Course Code	Course Title	Contact Hours per week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Autumn Semester	**Core Courses**									
		Psychology								
	PL20.101	Basic Psychological Processes-I	3	-	-	3	3	25	25	50
	PL20.103	Statistical Methods for Psychological Research-I	2	-	-	2	3	25	25	50
	PL20.105	Psychology Laboratory-I	-	-	2	1	3	25	25	50
	PL20.107	Child Psychology	3	1	0	4	3	25	25	50
	PL20.109	Social Psychology	4	1	0	5	3	25	25	50
	Generic Elective Courses (Any one of the following subject)									
	Forensic Science									
	FS20.101	Introduction to Forensic Science and Criminology	3	1	-	4	3	25	25	50
	Zoology									
	BS20.121	Animal Diversity	4	-	-	4	3	25	25	50
	BS20.123	Animal Diversity Laboratory	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Courses									
	EL20.109	Foundation Course in English	2	–	–	2	3	25	25	50
	Skill Enhancement Courses									
	FL-I	Foreign language-I	3	–	–	3	3	25	25	50
	Skill Enhancement Elective Course									
	SF 101	Personal Grooming, Fine Dining Non Credit	-	-	-	1	3	25	25	50
		SUB TOTAL								
		With Forensic Science	17	3	2	`24				
		With Zoology	18	2	6	26				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester	**Core Courses**									
		Psychology								
	PL 20.102	Basic Psychological Processes-II	3	-	-	3	3	25	25	50
	PL 20.104	Statistical Methods for Psychological Research-II	2	-	-	2	3	25	25	50
	PL 20.106	Psychology Laboratory -II	-	-	2	1	3	25	25	50
	PL 20.108	Psychology of Adolescence and Adulthood	3	1	0	4	3	25	25	50
	PL 20.110	Psychology of Relationships	4	1	0	5	3	25	25	50
	Generic Elective Courses (Any **one** of the following subject)									
	Forensic Science									
	FS 20. 102	Crime Scene Investigation	4	1	-	5	3	25	25	50
	FS 20. 104	Crime Scene Investigation Practical	-	-	4	2	3	25	25	50
	Zoology									
	BS20.122	Genetics and Evolutionary Biology	4	-	-	4	3	25	25	50
	BS20.124	Genetics and Evolutionary Biology Laboratory	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Courses									
	EV 20.102	Environmental Studies	4	0	0	4	3	25	25	50
	Skill Enhancement Courses									
	FL-II	Foreign language-II	3	–	–	3	3	25	25	50
	Skill Enhancement Elective Courses									
	SF 102	Social Grooming, Home & Decor and Business Communication (non credit)	0	0	2	1	3	25	25	50
		SUB TOTAL								
		With Forensic Science Practical	22	4	6	29				
		With Zoology	22	2	6	28				

Year: Second										
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
		Psychology								
	PL 20.201	Understanding Psychological Disorders-I	3	-	-	3	3	25	25	50
	PL 20.203	Introduction to Indian Psychological Thought	2	-	-	2	3	25	25	50
	PL 20.205	Psychology Laboratory -III	-	-	2	1	3	25	25	50
	PL 20.207	Biopsychology-I	3	1	0	4	3	25	25	50
	PL 20.209	Schools of Psychology	4	1	0	5	3	25	25	50
	Generic Elective Course (Any one of the following subject)									
	Forensic Science									
	FS20.205	Forensic Anthropology and Personal Identification	4	1	-	5	3	25	25	50
	FS20.207	Forensic Anthropology Practical	-	-	4	2	3	25	25	50
	Zoology									
	BS20.217	Animal Anatomy and Embryology of Vertebrates	4	-	-	4	3	25	25	50
	BS20.219	Animal Anatomy and Embryology Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Mody University Elective (any course from the list)	3	-	-	3		20	80	
	FL-III	Foreign Language-III	3	–	–	3	3	25	25	50
	SF 201	Personal Grooming, Fine Dining and Home Safety (non credit)				1				
		SUB TOTAL								
		With Forensic Science	22	3	6	28				
		With Zoology	22	2	6	27				

Autumn Semester

	Course Code	Course Title	Contact Hours per week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Core Courses									
		Psychology								
	PL 20.202	Understanding Psychological Disorders-II	3	-	-	3	3	25	25	50
	PL 20.204	Psychometrics	2	-	-	2	3	25	25	50
	PL 20.206	Psychology Laboratory -IV	-	-	2	1	3	25	25	50
	PL 20.208	Biopsychology-II	3	1	-	4	3	25	25	50
	PL 20.210	Schools of Psychology	4	1	-	5	3	25	25	50
	Generic Elective Courses (Any one of the following subject)									
	Forensic Science									
	FS 20.202	Forensic Toxicology	4	1	-	5	3	25	25	50
	FS 20.204	Forensic Toxicology Practical	-	-	4	2	3	25	25	50
	Zoology									
	BS20.214	Animal Physiology and Biochemistry	4	-	-	4	3	25	25	50
	BS20.216	Animal Physiology and Biochemistry Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
	FL-IV	Foreign Language-IV	3	–	–	3	3	25	25	50
		Mody University Elective (any course from the list)	3	-	-	3		20	80	
	SF 202	Social Grooming and Professional Skills (non credit)	0	0	2	1	3	25	25	50
		SUB TOTAL								
		With Forensic Science	**19**	**3**	**6**	**28**				
		With Zoology	**19**	**2**	**6**	**27**				

Year: Third										
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
		Psychology								
Autumn Semester	PL 20.301	Educational Psychology	3	0	0	3	3	25	25	50
	PL 20.303	Industrial and Organizational Psychology-I	2	0	0	2	3	25	25	50
	PL 20.305	Psychology Laboratory- V	-	-	2	1	3	25	25	50
	RM20.301	Research Methodology	2	-	-	2	-	25	25	100
	PL 20.307	Project	-	-	-	5	-	-	-	100
	Discipline Specific Elective Courses									
	PL 20.309	Perspectives in Psychology -I	5	1	0	6	3	25	25	50
	PL 20.311	Counseling and Guidance	5	1	0	6	3	25	25	50
	Skill Enhancement Courses									
	FL-V	Foreign Language -V	3	–	–	3	3	25	25	50
		Sub Total				**28**				
		SUB TOTAL								
	GE20.301	Proficiency (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Core Courses									
		Psychology								
	PL 20.302	Cognitive Psychology	3	0	0	3	3	25	25	50
	PL 20.304	Industrial and Organizational Psychology-II	2	0	0	2	3	25	25	50
	PL 20.306	Psychology Laboratory- VI	0	0	2	1	-	-	-	100
	PL 20.308[$]	Project	-	-	-	5	3	-	-	50
	Discipline Specific Elective Courses									
	PL 20.310	Perspectives in Psychology- II	5	1	0	6	3	25	25	50
	PL 20.312	Environmental Psychology	5	1	0	6	3	25	25	50
	Skill Enhancement Courses									
	FL-VI	Foreign Language -VI	3	–	–	3	3	25	25	50
		Sub Total				**26**				
		SUB TOTAL								
	GE20.302	Proficiency (Non credit)				1				

Final Credits Summary								
S.N.	Particulars	Credits Semester wise						
		I	II	III	IV	V	VI	Total
1.	Core Courses	15	15	15	15	13	11	**84**
2.	Discipline Specific Elective Courses					12	12	**24**
3.	Generic Elective Courses	4/6	7/6	7/6	7/6			**24/25**
4.	Ability Enhancement Compulsory Courses	2	4					**06**
5	Skill Enhancement Courses	3	3	6	6	3	3	**24**
Total		24/26	29/28	28/27	28//27	28	26	**163/162**

$CW (Course work) includes teacher assessment, assignments, class /quiz test.
Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

COURSE DESCRIPTION
B. Sc. (Hons) in Psychology
First Year
Autumn Semester

PL 20.101 BASIC PSYCHOLOGICAL PROCESSES-I 3-0-0-3

Course Objective: To introduce students to the basic concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology.	8
Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment.	7
Biological Bases of Behavior: Structure and Organization of the nervous system, function of the brain; Autonomic Nervous system.	8
Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.	7
Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality, Trait and type approaches, Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory, Assessment of personality.	9

Course Outcome:

- Understand the origin of Psychology
- Create awareness of a variety of major issues and theories in psychology.
- Describe the key role that psychology plays in our everyday lives.
- Analyze the scientific method and how it applies to psychological research.
- Evaluate the behavior and personality of individuals with whom they have frequent contact.
- Apply accurate and comprehensive understanding of human behavior and mental life in general.

Text Books:

1 Ciccarelli, K. Saundra: Psychology Pearson, South Asian Edition

2 Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

Reference Books:

1 Atkinson, R. L., Atkinson, R. C., &Hilgard, E. R. Introduction to Psychology. Harcourt Brace Jovanovich, New York.

2 Baron, R. A. Psychology: The Essential Science. Allyn& Bacon, New York.

3 Ajaya, S. (1983). Psychotherapy east and west: A unifying paradigm. Pensylvania: The Himalayan Institute.

4 Misra, G., &Mohanty, A.K. (2002). Perspectives on indigenous psychology .New Delhi Concept.

PL 20.103 STATISTICAL METHODS FOR PSYCHOLOGICAL RESEARCH-I 2-0-0-2

Course Objective: To familiarize students with the use of statistical methods in psychological research and the techniques of descriptive statistics for quantitative research.

Scientific Foundations of Research: Nature of Science and Scientific Method, Meaning and Purpose of Research, Techniques of data collection: Questionnaire, Interview, Observation, Survey, Experimental Method.	5
Problem, Variable and Hypothesis: Nature, Type and Sources. Control of variables	5
Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement.	5
Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks.	6
Measures of Central Tendency: Mean, Median and Mode	5

Course Outcome:

- Understand various methods of research in Psychology.
- Describe the purpose of research.
- Define types of variables.
- Analyze the nature and types of hypotheses.
- Understand the different levels of measurement.
- Apply the concepts like mean, mode and median

Text Books:

1 Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.
2 Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.

Reference Books:

1 Guilford, J. P., &Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.
2 McGuigan, F. J. ExperimentalPsychology. Prentice-Hall of India, New Delhi.
3 Kerlinger, F. N. (1983). Foundations of behavioural research. New Delhi: Surjeet Publications.

4 Minium, E. W., King, B. M., & Bear, G. (1993). Statistical reasoning in psychology and education. New York: John

PL 20.105 PSYCHOLOGY LABORATORY- I 0-0-2-1

Objective: To apply the concepts of psychology in real world.

Any 6 of the following:

1. Sentence Completion Test
2. Maudsley Personality Questionnaire
3. Sodhi's Attitude Scale
4. Parent Child Relationship Scale
5. Family Environment Scale
6. Dimensions of Friendship Scale
7. Serial Position Effect(nonsense syllables)
8. Miller's Span of Attention

Course Outcome:

1 Assess the personality of the subject.

2 Evaluate the attitude of the subject.

3 Measure the family environment of the subject.

4 Measure the attention span of the subject.

5 Analyze, interpret and discuss the report on the basis of results and scores

6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: Psychology Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw-Hill, New Delhi.

PL 20.107 CHILD PSYCHOLOGY 3-1-0-4

Objective: This course is an introduction to child development from conception through adolescence with emphasis on physical, cognitive and psychosocial growth. The effect of environmental and cultural

influences on development will be investigated. Developmental theories will be analyzed and tested through practical applications such as child observations and interviews

Concept of Development: Principles of growth. Maturation and development, Havighurtst's Developmental stages, Theories of Development: Piaget, Vygotsky, Chomsky, Erikson, Kohlberg	10
Determinants of Development: Biological and socio - cultural determinants of development, Methodological approaches: Longitudinal and cross-sectional; Sequential strategies and cohorts. Methods of study: Observation, experimentation, field study, interview and testing.	8
Prenatal and Neonatal Development: Stages and factors affecting it, Developmental Hazards The neonate: Physical characteristics, reflexes, sensory and motor capacities, Hazards of development in neonates.	8
Development during Infancy: Physical growth and motor development; Sensory and perceptual development; Language, emotional and social development, Developmental hazards.	6
Development during Childhood: Cognitive. Social, emotional and moral. Development of self - identity, Hazards of development in childhood.	7

Course Outcome:

1 Define developmental theory and explain how theories are used to understand child behavior and development.
2 Evaluate the effectiveness of theories in terms of their practical applications in parenting and teaching.
3 Illustrate the prenatal and neonatal development period.
4 Analyze the interdependence of the cognitive, psychosocial and physical domains of development.
5 Understand the development during infancy and childhood.
6 Demonstrate knowledge of the physical, social/emotional, cognitive and language development of children, both typical and atypical, in major developmental stages.

Text Books:

1 Hurlock, E. B. (1959). Developmental Psychology: A life span Approach. New Delhi: Tata McGraw Hill.
2 HurLock, E. B. (1967). Child psychology (English Version). New Delhi: Tata McGraw Hill.

Reference Books:

1 Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.
2 Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis

3 Santrock, J. W. Life-Span Development. McGraw-Hill, New York.

4 Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

PL 20.109 **SOCIAL PSYCHOLOGY** **4-1-0-5**

Objective:

- Develop an understanding of the individual in relation to the social world
- Introduce students to the realm of social influence, as to how individuals think, feel and behave in social situations.

Introduction: Nature and Scope of Social Psychology Social Psychology	8
Person Perception: Impression Formation; Impression Management; Attribution with Special References to Self Biases	12
Attitude: Nature, Formation and Change; Measurement, Attitudes as an effective social process.	8
Group Behavior: Structural and functional Properties; Formation; Process, Types, Effectiveness, Group ideology.	12
Other Issues: Terrorism, Poverty, Female infanticide and feticide.	12

Course Outcome:

1 Understand the nature and scope of social psychology.

2 Analyze the major theories, concepts, empirical findings, methods and techniques used in social psychology

3 Apply the knowledge of impression formation in everyday lives.

4 Analyze how psychological theory and empirical research are used to help explain human behavior in individuals and groups.

5 Understand the importance of attitudes.

6 Create awareness regarding social issues.

Text Books:

1 Baron, R.A. and Byrne, D (1994). Social Psychology : Understanding Human Interaction. ND Prentice Hall

2 Feldman, R.S. (1995). Social Psychology : N.J. Prentice Hall.

Reference Books:

1 Brigham, J.C (1991). Social Psychology. NY : Harper Collins.

2 Fisher, R.J (1982). Social Psychology: An Applied Approach. NY: St. Martin's.

3 Hewstone M., Strocbe, W. and Stephenson, G.M. (1996), Introduction to Social Psychology. NY: Blackwell.

4 Taylor, S.E. Peplau, L.A. Sears, D.O. Social Psychology (12th Ed) -Pearson Education.

FS20.101 **INTRODUCTION TO FORENSIC SCIENCE AND CRIMINOLOGY** **3-1-0-4**

Objective: To learn about various aspects of Criminology and Forensic Science

Basics of Criminology, Types of Crime and Criminal Behavior **11**

Definition: Crime, Criminal and Criminology; Criminology as Science, The field and scope of Criminology; Methods and Techniques in Criminology; Victimology; Classification of crimes; Theories of Criminal behavior – classical, positivist, sociological; Concept of a criminal and classification of criminals. Organized crime; White – collar crimes/ Occupational crimes; Murders; Sexual offences; Terrorism; Serial Crimes; Crime against women and children.

Juvenile Delinquency and Punishment **11**

Definition, Types of Juvenile Delinquents ; Classification of Juvenile Delinquents; Factors in Juvenile Delinquency, Custody of juvenile delinquents; Juvenile courts procedure; behavior modification techniques; Preventive Programmes. Concept of punishment, kinds of punishments, capital punishment in India, Introduction to criminal Laws: IEA, IPC and CRPC

Police Administration **10**

State police forces – organisational structure, field establishment; Duties and Responsibilities of the Police, Code of Conduct for the Police; Role of police in regard to criminals and investigation; Police role in the society; Custodial crimes: Complaints against police personnel; Interrogation of suspects and offenders; interviewing the criminals; improving the Police force.

Introduction to Forensic Science and History **10**

Definition, description, principles, concept, need and scope of Forensic Science. Historical aspects of Forensic Science. Broad components of Criminal Justice System; Evidence Applicability in Court; Definition, Various types of evidences, the law of evidence, Expert's testimony and admissibility of scientific evidence in court of Law. Frye case and Duabert standard. Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic

scientists.

Organizational set up of Forensic Science Laboratories in India **10**

Forensic Science Laboratories: Main Authority, Organizational structure of Forensic Science Laboratory – roles and responsibilities, Sections/ Divisions, Services provided. Central Forensic Science Laboratories, State Forensic Science Laboratories, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police Research & Development, Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. Police dogs.

Course Outcome: After studying this paper the students will able to

- Summarize the concept of crime, criminal and criminal behavior
- Categorize various types of crimes and criminals
- Describe the concept of juvenile delinquency and associated challenges
- Summarize the concept of punishment
- Explain police administration and importance of criminal justice system
- Describe forensic science and its history & implementation in India

Text Books

1 Ahuja, Ram, Criminology, Rawat Publication, New Delhi, 2000.
2 Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

Reference Books

1 Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
2 Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.
3 Abaadinsky, H., Organised Crime (2nd Edn.), Nelson – Hall, Chicago, 1998.
4 Adler, F., Mueller, G. O. W. and Laufer, W. S., Crminology, McGraw – Hill, Boston, 1991.

BS20.121 **ANIMAL DIVERSITY** **4-0-0-4**

Objective: To identify different characteristics and classification of various phyla's.

Kingdom Protista **4**

Generalcharactersandclassificationuptoclasses;LocomotoryOrganellesandlocomotioninProtozoa

PhylumPorifera, Cnidaria, Platyhelminthes &Nemathelminthes **12**

Generalcharactersandclassificationuptoclasses;CanalSysteminSycon
Generalcharactersandclassificationuptoclasses;PolymorphisminHydrozoa
Generalcharactersandclassificationuptoclasses;LifehistoryofTaeniasolium

Generalcharactersandclassificationuptoclasses;Lifehistoryof*Ascarislumbricoides*anditsparasiticadaptations

Phylum Annelida **14**

Arthropoda **Mollusc** **Echinoderma**t Generalcharactersandclassificationuptoclasses;Metamerismin*Annelida*;

Generalcharactersandclassificationuptoclasses;VisioninArthropoda,MetamorphosisinInsects.

Generalcharactersandclassificationuptoclasses;Torsioningastropods

General characters and classification up to classes; Water-vascular system in Asteroidea

General features and Phylogeny of Protochordata **14**

General features of Agnatha and classification of cyclostomes up to classes

General features and Classification up to orders; Osmoregulation in Fishes

General features and Classification up to orders; Parental care

General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

Aves & Mammals **8**

GeneralfeaturesandClassificationuptoorders;Flightadaptationsinbirds

Classificationuptoorders;Originofmammals

Course Outcome:

After completion of the course, students would be able to apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.

Note: Classification of Unit1-9 to be followed from "Barnes, R.D. (1982). InvertebrateZoology, VEdition"

Text books

1. RuppertandBarnes,R.D.(2006).InvertebrateZoology,VIIIEdition. HoltSaundersInternationalEdition.
2. Barnes,R.S.K.,Calow,P.,Olive,P.J.W.,Golding,D.W.andSpicer,J.I.(2002).TheInvertebrates:ANewSynthesis,IIIEdition,BlackwellScience

Reference books

3. Young,J.Z.(2004).TheLifeofVertebrates.IIIEdition.Oxforduniversitypress.
4. PoughH.Vertebratelife,VIIIEdition,PearsonInternational.
5. HallB.K.andHallgrimssonB.(2008).Strickberger'sEvolution.IVEdition.JonesandBartlettPublishersInc.

BS20.123 **ANIMAL DIVERSITY LABORATORY** **0-0-4-2**

Objective : To identify anatomical and physiological attributes of each animal group.

1. Studyofthefollowingspecimens: Amoeba,Euglena,Plasmodium,Paramecium,Sycon,Hyalonema,andEuplectella,Obelia,Physalia, Aurelia, Tubipora,Metridium,Taeniasolium,MaleandfemaleAscarislumbricoides,Aphrodite,Nereis,Pheretima,Hirudinaria,Palaemon,Cancer,Limulus,Palamnaeus,Scolopendra,Julus,Periplaneta,Apis,Chiton,Dentalium,Pila,Unio,Loligo,Sepia,Octopus,Pentaceros,Ophiura,Echinus,CucumariaandAntedon,Balanoglossus,Herdmania,Branchiostoma,Petromyzon,Sphyrna,Pristis,Torpedo,Labeo,Exocoetus,Anguilla,Ichthyophis/Ureotyphlus,Salamandra,Bufo,Hyla,Chelone,Hemidactylus,Chamaeleon,Draco,Vipera,Naja,Crocodylus,Gavialis,Anysixcommonbirdsfromdifferentorders,Sorex,Bat,Funambulus,Loris
2. Studyofthefollowingpermanentslides: T.S.andL.S.ofSycon,Studyoflifehistorystagesof Taenia,T.S.ofMaleandfemaleAscaris
3. KeyforIdentificationofpoisonousandnon-poisonoussnakes An"**animalalbum**"containingphotographs,cutouts,withappropriatewriteupabouttheabovementionedtaxa.Differenttaxa/topicsmaybegiventodifferentsetsofstudentsforthispurpose.

Course Outcome:

1 After completion of the course, students would be able to understand animal interactions with the environment and identify the major groups of organisms with an emphasis on animals and classify them within a phylogenetic framework.

EL20.109 **Foundation Course in English** **2-0-0-2**

Objective: Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct) 5

Articles: Definite and Indefinite & omission of articles

Transformation of Sentence Structure: Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative) 5

Correct Usage of Language: Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need) 6

Common Errors in Effective Communication: How to avoid

common sentence – structural errors, vocabulary and pronunciation

Writing Skills: Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing 6

Reading Comprehension: Efficient reading and note taking 4

Course Outcome: The student will be able to:

1 Learn the essentials of English Grammar.
2 Apply the rules of grammar to use flawless English in speech and writing.
3 Analyze, identify and rectify the common errors in speech and writing.
4 Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.
5 Evaluate a piece of writing keeping in mind all the rules of grammar studied.
6 Read and comprehend English

Text Books:

1 Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
2 Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.

Reference Books:

1 Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
2 Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3 Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
4 Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

PL 20.102 BASIC PSYCHOLOGICAL PROCESSES-II 3-0-0-3

Objective: To introduce students to the basic concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. 8

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. 7

Intelligence: Nature, Theories of Intelligence: Factor, Process and Gardener's Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. 7

Memory and Forgetting: Sensory, Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. 7

Motivation and Emotion: Meaning and Nature, Types of Motives: Primary and Secondary, Biogenic and Sociogenic Motives, Intrinsic and 10

Extrinsic Frame Work, Theories of Motivation – Drive Reduction, Arousal, Incentive, Opponent Process, Cognitive and Need Hierarchy; Techniques of Assessment of Motivations; Frustration and Conflict . Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.

Course Outcome:

1 Create a scientific understanding of the mind, brain, behaviour and experience and how they interact with the complex environments in which they exist
2 Understand sensation and perception.
3 Describe thinking processes and concept formation.
4 Understand the concept of memory and forgetting.
5 Describe various human emotions and theories behind them.
6 Analyze the concept of motivation.

Text Books:

1 Ciccarelli, K. Saundra: Psychology Pearson, South Asian Edition
2 Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw- Hill, New Delhi.

Reference Books:

1 Atkinson, R. L., Atkinson, R. C., &Hilgard, E. R. Introductionto Psychology. Harcourt Brace Jovanovich, New York.
2 Baron, R. A. Psychology: The Essential Science. Allyn& Bacon, New York.
3 Zimbardo, P.G., & Weber, A.L. (1997). Psychology. New Yyork: Harper Collins College Publishers.
4 Feldman, R.S. (1998). Understanding Psychology. N.D.: Tata McGraw Hill.

PL 20.104 STATISTICAL METHODS FOR PSYCHOLOGICAL RESEARCH-II 2-0-0-2

Objective: To familiarize students with the use of statistical methods in psychological research and the techniques of descriptive statistics for quantitative research.

Sampling Methods: Probability and Non-Probability Sampling Methods.	5
Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs	5
Measures of Variability: Range, Quartile Deviation and Standard Deviation.	5
Normal Probability Curve: Properties and Applications. Skewness and Kurtosis.	5

Reliability of Statistics: Product Moment Method and Rank Order Method, Chi-Square, t-test: Mean for large and small independent samples,ANOVA. 6

Course Outcome:

1 Understanding sampling methods.

2 Apply different experimental designs in research.

3 Define various measures of variability.

4 Understand normal probability curve.

5 Analyze statistical techniques.

6 Evaluate the use of different statistical techniques.

Text Books:

1 Broota, K. D. Experimental Design in Behavioural Research. Wiley Eastern, New Delhi.

2 Garrett, H. E. Statistics in Psychology and Education. Paragon International Publishers, New Delhi.

Reference Books:

1 Guilford, J. P., &Fruchter. Fundamentals of statistics in Psychology and Education. Kogakusha, Tokyo.

2 McGuigan, F. J. ExperimentalPsychology. Prentice-Hall of India, New Delhi.

3 Kerlinger, F. N. (1983). Foundations of behavioural research. New Delhi: Surjeet Publications.

4 Minium, E. W., King, B. M., & Bear, G. (1993). Statistical reasoning in psychology and education. New York: John

PL 20.106 PSYCHOLOGY LABORATORY- II 0-0-2-1

Objective: To apply the concepts of psychology in real world.

1. Depth Perception
2. Size Constancy
3. Standard Progressive Matrices
4. DBDA
5. 8SQ
6. Muller Lyer Illusion
7. Sociometry

8. Emotional Maturity

Course Outcome:

1 Analyze, interpret and discuss the report on the basis of results and scores

2 Understand the usage of psychological tools in practice.

3 Measure the aptitude of subject

4 Understand the group preference

5 Measure IQ, Emotional maturity

6 Create illusions

Text Books:

1. Manuals of the above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: Psychology Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw- Hill, New Delhi.

PL 20.108 PSYCHOLOGY OF ADOLESCENCE AND ADULTHOOD 3-1-0-4

Objective: To understand the transition from adolescence to adulthood.

Puberty: Characteristics, Criteria and causes of puberty, Body changes at puberty, Effects of puberty changes, Effects of deviant Maturing, Sources of Concern, Hazards of Puberty.	8
Adolescence: Characteristics, Developmental tasks, Physical and psychological changes, Emotionality, Social changes and morality in adolescents, Family relationships in adolescence, Hazards of adolescence.	8
Early Adulthood: Characteristics, Developmental tasks, Changes in interests, Social mobility and sex role adjustments in early adulthood, Vocational and marital adjustments, Adjustment to parenthood, Hazards during early adulthood.	8
Middle Adulthood: Characteristics, Developmental tasks, Adjustment to physical and mental changes, adjustment to changed interests, Social andvocational Adjustments, Adjustments to loss of a spouse, approaching old age and retirement. Hazards of Middle adulthood.	8
Old Age: Characteristics, Developmental tasks, adjustment to physical changes, motor abilities , mental abilities and interests in oldage. Hazards of old age.	7

Course Outcome:

1 Analyze the problems faced by adolescents and emerging adults.

2 Evaluate the goals for healthy development in the adolescent and emerging adult period.

3 Demonstrate an ability to utilize readings, experiences and research to pursue knowledge in some relevant area.

4 Apply the main theories of adolescent and emerging adult development.

5 Analyze the developmental issues facing adolescents and old age people.

6 Understand the adjustment during middle adulthood.

Text Books:

1 Hurlock, E. B. (1959). Developmental Psychology: A life span Approach. New Delhi: Tata McGraw Hill

2 Shaffer, D. R. Developmental Psychology. Brooks &Cole, California. Shaffer, D. R. Developmental Psychology. Brooks &Cole, California.

Reference Books:

1 Berk, L. E. Child Development. Prentice-Hall of India, New Delhi.

2 Kaluger, G. S., &Kaluger, M. F. Human Development: The Span of Life. Times Mirror, St. Louis

3 Santrock, J. W. Life-Span Development. McGraw-Hill, New York.

4 Brodzinky, D.M. Gormly, A.V. &Aniborn. S.R.(1986). Life Span Human Development. New Delhi: DBS Publisher.

PL 20.110 **PSYCHOLOGY OF RELATIONSHIPS** **4-1-0-5**

Objective: To make student aware of different social relationships and how to work effectively with people.

Social Relationships: Nature, Types, Theories (reinforcement, social exchange and cognitive), Social Learning, Situational Learning.	10
Interpersonal Communication: Communication Process; Verbal and Non-verbal Communication; Factors Affecting Communication.	11
Interpersonal Attraction: Nature, theories, affective basis of attraction.	10
Intergroup Relations: Nature, Strategies, Intergroup conflict, Stereotypes and Prejudices – Formation. Maintenance and Change.	10
ProsocialBehaviour: Altruism: diffusion of responsibility, pluristic ignorance, confusion of responsibility, empathy, attribution, emotion and mood, norms and helping.	11

Course Outcome:

1 Understand and apply different theories of social relationships.

2 Analyze the process of communication.

3 Apply the concept of interpersonal attraction.

4 Describe the nature and strategies of intergroup conflict.

5 Understand the concept of stereotype and prejudice.

6 Apply prosocial behavior.

Text Books:

1 Baron, R.A. and Byrne, D (1994). Social Psychology : Understanding Human Interaction. ND Prentice Hall.

2 Feldman, R.S. (1995). Social Psychology : N.J. Prentice Hall.

Reference Books:

1 Snyder, C. R., Lopez, S. J., &Pedrotti, J. T. (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi, India: Sage Pub. Chapter 12: Attachment, love and Flourishing relationships.

2 Durkin, K. (1995). Developmental Social Psychology: From Infancy to Old Age. MA: Blackwell Publishing

3 Gala, J., &Kapadia, S. (2013). Romantic Relationships in Emerging Adulthood: A Developmental Perspective. Psychological Studies. 58(4), 406-418.

4 Taylor, S.E. Peplau, L.A. Sears, D.O. Social Psychology (12th Ed) -Pearson Education.

FS20.102	**CRIME SCENE INVESTIGATION**	**4-1-0-5**
Prerequisite:	To learn about various aspects of crime scene investigation	
Objective:	Basic elements of crime scene investigation. It covers various aspects of crime scene, basic principles, various processes which takes place on a crime scene; evidences & their classification.	**10**
	Types of Crime Scenes Types of crime scenes: Primary, Secondary, Indoor, Outdoor. Role of different agencies involved in crime scene management: Police, Medico legal experts, Judicial officers.	**15**
	Recording the Scene of Crime Barricading of crime scene; Documenting crime scene: Crime scene photography and videography, Crime scene notes. Crime scene sketching: Indoor and outdoor, triangulation method, baseline method, polar coordinate method. Search: definition, objectives, search patterns – Strip method, grid method, zone/quadrant method, spiral method (Inward and outward), wheel method.	**18**
	Physical Evidences Definition, types of physical evidences, Collection, packaging, preservation and forwarding of physical evidences, Chain of custody.	**12**

Crime scene reconstruction **10**

Crime scene reconstruction: Introduction, importance, nature and principles: recognition, identification, individualization and reconstruction, stages: data collection, conjecture, hypothesis formulation, testing, theory formation.

Course Outcome: After studying this paper the students will able to

1 Explain nature and problems of crime scene.
2 Categorize various types of crime scenes.
3 Create crime scene field notes, sketches and photographs.
4 Interpret various types of physical evidences found at a crime scene.
5 Use procedures of crime scene reconstruction.
6 Analyse scene of crime and evidences.

Text Books

1 Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.
2 James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

Reference Books

1 DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
2 W.J. Tilstone (2013), M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton.
5. Pepper, I.K. (2010) Crime Scene Investigation: Methods and Procedures, 2nd Edition, Open University Press.
3. A Scientific Method Approach; Robert C. Shaler, CRC Press, 2012.
4. Crime Reconstruction, W Jerrychisum and Brent and Turvy, Elsevier Academic Press, 2011.
6. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.

CRIME SCENE INVESTIGATION PRACTICAL

FS20.104 **0-0-4-2**

1. Securing the crime scene, clothing, and plan for crime scene management.
2. Demonstration of photography of scene of crime and evidences.
3. Searching and Listing of evidences at indoor crime scene. '
4. Searching and Listing of evidences at outdoor crime scene.
5. Sketching of Crime scene by triangulation method.
6. Sketching of Crime scene by baseline method.

7. Sketching of Crime scene by Polar coordinate method.
8. Evidence collection, preservation, packaging, sealing and labeling of physical evidences.
9. Evidence collection, preservation, packaging, sealing and labeling of biological evidences.
10. Demonstration of reconstruction of scene of crime.

BS20.122 **Genetics and Evolutionary Biology** **4-0-0-4**

Objective: The course gives students a very basic overview of some principles behind these very fundamental areas of biology.

Introduction to Genetics, Mendelian Genetics and its Extension **8**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co- dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance.

Linkage, Crossing Over and Chromosomal Mapping **6**

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

Mutations &Sex Determination **8**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations.

Chromosomal mechanisms, dosage compensation

History of Life, Introduction to Evolutionary Theories, Direct Evidences of Evolution&Processes of Evolutionary Change **16**

Major Events in History of Life

Lamarckism, Darwinism, Neo-Darwinis

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Species Concept, Macro-evolution&Extinction **14**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Macro-evolutionary Principles (example: Darwin's Finches)

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution.

Course Outcome:

1 Students will be able to explain and apply the learnt principles and fundaments of genetics.

Text books:

1. Gardner,E.J.,Simmons,M.J.,Snustad,D.P.(2008).PrinciplesofGenetic

s.VIIIEdition.WileyIndia.
2. Snustad,D.P.,Simmons,M.J.(2009).PrinciplesofGenetics.VEdition.JohnWileyandSonsInc.

Reference Books:

3. Klug,W.S.,Cummings,M.R.,Spencer,C.A. (2012). ConceptsofGenetics. XEdition.BenjaminCummings.
4. Russell,P.J.(2009).Genetics-A Molecular Approach. III Edition. BenjaminCummings.
5. Griffiths,A.J.F.,Wessler,S.R.,Lewontin,R.C.andCarroll,S.B.IntroductiontoGeneticAnalysis.IXEdition.W.H.FreemanandCo.
6. Ridley,M.(2004).Evolution.IIIEdition.BlackwellPublishing
7. Barton, N.H.,Briggs, D.E. G.,Eisen, J.A.,Goldstein,D. B.andPatel,N.H. (2007). Evolution.ColdSpring,HarbourLaboratoryPress.
8. Hall,B.K.andHallgrimsson,B.(2008).Evolution.IVEdition.JonesandBartlettPublishes
9. Campbell,N.A.andReeceJ.B.(2011).Biology.IXEdition,Pearson,Benjamin,Cummins.
10. Douglas,J.Futuyma(1997).EvolutionaryBiology.SinauerAssociates.

BS20.124 Genetics and Evolutionary Biology Laboratory 0-0-4-2

Objective: To understand the basic scientific methods, including data analysis, used in these fields, and be able to carry out simple analyses using empirical population genetics and quantitative genetics data.

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Charts:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

Course Outcome:

1 Student will be able to combine this knowledge to interpret results from studies in population and quantitative genetics.

EV20.102	**Environmental Studies**	**4-0-0-4**
Couse Objective	To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.	
	Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	**9**
	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
	Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
	Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**

	Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	**7**
	Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	**6**
	Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	**5**
Course Outcome	After completion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.	

Suggested Readings
Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer

Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Refence Books:

1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
2. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
3. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
4. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
5. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
6. www.nacwc.nic.in 22.www.opcw.org

PL 20.201 UNDERSTANDING PSYCHOLOGICAL DISORDERS-I 3-0-0-3

Objective: The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information on psychopathology and dispel myths regarding it.

Concept of normality and abnormality: Criteria for determining abnormality, Historical perspectives on abnormal behavior, Research methods in abnormal psychology: Scientific Method, Naturalistic Observation, Correlational Method, Experimental Method, Epidemiological studies, Kinship studies and Case studies	8
Contemporary perspectives Methods of Assessment and Treatment: Biological, Psychodynamic, Behavioristic, Humanistic, Socio-Cultural and Bio-psychosocial perspective; Types of helping professionals, Methods of Treatment by therapies.	7
Stress related Disorders: Stress And Health; Endocrine System, Immune System, General Adaptation Syndrome, Stress and Life Changes, Psychological factors that moderate stress, Adjustment Disorder; Traumatic Stress Disorders; Theoretical perspective and treatment approaches.	8
Anxiety Disorders: Overview, Panic disorder, Phobic disorder, Generalized Anxiety Disorder, Obsessive Compulsive and related disorders, theoretical	8

perspective and treatment approaches.

Mood Disorders: Types: Major Depressive Disorder, Persistent Depressive Disorder, Premenstrual Dysphoric Disorder, Bipolar disorder, Cyclothymic disorder; Causal factors and treatment. 8

Course Outcome:

1 Understand the concepts of normality and abnormality.

2 Define DSM and ICD guidelines.

3 Analyze methods of assessment and treatments.

4 Determine etiology, symptoms, diagnosis and treatment of stress related disorders.

5 Apply etiology, symptoms, diagnosis and treatment of anxiety disorders.

6 Understand etiology, symptoms, diagnosis and treatment of mood disorders.

Text Books:

1 Nevid J.S, Rathus. S.,GreeneB.,Abnormal psychology in a changing world (9th ed). Pearson, US.

2 Kaplan, H.I. Saddock, B.J. and Grebb. J.A. Kaplan, and Saddock. Synopsis of Psychiatry (11th ed) ND: Waverly Press

Reference Books:

1 Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM V). Washington, D.C. : APA Publication.

2 Carson, R.C.; Butcher, J.N., et al..Abnormal Psychology. New Delhi: Pearson Education.

3 Davison, G.C. & Neale, J.M. Abnormal Psychology. New York: Wiley.

4 Sarason, I.G. and Sarason, B.R. Abnormal Psychology: The Problem of Maladaptive Behavior. New Delhi: Pearson Education Inc

PL 20.203 INTRODUCTION TO INDIAN PSYCHOLOGICAL THOUGHT 2-0-0-2

Objective: To introduce students to the basic psychology with reference to Indian context.

Introduction to Indian psychological thought – what is psychology and what could it be: alternative perspectives; what the Indian tradition can contribute: a psychology friendly philosophy; rigorous methods of enquiry in the subjective domain; effective methods for therapy and the harmonious development of the individual and the society; 5

Sri Aurobindo's 4 types of knowledge; stages in experiential learning; self-knowledge for its own sake, for healing, and for developing one‘s potential.

Self and personality: Who am I? – different Indian traditions on the self and the structure of personality; the character and location of the border between self and world; personality types; emotion and attitudes; states of 5

	consciousness and their effect on perception and quality of life. **Individual development** – various determinants of who and how we are; prenatal influences; past impressions and formations during childhood, adolescence and adulthood; Ashramas then and now .	
	Self in action: Self in the social context – relationships with family, friends and partners, social groups, work and the world; relationship with oneself and one's Self; group membership by birth and by choice; roles and hierarchies; shifting identities; positive and negative group-derived values and judgments.	5
	Application of Indian Psychology in Counselling and therapy – Vipassana and mindfulness; Hathayoga-based therapies; The Gita as guide.	5
	Application of Indian Psychology in Education, Organizational behaviour& community work – Gandhi's NaiTalim; Tagore's system of education; Sri Aurobindo's integral education; Gita-based approaches to OB.	6

Course Outcome:

1. Build insight about Indian psychological thoughts.
2. Apply the concept of self and personality on the basis of Indian structure.
3. Understand the Indian approach to relationships.
4. Analyze Yoga and Vipassana as therapy
5. Understand concepts of Gita and associating it to psychology
6. Apply Indian psychology to education, organization and community behavior.

Text Books:

1. Cornelissen, R. M. M., Misra, G., &Varma, S. (Eds.) (2014). Foundations and applications of Indian psychology. New Delhi: Pearson.
2. Hiriyanna, M. (2000). The essentials of Indian philosophy. New Delhi: MotilalBanarsidas Publishers.

Reference Books:

1. Dalal, A. S. (Ed.) (2001). Living within. Pondicherry: Sri Aurobindo Ashram Trust.
2. Cortright, B. (2007). Integral psychology. Albany: State University of New York.
3. Mascaro, J. (1994). The Bhagavad Gita. New Delhi: Penguin Books India.
4. Mascaro, J. (1994). The Upanisads. New Delhi: Penguin Books India.

PL 20.205 **PSYCHOLOGY LABORATORY- III** **0-0-2-1**

Objective: To apply the concepts of psychology in real world.

Any 6 of the following:

1. Stress Inventory

2. Anxiety Scale
3. Aggression Scale
4. Psychological Needs for Counseling Scale
5. Guidance Need Inventory
6. Fear Checklist
7. State- Trait Anxiety
8. Parenting Scale

Course Outcome:

1 Analyze, interpret and discuss the report on the basis of results and scores
2 Understand the usage of psychological tools in practice.
3 Measure anxiety and anger.
4 Measure psychological needs for counseling.
5 Measure stress
6 Analyze types of parenting.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Hiriyanna, M. (2000). The essentials of Indian philosophy. New Delhi: MotilalBanarsidas Publishers.
2. Nevid J.S, Rathus. S.,GreeneB.,Abnormal psychology in a changing world (9th ed). Pearson, US.

PL 20.207 **BIOPSYCHOLOGY-I** **3-1-0-4**

Objective: To explore the biological basis of experience and behaviour. bodily system.

Introduction to Physiological Psychology: Definition, Historical Background, Methods, Approaches.	7
Cell Biology: Structure and Function of Cells	8
Nerve Physiology: Structure and Function of Neuron, Nerve Impulse Transmission (Electrical and Chemical).	9
Central Nervous System: Brain and Spinal Cord; Brain disorders	8

Peripheral Nervous System: Somatic, Autonomic. 7

Course Outcome:

1 Understand the influence of behavior, cognition, and the environment on bodily system.
2 Analyze the neurobiological basis of psychological function and dysfunction.
3 Apply knowledge of central nervous system in relation to human behavior.
4 Understand peripheral nervous system and its relation to human behavior.
5 Describe cell biology and its relation to human behavior.
6 Understand nerve physiology and its effect on psychological issues.

Text Books:

1 Leukel, Francis (1985). Introduction to Physiological Psychology. C.B.S. Publishers and Distributors, New Delhi.
2 Levinthal, C.F. (1996). Introduction to Physiological Psychology. 3rd Ed. Prentice Hall.

Reference Books:

1 M.R. Rosenzweig and A.R. Lieman (1982). Physiological Psychology, D.C. Health and Co. Lexington.
2 Morgan, C.T. (1965) Physiological Psychology, McGraw Hill Inc. New York.
3 Carlson, N. (2000). Psychology of Behavior. Allyn& Bacon.
4 Hay,D.(1985). Essentials of Behavior Genetics. Blackwell Scientific.

PL 20.209 **SCHOOLS OF PSYCHOLOGY-I** **4-1-0-5**

Objective: To develop the understanding of various schools of psychology.

The study of the history of Psychology: Why study the history of psychology, The data of history: Reconstructing the Psychology's past, Contextual forces in Psychology, Philosophical influences and physiological influences on Psychology. 11

Beginning of Scientific Psychology – Wundt, Weber, Fechner, Helmholtz. 11

Associationism: Associationism of S-R, Pavlov, Thorndike, Associationism as a system; criticism. 11

Structuralism : Wundt and Titchener: As a System; criticism. 9

Functionalism : James, Dewey: Functionalism as a system, criticism. 10

Course Outcome:

1 Create knowledge about the origin and history of psychology.

2 Describe the philosophical and physiological influences on psychology.

3 Create insight at the work of people who in the scientific era of psychology.

4 Understand the contribution of associationists'.

5 Analyze the impact of structuralists' work on psychology today.

6 Apply the concepts given by functionalism school.

Text Books:

1 Schultz & Schultz. History of Modern Psychology (10th ed). Wadsworth Cengage Learning.

2 Chaplin, T. Kraweic, T.S. Systems and Theories of psychology. Holt Rinehart and Winston.

Reference Books:

1 Marx, M.H. &Hillix, W.A. (1986). Systems and Theories in Psychology. NY: McGraw Hill.

2 Leahey,T.H.(1994). A History of Modern psychology. N.J. Prentice Hall.

3 Brennan, J.F. (!991). History and Systems of Psychology. N.J.: Prentice Hall.

4 Hall C.S. :Lindzey, G.Theories of Personality. New York : Wiley Eastern Limited.

FS20.205 **FORENSIC ANTHROPOLOGY AND PERSONAL IDENTIFICATION** **4-1-0-5**

Objective: To learn about various aspects of Forensic Anthropology & Forensic Odontology

Significance of Forensic Anthropology **13**

Definition, scope and application of Forensic Anthropology. Study of Human Skeleton. Nature, formation and identification of human bones. Estimation of age, race, sex and stature from skeletal material – skull, pelvis, long bones.

Personal Identification-I **13**

Importance and need for personal identification, cases that will require personal identification.

Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, lips, chin, Darwin's tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of

head, prognathism. Scar marks, occupational marks and tattoo marks.

Human Body physique – classification: Viola, Sheldon, Heath-Carter.

Genetic and congenital anomalies – causes, types, identification and their forensic significance.

Personal Identification-II **12**

Somatometry – measurements of head, face, nose, cheek, ear, hand and foot, body weight, height. Indices - cephalic index, nasal index, cranial index, upper facial index.

Study of burned bones and bone fragments in mass disasters; Establishment of Partial and Complete identity of skeletal material and dead bodies.

Facial Reconstruction **13**

Facial superimposition techniques, Craniofacial superimposition techniques – photographic superimposition. Facial reconstruction and its importance. Importance of tissue depth in facial reconstruction. Use of somatoscopic and craniometric methods in reconstruction.

Forensic Odontology **14**

Development, scope and role of forensic odontology in mass disaster and anthropology. Introduction to human dentition, structure of teeth, Types and functions of teeth and their comparative anatomy. Estimation of age from teeth.

Bite Marks: Types of bite marks; collection and preservation and photography of bite mark evidence, forensic importance of bite marks.

Course Outcome: After studying this paper the students will able to

1 Explain the importance of Forensic Anthropology
2 Assess the age, sex, race and stature of unknown individuals based on anthropological evidence
3 Assess the identity of an unknown individual based on Somatoscopy
4 Assess the identity of an unknown individual based on Somatometry
5 Explain the facial reconstruction process for personal identification
6 Explain the use of Odontology in forensic science

Text Books

1 The Use of Forensic Anthropology by Robert B. Pickering, David Bachman,

CRC Press (2009)
2 Human Body Measurement: Concepts and Applications by S. P. Singh, Promila Mehta; PHI Learning Pvt. Ltd. (2009)

Reference Books

1 Fundamentals of Forensic Anthropology (Advances in Human Biology)-Wiley-Liss (2006) Linda L. Klepinger
2 Steven N. Byers, Introduction to Forensic Anthropology, Routledge, Taylor & Francis Group, [5th Edition] 2017
3 A textbook of Medical Jurisprudence and Toxicology by Dr. Jaising P. Modi; Lexis NexisButterworths (1957); 24th Edition (2012)
4 Max M. Houck and Jay A. Siegel, Fundamentals of Forensic Science [3rd Edition], Academic Press, Oxford, 2015
5 Fisher, B., Techniques of Crime Scene Investigation (6thEdn.) CRC Press, Boca Raton, Florida, 2000
6 James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003
7 Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001
8 Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

FORENSIC ANTHROPOLOGY PRACTICALS

FS20.207 **0-0-4-2**

1. To determine of age from skull and teeth.
2. To determine of sex from skull.
3. To determine sex from pelvis.
4. To study identification and description of bones and their measurements.
5. To investigate the differences between animal and human bones.
6. To perform somatometric measurements on living subjects.
7. To carry out craniometric measurements of human skull.
8. To estimate stature from long bone length.

BS20.217 ANIMAL ANATOMY AND EMBRYOLOGY OF VERTEBRATES 4-0-0-4

Objective: To understand the fascinating world of vertebrates and their embryology.

Integumentary and Skeletal System **7**

Derivatives of integument w.r.t. glands and digital tips, Evolution of visceral

arches

Digestive, Respiratory and Circulatory System **13**

Brief account of alimentary canal and digestive glands, Brief account of Gills, lungs, air sacs and swim bladder, Evolution of heart and aortic arches

Urinogenital, NrevousSystem and Sense Organs **10**

Succession of kidney, Evolution of urinogenital ducts, Comparative account of brain and Types of receptors

Early Embryonic Development **12**

Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

Late Embryonic Development &Control of Development **18**

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

Course Outcome:

1 After completion of the course, students would be able to apply the knowledge of developmental behaviour of animal anatomy and vertebrate's embryology in research.

Text Books:

1. Kardong,K.V.(2005)Vertebrates'ComparativeAnatomy,FunctionandEvolution.IVEdition.McGraw-HillHigherEducation.
2. Kent,G.C.andCarrR.K.(2000).ComparativeAnatomyoftheVertebrates.IXEdition.TheMcGraw-HillCompanies.

Reference Books

3. Hilderbrand,MandGaslowG.E.AnalysisofVertebrateStructure,JohnWileyandSons.
4. Walter,H.E.andSayles,L.P;BiologyofVertebrates,KhoslaPublishingHouse.
5. Gilbert,S.F.(2006).DevelopmentalBiology,VIIIEdition,SinauerAssociates,Inc.,Publishers,Sunderland,Massachusetts,USA.
6. Balinsky,B.I.(2008).AnintroductiontoEmbryology,InternationalThomsonComputerPress.
7. Carlson,BruceM(1996).Patten'sFoundationsofEmbryology,McGrawHill,Inc.

BS20.219 ANIMAL ANATOMY AND EMBRYOLOGY LABORATORY 0-0-4-2

Objective: To become proficient in the experiments related to animal anatomy and embryology.

1. Osteology:
   a) Disarticulated skeleton of fowl and rabbit
   b) Carapace and plastron of turtle /tortoise
   c) Mammalian skulls: One herbivorous and one carnivorous animal.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
4. Study of placental development in humans by ultrasound scans.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Course Outcome:

1 After completion of the course, students would be able to apply the experimental knowledge of animal anatomy and embryology.

PL 20.202 UNDERSTANDING PSYCHOLOGICAL DISORDERS-II 3-0-0-3

Objective: The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information on psychopathology and dispel myths regarding it.

Dissociative Disorders & Psychological Factors Affecting Physical Health: Dissociative Identity Disorder, Dissociative Amnesia, Depersonalization Disorder; Theoretical perspective and treatments. Psychological factors affecting physical health: Headaches, Cardiovascular Disease, Asthma, Cancer and AIDS.	7
Schizophrenia Spectrum Disorder: Course of development, Diagnostic features, Theoretical perspectives, Treatment approaches; Other Schizophrenia Spectrum disorders: Brief Psychotic disorder, Schizophreniform disorder, Delusional disorder, Schizoaffective disorder.	8
Personality Disorders & Impulse Control Disorders: Types: Personality Disorders characterized by odd or eccentric behavior, Schizotypal disorder, Personality disorders characterized by dramatic, emotional or erratic behavior, Antisocial behavior, Personality disorders characterized by Anxious or Fearful behavior; Theoretical perspectives and Treatment. Impulse Control Disorders: Kleptomania, Intermittent Explosive Disorders, Pyromania.	9

	Substance related and Addictive Disorders: Substance use and Abuse, Clarifying terms, Pathways to addiction, Drugs of abuse: Depressants, Stimulants, Hallucinogens. Theoretical perspectives and treatment.	8
	Therapeutic Approaches: Psychodynamic therapies ; Behaviour therapies; Client centered therapy; Cognitive therapies; Indigenous therapies (Yoga, Meditation); Bio-feedback therapy; Prevention and rehabilitation of the mentally ill; Fostering mental health.	7

Course Outcome:

1 Understand etiology, symptoms, cases, diagnosis and treatment of dissociative disorders

2 Describe etiology, symptoms, cases, diagnosis and treatment of personality disorders

3 Apply etiology, symptoms, cases, diagnosis and treatment of impulsive control disorders

4 Analyze etiology, symptoms, cases, diagnosis and treatment of addictive disorders

5 Understand etiology, symptoms, cases, diagnosis and treatment of schizophrenia spectrum disorders

6 Create knowledge of various therapeutic approaches.

Text Books:

1 Nevid J.S, Rathus. S.,GreeneB.,Abnormal psychology in a changing world (9th ed). Pearson, US.

2 Kaplan, H.I. Saddock, B.J. and Grebb. J.A. Kaplan, and Saddock. Synopsis of Psychiatry (11th ed) ND: Waverly Press.

Reference Books:

1 Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM V). Washington, D.C.: APA Publication.

2 Carson, R.C.; Butcher, J.N., et al..Abnormal Psychology. NewDelhi: Pearson Education.

3 Davison, G.C. & Neale, J.M.Abnormal Psychology. New York: Wiley.

4 Sarason, I.G. and Sarason, B.R.Abnormal Psychology: The Problem of Maladaptive Behavior. New Delhi: Pearson Education Inc.

PL 20.204 **PSYCHOMETRICS** **2-0-0-2**

Objective: To provide an advanced understanding of psychometrics and its research applications.

Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.	5
Psychometric properties of tests:Reliability: Meaning, sources of error, methods of estimate, and special problems. **Validity:** meaning, validation procedures, and special problems.	5
Construction and Standardization of Psychological Tests General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for	6

speed test; cross validation.

Personality Tests: Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors. Projective- Rorschach and TAT.	5
Intelligence Tests: WAIS, Raven's Standard and Color progressive Matrices, Bhatia battery.	5

Course Outcome:

1 Evaluate the types, sources and ethics of psychological tests.

2 Create a test: test design, use of factor analysis and item response theory in test development.

3 Analyze observational approaches to personality assessment.

4 Understand Reliability and validity.

5 Analyze problems in testing: fundamental measurement issues, response sets, test bias.

6 Apply critical approaches to the research literature.

Text Books:

1 Aiken, L.R. Psychological Testing and Assessment. Boston: Allyn and Bacon.

2 Anastasi, A. and Urbina, S Psychological Testing. Upper Saddle River (NJ): Prentice Hall.

Reference Books:

1 Freeman, F.S.,Theory and practice of psychological testing. New Delhi :Oxford and IBH.

2 Friedenberg, L.PsychologicalTesting: Design, Analysis and Use,Boston: Allyn and Bacon.

3 Guilford, J.P. Psychometric Methods. New York: McGraw Hill.

4 Weiner, I.B. Clinical methods in psychology. New York: Wiley inter science publication.

PL 20.206 PSYCHOLOGY LABORATORY- IV 0-0-2-1

Objective: To apply the concept of psychology in real world.

Any 6 of the following:

1. Big Five Personality Test
2. Rorschach Inkblot Test
3. Thematic Apperception Test
4. Bhatia Battery

5. Eyesenck Personality Questionnaire (Revised)
6. Defense Mechanism Inventory
7. 16 PF
8. Home Environment Inventory

Course Outcome:

1 Analyze, interpret and discuss the report on the basis of results and scores
2 Understand the usage of psychological tools in practice.
3 Analyze very famous personality tests.
4 Measure personality through protective techniques.
5 Measure IQ through protective techniques.
6 Understand the norms of psychological tests.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Aiken, L.R. Psychological Testing and Assessment. Boston: Allyn and Bacon.
2. Kaplan, H.I. Saddock, B.J. and Grebb. J.A. Kaplan, and Saddock. Synopsis of Psychiatry (11th ed) ND: Waverly Press.

PL 20.208 **BIOPSYCHOLOGY-II** **3-1-0-4**

Objective: To explore the biological basis of experience and behaviour. bodily system.

States of Consciousness : Overview, Physiological and psychological states, Sleep and activation, sleep theories, Sleep Cycle, Dreaming and Circadian Rhythm.	7
Motivation and Emotion: Overview, Specific motives, Characteristics of drives and motives, Regulation of thirst , hunger and sex drive; Approaches to emotion, Theories, Neural mechanism in emotion.	8
Learning and Language: Overview, Locus of the memory trace; Language and brain, Learning and memory; Biofeedback, Types of conditioning and time course of brain activity in learning, Hologram model.	8
Audition and Vision: Anatomy of auditory and visual mechanism, Auditory defects, Complex auditory phenomena: aural harmonics, masking, after sensations, speech and localizations; Nervous	8

connection of the eye, color vision theory, duplicity theory, electroretinogram, Response of cerebral cortex to visual information.

Science of Genetics : Mitosis; Meiosis; Mendel's Law, Linkage and Cross Over. Introduction to the theory of evolution by Darwin, Human Behavior, Genetic Analysis (Family and Twin Methods). Inheritance of Intelligence and Psychopathology (mood disorder) in Humans. 8

Course Outcome:

1 Understand the concept of sleep.

2 Analyze neural mechanism of emotions.

3 Create knowledge about relationship between language and brain.

4 Describe effect of learning on memory.

5 Apply anatomy of auditory and visual mechanism.

6 Evaluate the science of genetics.

Text Books:

1 Leukel, Francis (1985). Introduction to Physiological Psychology. C.B.S. Publishers and Distributors, New Delhi.

2 Levinthal, C.F. (1996). Introduction to Physiological Psychology. 3rd Ed. Prentice Hall

Reference Books:

1 M.R. Rosenzweig and A.R. Lieman (1982). Physiological Psychology, D.C. Health and Co. Lexington.

2 Morgan, C.T. (1965) Physiological Psychology, McGraw Hill Inc. New York.

3 Hay, D. (1985). Essentials of Behavior Genetics. Blackwell Scientific

4 Strickberger, M.W. (1993). Genetics. McMillan

PL 20.210 **SCHOOLS OF PSYCHOLOGY-II** **4-1-0-5**

Objective: To develop the understanding of various schools of psychology.

Behaviorism : Watson, Skinner, Behaviorism as a System, criticism 10

Gestalt Psychology : Antecedents of Gestalt Movement, Berlin and Leipzig School, Gestalt Psychology as a system. Criticism. 12

Psychoanalysis : Freud, Adler, Jung 10

Neo Freudians : Horney, Fromm, Sullivan 10

Dynamic Psychology : Woodworth and McDougall 10

Course Outcome:

1 Create insight of the contribution of behaviorists'.

2 Understand the importance of the work of gestalt psychology school.

3 Develop knowledge of the work of Sigmund Freud.

4 Apply Psychoanalysis.

5 Analyze the role of neo Freudians in psychology.

6 Evaluate contribution of Woodworth and McDougall.

Text Books:

1 Schultz & Schultz. History of Modern Psychology (10th ed). Wadsworth Cengage Learning.

2 Chaplin, T. Kraweic, T.S. Systems and Theories of psychology. Holt Rinehart and Winston.

Reference Books:

1 Marx, M.H. &Hillix, W.A. (1986). Systems and Theories in Psychology. NY: McGraw Hill.

2 Leahey,T.H.(1994). A History of Modern psychology. N.J. Prentice Hall.

3 Brennan, J.F. (!991). History and Systems of Psychology. N.J.: Prentice Hall.

4 Hall C.S. :Lindzey, G. Theories of Personality. New York : Wiley Eastern Limited.

FS20.202 **FORENSIC TOXICOLOGY** **4-1-0-5**

Objective: To learn about various aspects of Forensic Toxicology

Unit 1 **Toxicology and Drugs of Abuse** 13

Definition, dosage, administration of poisons, Classification of poisons on analytical basis and medical basis; Sedatives, Narcotics, Stimulants and Hallucinogens, Drug Addiction and its signs and symptoms, Drug Toxicity; Drugs and Crime; NDPS Act, 1985; The role of drug recognition expert, Interpreting drug findings

Unit 2 **Toxicology of Alcohol** 13

Introduction to Forensic Pharmacology, Pharmacodynamics and Pharmacokinetics; Fate of ethyl alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, analysis of blood for alcohol

Unit 3 **Metallic Poisons, Barbiturates and Corrosive Poisons** 13

Arsenic, Mercury: Nature, administration, symptoms,

	postmortem findings, Detection and medicolegal aspects; Barbiturates: Classification, administration, symptoms, postmortem findings, detection and medico-legal aspects; Corrosive poisons: Acids- HCl, H_2SO_4, HNO_3 and Alkalis- NaOH, KOH	
Unit 4	**Insecticides, Volatile Poisons**	13
	Organophosphorous compounds, Organochloro Compounds and Carbamates: Nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal findings; Volatile Poisons: Methyl alcohol, Chloroform. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings	
Unit 5	**Miscellaneous Poisons**	13
	Animal poisons: Snake; Vegetable Poisons: Opium, Cannabis, Dhatura, Oleander, Abrusprecatrious, etc. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings	

Course Outcome:

1. Explain the effects of various types of drugs on human body
2. Describe the toxicology of ethyl alcohol and its detection
3. Describe the toxicology of metallic poisons, barbiturates and corrosive poisons
4. Describe the toxicology of various categories of insecticides and volatile poisons
5. Describe the toxicology of animal and plant poisons
6. Analyze the cases of poisoning on the basis of laboratory, clinical and postmortem findings

Text Books

1. A Textbook of Modern Toxicology 4th ed. - Ernest Hodgson Wiley [2010]
2. Textbook of Forensic Medicine and Toxicology, P C Dikshit, Peepee publishers and distributors (P) Ltd. [2010]

Reference Books

1. Clarke's Analytical Forensic Toxicology – Edited by Sue Jickells and Adam Negrusz; Pharmaceutical Press [2008]
2. PRINCIPLES OF TOXICOLOGY Environmental and Industrial Applications, 2nd ed., Edited by Phillip L. Williams, Robert C. James and Stephen M. Roberts; Wiley [2000]
3. Benjamin, D. M., Forensic Pharmacology. In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentic-Hall, Englewood Cliffs, New Jersey, 1993
4. Caplan, Y. H., The Determination of Alcohol in Blood and Breath, In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, New Jersey, 1982
5. Karch, S. B., The Pathology of Drug Abuse. (2ndEdn.) CRC Press, Boca Raton, Florida, 1996

FORENSIC TOXICOLOGY PRACTICAL

FS20.204 **0-0-4-2**

1. Analysis of metallic poisons
2. Analysis of volatile and non-volatile poisons
3. TLC of insecticides, Barbiturates and other drugs
4. Analysis of vegetable poisons
5. TLC of different kinds of inks
6. Lab Tests for Hallucinogens

BS20.214 **ANIMAL PHYSIOLOGY AND BIOCHEMISTRY** **4-0-0-4**

Objective: To acquire the knowledge of the animal cell behaviour.

Nerve and muscle **7**

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Digestion Respiration&Excretion **16**

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Cardiovascular system Reproduction and Endocrine Glands **14**

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle

Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

Carbohydrate, Lipid & Protein Metabolism **8**

Glycolysis, Kreb's cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Enzymes **7**

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

Course Outcome:

1 After completion of the course, students would be able to apply the knowledge of biochemical and physiological aspects of animals in practical field.

Text Books

1. Tortora,G.J.andDerrickson,B.H.(2009).PrinciplesofAnatomyandPhysiology,XIIEdition,JohnWiley&Sons,Inc.
2. Widmaier,E.P., Raff,H.andStrang,K.T.(2008)Vander's HumanPhysiology, XIEdition.,McGrawHill

Reference Books

3. Guyton,A.C.andHall,J.E.(2011). Textbookof Medical Physiology,XIIEdition,HarcourtAsiaPvt.Ltd/W.B.SaundersCompany
4. Berg,J.M.,Tymoczko,J.L.andStryer,L.(2006).Biochemistry.VIEdition.W. HFreemanandCo.
5. Nelson,D.L.,Cox,M.M.andLehninger,A.L.(2009).PrinciplesofBiochemistry.IVEdition.W.H.FreemanandCo.
6. Murray,R.K., Granner,D.K.,Mayes,P.A.andRodwell, V.W.(2009). Harper'sIllustratedBiochemistry.XXVIIIEdition.LangeMedicalBooks/McGraw3Hill.

BS20.216 ANIMAL PHYSIOLOGY AND BIOCHEMISTRY LABORATORY 0-0-4-2

Objective: To gain the acquaintance of latest laboratory technology towards cell animal physiology and biochemistry.

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
5. Estimation of total protein in given solutions by Lowry's method.
6. Study of activity of salivary amylase under optimum conditions.

Course Outcome:

1 After completion of the course, students would be able to apply the knowledge of conduction of successful laboratory experiments.

PL 20.301 EDUCATIONAL PSYCHOLOGY 3-0-0-3

Objective: To understand the applications of psychology in the area of education.

Introduction to Educational Psychology: Nature, scope & relevance of Educational Psychology, professional knowledge and skills of effective teaching	6
Conceptual and Theoretical Perspectives in Educational Psychology: Information-Processing approach, Behavioral and Social Cognitive approaches, Social Constructivist approach.	9
Human Diversity and Education: Intelligence & Creativity, Learning & thinking styles, Personality and Temperament; Socio-Cultural diversity- culture & ethnicity, multicultural education and gender.	10
Classroom Management: Classroom management issues, designing physical environment of classroom, creating positive environment for learning, being a good communicator, dealing with problem behaviours, technology and education.	8
Exceptionality and Special Education: Conceptualizing Exceptionality: Categorization, Labelling and its educational implications; Responsibilities of Teachers towards learners with Special Needs.	6

Course Outcome:

1. Explain the meaning, scope and functions of concepts of education and psychology.
2. Analyze the fundamentals of development.
3. Create knowledge of different approaches.
4. Understand role of an educational psychologist in learning environment.
5. Recognize the difficulties and benefits that can arise from the application of diagnostic labels.
6. Understand the responsibilities of teacher towards special children.

Text Books:

1. Santrock John W. (2010) Educational Psychology, Inwin Professional Publishers, Delhi.
2. Sternberg R. J. Williams W.M., (2010) Educational Psychology (2nd Edition), Pearson Publications.

Reference Books:

1. Lahey R.B. Graham J. E., (2000) An Introduction to Educational Psychology, 6th Ed., Tata McGraw Hill Publishers, New Delhi
2. Slavin, R. (2008). Educational psychology: Theory into practice, (9th ed.). Boston: Allyn and Bacon.
3. Woolfolk Anita (2004) Educational Psychology, 9th Edition, Alyyn and Bacon, Boston.

4 Woolfolk Anita &Woolfolk Hoy Anita (2008) Educational Psychology, Pearson, New Delhi.

PL20.303 INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY-I 2-0-0-2

Objective: To develop an awareness of the concepts related to organizational behavior.

Industrial/Organizational Psychology: Nature, historical development and scope.	5
Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.	6
Training of Personnel: Nature, Principles and Methods: On the job and of the job training methods. Evaluation of training programme.	5
Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal	5
Work environment: Noise, atmospheric conditions. Illumination and performance.	5

Course Outcome:

1 Develop connectivity between concepts and practices of organizations.

2 Describe major topics and subspecialties including critical theory and research finding that have defined the field of I/O psychology

3 Measure personnel performance through different criteria.

4 Apply procedures and assessment methods for personnel selection.

5 Understand work environment.

6 Analyze effect of working environment of performance.

Text Books:

1 Blumm M.L. &Nylor, J.C. Industrial Psychology. N.Y : Harper & Row.

2 Dunnet, M.D. Handbook of Industrial and Organizational Psychology. Chicago :Raud McNally.

Reference Books:

1 Ganguli, H.C.The Industrial worker Psychological Studies. Delhi :Siddharth.

2 Ghiselli, E.E. and Brown C.W. Personnel and Industrial Psychology : McGraw Hill.

3 Hersay, R.E. and Blanchard, T.The Management of organizational behaviour,New Delhi : Prentice Hall

4 Luthans. F. Organizational Behaviour. New York :McGraw Hill.

PL 20.305 **PSYCHOLOGY LABORATORY- V** **0-0-2-1**

Objective: To apply the concept of psychology in real world.

Any 6 of the following:

1. Leader Behavior Scale
2. Occupational Stress Inventory
3. Work Motivation Questionnaire
4. Happiness Scale
5. General Wellbeing Scale
6. Teacher's Job Satisfaction Scale
7. Multiphasic Interest Inventory
8. Koh's Block Design

Course Outcome:

1 Analyze, interpret and discuss the report on the basis of results and scores

2 Understand the usage of psychological tools in practice.

3 Measure wellbeing and happiness.

4 Understand job satisfaction by measuring it.

5 Analyze aptitude and interest.

6 Apply psychological tools in organizations.

Text Books:

1. Manuals of the above mentioned psychological tools.

Reference Books:

1. Blumm M.L. &Nylor, J.C. Industrial Psychology. N.Y : Harper & Row.
2. Santrock John W. (2010) Educational Psychology, Inwin Professional Publishers, Delhi.

RM20.301 **Research Methodology** **2-0-0-2**

Objective: To acquire fundamental knowledge research methodology and apply in liberal arts, sciences and applied sciences.

Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, **05**

Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	
Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation - Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of research methodology in liberal arts, sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Suggested Readings:

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

PL 20.307 **PROJECT** **0-0-0-5**

Objective: Students should be enabled to design and conduct an original and ethical research. They should be able to write a dissertation in the APA format. The research done can either be empirical/data based (quantitative, qualitative, or mixed-methods) or it can be in the form of a critical review of research and theory.

Course Outcome:

1 Enhance the ability of the student to use their knowledge of research, statistics, and evaluation methods to inform all areas of practice, from choosing appropriate methods for collecting information to making recommendations for interventions based on empirical evidence.
2 Formulate and identify null and alternative hypotheses in research
3 Define and give examples of independent variables, dependent variables, and scales of measurement.
4 Generate and interpret various types of graphical displays and tables from research data.
5 Differentiate between descriptive and inferential statistics
6 Analyze data using statistical software (SPSS)

Reference Books:

1 Latest APA manual for dissertation.

PL 20.309 **PERSPECTIVES IN PSYCHOLOGY- I** **5-1-0-6**

Objective: To understand different applications of psychology.

Introduction: Nature, Fields of applied psychology, Role of applied psychologist; Trends of Psychology in the 21st century	12
Psycho-oncology: Understanding cancer, emergence of psycho-oncology, role of psycho-oncologists, psychosocial issues, psychosocial screening, communication and interpersonal skills in psycho-oncology, psychological interventions used in cancer care.	13
Community Psychology: Definition of community psychology; types of communities; models; core values (Individual and family wellness; sense of community; respect for human diversity; social justice; empowerment and citizen participation; collaboration and community strengths); process of community organization for health promotion; Community program for: child and maternal health, physical challenged and old age in the Indian context.	14
Health & Wellbeing- Components of health, characteristics, barriers and theories of health behavior, health enhancing behaviors (exercise, nutrition, safety, pain, stress management), happiness, life satisfaction, resilience, hope and optimism.	13

Youth, Gender and Identity: Transition to Adulthood , Sexual Orientation, Gender Roles; youth and identity (family, peer group, workplace identity and relationships); Gender and Identity (issues of sexuality in youth, gender discrimination); issues related to youth, gender & violence, women empowerment, encouraging non-gender stereotyped attitudes in youth. 13

Course Outcome:

1 Understand the nature and importance of applied psychology.

2 Create awareness regarding the field of psyco-oncology.

3 Analyze the role of community psychologist.

4 Describe the contribution of psychologists in the area of health and wellbeing.

5 Understand work of psychologists towards gender and identity.

6 Apply knowledge to help and understand youth.

Text Books:

1 Anastasi, A. Fields of Applied Psychology. Tata McGraw-Hill, New Delhi.
2 Goldstein, A. P., & Krasner, B. Modern Applied Psychology. Pergmon Press, New York.

Reference Books:

1 Baron, R.A., Byrne, D. &Bhardwaj.G (2010). Social Psychology (12th Ed).New Delhi: Pearson.
2 Bartlett, S., & Burton, D. (2012). Introduction to education studies. London: Sage.
3 Berk, L. E. (2010).Child Development (9th Ed.). New Delhi: Prentice Hall.
4 Cohen, L.M., McChargue, D.E., & Collins, F.J. (2003). The Health PsychologyHandbook. New Delhi: Sage Publications.
5 Kloos B. Hill, J Thomas, Wandersman A, Elias M.J. & Dalton J.H. (2012). Community Psychology: Linking Individuals and Communities, Wadsworth Cengage Learning.
6 Long, M. (2000). The Psychology of Education. Sussex: Routledge.
7 Singh, R., &Shyam, R. (2007). Psychology of Well Being. New Delhi : Global Vision Publishing House

PL 20.311 **COUNSELING AND GUIDANCE** **5-1-0-6**

Objective: To develop an understanding of basic concepts, processes, and techniques of Counseling.

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational. 12

Counseling: Definition, Nature, Goals; Necessary personal characteristics/qualities of effective counselors; Counseling as a profession: professional ethics (Latest version of American Counseling Association – ACA); status of counseling psychology in 13

India.

Counseling approaches: Psychoanalytic techniques; Humanistic techniques; Behavioral techniques; Cognitive techniques; Indian techniques: Yoga and Meditation.	14
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.	13
Areas of Counseling: Child, career, family and marital gerontological and weaker sections; Stress management oriented counseling; Crisis Intervention: suicide, grief, and sexual abuse.	13

Course Outcome:

1. Create the learner with the challenges of Counseling.
2. Understand the concepts of guidance and counseling.
3. Apply counseling approaches to real life counseling.
4. Analyze step wise guide to counseling.
5. Create awareness of the ethics of a professional counselor.
6. Understand different areas where counselors work.

Text Books:

1. Gladding, T. Samuel. Counselling: A Comprehensive Profession. Prentice-Hall, New Jersey.
2. Bhatnagar, Asha, Guidance and Counselling, Vikas Publishing House pvt. Ltd

Reference Books:

1. Jones. A.J., Principal of Guidance, McGraw Hill, N.Y.
2. Psricha, Guidance and Counselling in Indian education, New Delhi, NCERT.
3. Mayers, G.E., Principles and Techinques of Vocational Guidance, McGraw Hill, N.Y.
4. Nelson-Jones, R. (1994). Handbook of Counselling Psychology.London : Sage.

PL 20.302 **COGNITIVE PSYCHOLOGY** **3-0-0-3**

Objective: To give students knowledge of the most important concepts, themes, problems and empirical research in modern cognitive theory as it concerns how we receive, interpret, edit, use and save information.

Introduction to Cognitive Psychology: Definition, philosophical and psychological antecedents, Research methods, Fundamental ideas in cognitive psychology.	7
Memory: Models of memory, Exceptional memory and neuropsychology; Memory processes: Encoding and transfer of	8

information, Retrieval, Process of Forgetting and memory distortion; Mental images, maps and propositions.

Language: Properties of language: basic components of words and sentences; Language comprehension: Understanding words, semantics and syntax; Language and thought; Neuropsychology of language — 8

Problem Solving and Creativity: Problem solving cycle, types of problems, Obstacles and aids to problem solving; Creativity: characteristics of creative people, neuroscience and creativity. — 9

Decision Making and Reasoning: Judgment and Decision making, Neuroscience of Decision Making, Deductive Reasoning, Inductive Reasoning, Neuroscience of Reasoning. — 7

Course Outcome:

1 Understand how human cognition works from attention, sensation, perception, action, language processes, problem solving and thinking to learning and memory.
2 Describe key methods used in modern cognitive psychology research.
3 Analyze and discuss scientific issues within the subject area.
4 Evaluate the neuropsychology of language.
5 Create a scientific attitude towards neuroscience of decision making and reasoning.
6 Understand the concept of memory.

Text Books:

1 Sternberg, R.J.(2007). Cognitive psychology. New Delhi. Cengage Learning.
2 Solso, R. L., MacLin, M. K., &MacLin, O. H. (2005). Cognitive psychology. Boston: Pearson/A and B.

Reference Books:

1 Harley, Treror, A. (1997). The psychology of language: From data to theory. Taylor Francis.
2 Smith, E.E. &Kosslyyn, (2007). Cognitive psychology: mind and brain. Prentice Hall.
3 Baddley, A. (1997). Human Memory: Theory and Practice . New York: Psychology Press.
4 Reigler, G.R &Reigler, B.R.(2008).Cognitive psychology. New Delhi: Pearson education.

PL 20.304 INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY-II 2-0-0-2

Objective: To develop an awareness of the concepts related to organizational behavior.

Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory. — 6

	Job Satisfaction, Supervision and leadership: Concept, determinants and measurement; Functions and approaches. Trait, behavioral and contingency models.	5
	Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.	5
	Human engineering: Man-machine system. Designs, displays, controls and action.	5
	Occupational stress: Counterproductive behavior, role conflicts, absenteeism and burnouts, their causes and interventions.	5

Course Outcome:

1. Apply motivation theories to work culture.
2. Understand the nature of job satisfaction.
3. Create effective leaders in organizations.
4. Apply the concept of safety measures in industries and organizations.
5. Understand the role of psychologists in designing work areas.
6. Analyze employees' motivation to have a stress free life.

Text Books:

1. Blumm M.L. &Nylor, J.C. Industrial Psychology. N.Y. : Harper & Row.
2. Davis. K. Human Behaviour at Work. New Delhi : Tata McGraw Hill.

Reference Books:

1. Hersay, R.E. and Blanchard, T.The Management of organizational behaviour,New Delhi : Prentice Hall.
2. Saal, F.E. and Knight P.A. Industrial / Organizational Psychology, Sciences & Practice. Pacific Grove : Brooks / Cole.
3. Luthans. F. Organizational Behaviour. New York :McGraw Hill.
4. Mohanty G. Industrial and Organizational psychology New Delhi: Oxford and IBH.

PL 20.306 **PSYCHOLOGY LABORATORY- VI** **0-0-2-1**

Objective: To apply the concept of psychology in real world.

Any 6 of the following:

1. Maze Learning
2. Retroactive Inhibition
3. Verbal test for Creative Thinking

4. Ergograph
5. Seguin Form Board Test
6. Mirror Drawing Apparatus
7. Picture Frustation Test
8. Judging Emotions through Photograph

Course Outcome:

1 Analyze, interpret and discuss the report on the basis of results and scores
2 Understand the usage of psychological tools in practice.
3 Understand the concept of trial and error learning through experiment.
4 Measure levels memory
5 Measure attention
6 Analyze emotions through photographs

Text Books

1. Manuals of above mentioned psychological tools.

Reference Books

1. Ciccarelli, K. Saundra: Psychology Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., &Schopler, J. Introduction to Psychology. Tata McGraw- Hill, New Delhi.

PL 20.308[$] **PROJECT** **0-0-0-5**

Objective: Students should be enabled to design and conduct an original and ethical research. They should be able to write a dissertation in the APA format. The research done can either be empirical/data based (quantitative, qualitative, or mixed-methods) or it can be in the form of a critical review of research and theory.

Course Outcome:

1 Enhance the ability of the student to use their knowledge of research, statistics, and evaluation methods to inform all areas of practice, from choosing appropriate methods for collecting information to making recommendations for interventions based on empirical evidence.
2 Formulate and identify null and alternative hypotheses in research

3 Define and give examples of independent variables, dependent variables, and scales of measurement.
4 Generate and interpret various types of graphical displays and tables from research data.
5 Differentiate between descriptive and inferential statistics
6 Analyze data using statistical software (SPSS)

Reference Books:

1 Latest APA manual for dissertation.

PL 20.310 PERSPECTIVES IN PSYCHOLOGY-II 5-1-0-6

Objective: To understand various applications of psychology.

Consumer Psychology: Testing advertising effectiveness, consumer opinion surveys, assessment of consumer attitude, psychological marketing segmentation, product testing, observing consumer behavior; perceptual, cognitive, emotional and motivational factors of consumer behavior, decision making process, safeguarding consumer rights and wellbeing.	14
Peace Psychology: Meaning, psychology of peace; management to transformation - key concepts: peacekeeping, peacemaking, peace-building, reconciliation, conflict management, conflict resolution, conflict prevention, and conflict transformation; building peace (structure, Process, Integrated framework for peace building, peace education).	12
Media Psychology: Understanding the interface between media & psychology, Portrayal of Social Groups in Media: Gender, Minority Groups; Effect of Media Violence**;** Use & Abuse of Media: Internet Addiction**;** Role of Media in Social Change.	13
Military Psychology: Origin, concept, utility, scope; individual factors in armed forces (personnel selection, intelligence, personality); group dynamics in military life (structure, types, function, leadership, morale); psychological welfare (propaganda, rumor, coercive persuasion, brain washing	13
Para Psychology: Introduction of the field and concepts, History of Para Psychology, Subject variables affecting Psi test performance (Gender, Personality and attitudes), Implications and Applications of Psi, Out of Body Experiences and Near Death Experiences, Emotional problems and adjustment during war and peace.	13

Course Outcome:

1 Understand the psychology of consumers.
2 Create awareness about national and international peace and conflict process and how psychology can play an important role.
3 Understand the effect of media on human psyche and to develop a critical awareness of the underlying psychological processes and mechanisms
4 Apply psychological knowledge in creating more impactful advertisements.
5 Understand the role of psychologists in defense.
6 Describe the super natural side of psychology.

Text Books:

1 Albarram, A.B. (2007). Management of Media. UK: Thomson.
2 Bartlett, F.C., (1927) Psychology and the Soldier, Cambridge University Press, Cambridge.

Reference Books:

1 Beloff, J. (2000).New Directions in Para Psychology. London: FlakScience.
2 Boring, Edward G., (ed.), (1945) Psychology for the Armed Services, Natraj Publishers, Dehradun
3 Cheistie, D. J., Hare, A. P., &Winter, D. D. (2001). Peace, Conflict and Violence: Peace Psychology for the 21st Century. Englewood Cliffs, New Jersey: Prentice-Hall.
4 Kirsh, S.J. (2006). Children Adolescents and Media Violence. New York: Sage.
5 Maheshwari,Nidhi. (2016) Military Psychology: Concepts, Trends and Interventions, Sage Publication India Pvt Ltd, New Delhi.
6 Narain, Raj. (1979) Military Psychology, National Psychological Corporation, Agra.
7 Webel, C., &Galtung, J. (2007).Handbook of Peace and Conflict Studies. New York, Routledge.
8 Wolman, B.J. (Ed.) (1977). Handbook of Parapsychology. New York: Van Nostrand.

PL 20.312 **ENVIRONMENTAL PSYCHOLOGY** **5-1-0-6**

Objective: To understand the concept of environmental psychology.

Emergence of environmental psychology and its growth: Definition and scope. Human-environment relationship: different worldviews to understand human-environment relationship; Salient features of environmental psychology; Recent trends and future directions in environmental psychology.	12
Human-environment transaction: Personal space, territoriality, crowding; Indian research on crowding and personal space.	14
Theoretical models: stimulus overload, behavioral constraint, ecological and adaptation.	
Environmental stress: Concept and type of stress. Sources of stressors: Cataclysmic, ambient stressors, daily hassles.	13
Pollutions: noise, air, water, chemical and their consequences.	13
Pro-environmental behaviour: Changing the environmental destructive mindset; Environmental education, environmental prompts and cues; Reinforcement strategies, Environmental movements	13

Course Outcome:

1 Understand the theory and research practice of the field of environmental psychology.
2 Apply psychological research methods to improve the functioning of physical settings

3 Create awareness of the impact of your physical surroundings on your behavior and be willing to change the environment to meet your needs
4 Apply knowledge and skills within and across the fundamental ways of knowing
5 Analyze principles of physical and emotional health to wellness
6 Understand the consequences of pollution on mental health.

Text Books:

1 Nagar, D. (2006). Environmental psychology. New Delhi, India: Concept.
2 Fisher, J.D., Bell, P.A. and Baum, A. (1984). Environmental Psychology. NY : Holt, Rinehart and Winston.

Reference Books:

1 Jain, U. (1987). The psychological consequences on crowding. New Delhi, India: Sage.
2 Jain, U., &Palsane, M. N. (2004). Environment and behaviour. In J. Pandey (Ed.), Psychology in India revisited: Developments in the discipline (Vol. 3: Applied social and organizational psychology, pp. 261-308). New Delhi, India: Sage.
3 Holahan, C.J. (1982). Environmental Psychology. NY : Random House.
4 W.H., Proshansky, H.M. Rilvin, E.G.; Winkle, G.H. & Dempsey, D. (1974). An Introduction to Environmental Psychology. New York: Rinehart and Winston.

Mody University of Science & Technology

Bachelor of Science (Hons) Biotechnology

(Effective from Academic Year 2020-21)

[B.Sc. (Hons) Biotechnology]
(Session 2020-2021 onwards)

Programme **Level:**Undergraduate	**No. of Seats:** 15	**Duration: Three Years (Six Semesters)**

Affiliation: The proposed programme shall be governed by the Department of - Biosciences, SLAS, MUST, Laxshmangarh.

Programme Educational Objectives:

The graduate will

PEO1 Graduates are prepared to be employed in industry, academia and research laboratories and by providing expected domain knowledge.

PEO2 Graduates are provided with practical training, hands-on and project experience to meet the industrial needs.

PEO3 Graduates are motivated in career and entrepreneurial skill development to become global leaders.

PEO4 Graduates are trained to demonstrate creativity, develop innovative ideas and to work in teams to accomplish a common goal.

PEO5 Graduates are addressed with social issues and guided to operate problems with solutions.

Programme Outcome:

At the end of the B.Sc. (Hons.) Biotechnology Programme, graduates will be able to

PO1 **Critical Thinking:** Apply knowledge of biotechnology field to identify, analyze problems of society and to provide effective solution.

PO2 **Employability Skills:** Inculcate skills to excel in the fields of biotechnology in Government and Private sectors in academia and research industries.

PO3 **Ethics**: Instill ethical responsibilities, human and professional values and make their contribution to the society.

PO4 **Self-Directed and Life-long Learning:** Engaged in lifelong learning to equip them to

the changing environment and be prepared to take-up entrepreneurship skills.

Programme Specific Outcome:

PSO 1 To integrate the knowledge of biology for developing technologies for food, pharma and healthcare industries.

PSO 2 To impart knowledge for understanding of legal issues affecting biotechnology industries.

PSO 3 To enhance expertise in tools and techniques in applied fields of biotechnology.

Scope:

The Biotechnology Scope is vast due to an increase in the research and science field. However, as we are living in the age of research where science has taken the new form. We are at the pace of making new applications and innovations every day and this could be possible with combining Technology and biology together. So, students have a lot of job options available. Biotechnologists can work in various works of environments like the industrial sector, medical sector, food manufacturing, and pharmaceuticals. This course provides the knowledge to understand the occurrence and treatment of disease, food production, the development of agriculture, protection of the environment and many more.

Input Qualification:

The minimum eligibility criteria needed to be met for admission to the course are:

Candidate should have passed 10+2 PCB with minimum 50% marks in Science stream from a recognized Board with proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody Universityshall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [5] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation: Year up-gradation of the student will be as per the University ordinance.

B.Sc. (Hons) Biotechnology
First Year

Name of the Programme: B.Sc. (Honours) Biotechnology										**Year: First**
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Autumn Semester	**Core Courses**									
	BS20.101	Cell Biology	4		-	4	3	25	25	50
	BS20.103	Cell Biology Laboratory	-	-	4	2	4	25	25	50
	BS20.105	General Biochemistry	4	-	-	4	3	25	25	50
	BS20.107	General Biochemistry Laboratory	-	-	4	2	4	25	25	50
	CH20.113	Chemistry I	4	-	-	4	3	25	25	50
	CH20.115	Chemistry Laboratory I	-	-	4	2	4	25	25	50
	Generic Elective Courses									
	BS20.113	Biotechnology and Human Welfare	4	-	-	4	3	25	25	50
	BS20.115	Biotechnology Laboratory	-	-	4	2	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EL20.109	Foundation Course in English	2	–	–	2	3	25	25	50
	Skill Enhancement Courses									
	FL-I	Foreign language-I	3	–	–	3	3	25	25	50
		Sub Total				**29**				
	SF 101	Personal Grooming, Fine Dining (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	**Core Courses**									
	BS20.102	Genetics	4		-	4	3	25	25	50
	BS20.104	Genetics Laboratory	-	-	4	2	4	25	25	50
	BS20.106	General Microbiology	4	-	-	4	3	25	25	50
	BS20.108	General Microbiology Laboratory	-	-	4	2	4	25	25	50
	CH20.114	Chemistry II	4	-	-	4	3	25	25	50
	CH20.116	Chemistry Laboratory II	-	-	4	2	4	25	25	50
	Generic Elective Courses									
	BS20.114	IPR, Bioethics and Biosafety	4	-	-	4	3	25	25	50
	BS20.116	IPR, Bioethics and Biosafety Laboratory	-	-	4	2	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EV20.102	Environmental Studies	4	-	-	4	3	25	25	50
	Skill Enhancement Courses									
	FL-II	Foreign language-II	3	–	–	3	3	25	25	50
		Sub Total				**31**				
	SF 102	Social Grooming, Home & Decor and Business Comm unication(Non credit)				1				

Name of the Programme: B.Sc. (Honours) Biotechnology										Year: Second
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester										
	Core Courses									
	BS20.201	Molecular Biology	4	-	-	4	3	25	25	50
	BS20.203	Molecular Biology Laboratory	-	-	4	2	4	25	25	50
	BS20.205	Immunology	4	-	-	4	3	25	25	50
	BS20.207	Immunology Laboratory	-	-	4	2	4	25	25	50
	Generic Elective Course									
	BS20.209	Developmental Biology	4	-	-	4	3	25	25	50
	BS20.211	Developmental Biology Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Mody University Elective Course (any course from the list)	3	-	-	3		20	80	
	FL-III	Foreign language-III	3	–	–	3	3	25	25	50
	BS20.225	Enzymology	2	-	-	2	3	25	25	50
		Sub Total				**26**				
	SF 201	Personal Grooming, Fine Dining and Home Safety(Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CWS	MTE	ETE
Spring Semester										
	Core Courses									
	BS20.202	Mammalian Physiology	3		-	3	3	25	25	50
	BS20.204	Mammalian Physiology Laboratory	-	-	4	2	4	25	25	50
	BS20.206	Plant Physiology	3	-	-	3	3	25	25	50
	BS20.208	Plant Physiology Laboratory	-	-	4	2	4	25	25	50
	Generic Elective Courses									
	BS20.210	Entrepreneurship Development	3	-	-	3	3	25	25	50
	MS20.214	Math and Biostatistics for Biology	3	-	-	3	3	25	25	50
	Skill Enhancement Courses									
		Mody University Elective course (any course from the list)	3	-	-	3		20	80	
	FL-IV	Foreign language-IV	3	–	–	3	3	25	25	50
	BS20.218	Molecular Diagnostics	2	-	-	2	3	25	25	50
		Sub Total				**24**				
	SF 202	Social Grooming and Professional Skills (Non credit)				1				

Name of the Programme: B.Sc. (Honours) Biotechnology										Year: Third
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
	BS20.301	Recombinant DNA Technology	3	-	-	3	3	25	25	50
	BS20.303	Recombinant DNA Technology Laboratory	-	-	4	2	4	25	25	50
	BS20.305	Bioprocess Technology	4	-	-	4	3	25	25	50
	BS20.307	Bioprocess Technology Laboratory	-	-	4	2	4	25	25	50
	RM20.301	Research Methodology	2	-	-	2	3	25	25	50
	Discipline Specific Elective Courses									
	BS20.311	Environmental Biotechnology	4	-	-	4	3	25	25	50
	BS20.313	Environmental Biotechnology Laboratory	-	-	4	2	4	25	25	50
	BS20.315	Bioinformatics	4	-	-	4	3	25	25	50
	BS20.317	Bioinformatics Laboratory	-	-	4	2	4	25	25	50
		Sub Total				**25**				
	Skill Enhancement Courses									
	FL-V	Foreign Language -V	3	–	–	3	3	25	25	50
		Sub Total				**28**				
	GE20.301	Proficiency (Non credit)				1				

Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester										
	Core Courses									
	BS20.302	Genomics and Proteomics	3	-	-	3	3	25	25	50
	BS20.304	Genomics and Proteomics Laboratory	-	-	4	2	4	25	25	50
	BS20.306	Bio-Analytical Tools	4	-	-	4	3	25	25	50
	BS20.308	Bio-Analytical Tools Laboratory	-	-	4	2	4	25	25	50
	BS20.310	Project work	-	-	4	2	-	-	-	100
	Discipline Specific Elective Courses									
	BS20.312	Animal Biotechnology	4	-	-	4	3	25	25	50
	BS20.314	Animal Biotechnology Laboratory	-	-	4	2	4	25	25	50
	BS20.316	Plant Biotechnology	4	-	-	4	3	25	25	50
	BS20.318	Plant Biotechnology Laboratory	-	-	4	2	4	25	25	50
		Sub Total				**25**				
	Skill Enhancement Courses									
	FL-VI	Foreign Language -VI	3	–	–	3	3	25	25	50
		Sub Total				**28**				
	GE20.302	Proficiency (Non credit)				1				

Final Credits Summary								
S.N.	Particulars	Credits Semester wise						
		I	II	III	IV	V	VI	Total
1.	Core Courses	18	18	12	10	13	13	**84**
2.	Discipline Specific Elective Courses	-	-	-	-	12	12	**24**
3.	Generic Elective Courses	6	6	6	6	-	-	**24**
4.	Ability Enhancement Compulsory Courses	2	4	-	-	-	-	**06**
5	Skill Enhancement Courses	3	3	8	8	3	3	**28**
Total		29	31	26	24	28	28	**166**

$CW (Course work) includes teacher assessment, assignments, class /quiz test.
Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

BS20.101 Cell Biology 4-0-0-4

Course Objective: To get hold of basic familiarity of cell and molecular biology for application in biotechnology

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport. [10]

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion. [10]

Lysosomes: Vacuoles and microbodies: Structure and functions. Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure. [20]

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. [06]

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer. [06]

Course Outcome: After completion of the course, students would be able to apply the knowledge of cell biology in sciences and applied sciences

Text Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

1. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

BS20.103 Cell Biology Laboratory 0-0-4-2

Course Objective: To get acquainted for application of experiments of cellular biology in biotechnology and other applied research fields

Practicals

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

Course outcome: After completion of the course, students would be able to apply the knowledge in conduction of successful laboratory experiments.

BS20.105 General Biochemistry 4-0-0-4

Course Objective: To get acquainted for application chemistry biological sciences

Introduction to Biochemistry: [10]

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

Lipids and Nucleic acids:

Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. [10]

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Enzymes

Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites. [10]

Enzyme specificity: [6]

Types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

Carbohydrates Metabolism: [16]

Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Course Outcome: After completion of the course, students would be able to apply the knowledge Biochemistry in understanding of Biotechnological

Text Books:

1. Bhardwaj Uma (2014). Biochemistry for Life Sciences. Dorling Kindersley (India) Pvt. Ltd, Pearson IN.
2. Jain J L, Jain Supriya and Jain N (2005) Fundamentals of Biochemistry. S Chand and Compant Ltd. New Delhi

Reference Books:

1. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 Freeman and Company, New York, USA. edition, W.H.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

BS20.107 General Biochemistry Laboratory 0-0-4-2

Course Objective: To get hands on experience in Biochemical techniques and calculation

Practicals

1. Preparation of buffers.
2. To study activity of any enzyme under optimum conditions.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission.
5. Separation of Amino acids by paper chromatography.
6. Qualitative tests for Carbohydrates, lipids and proteins
7. Quantitative tests for Carbohydrates
8. Qualitative tests for Carbohydrates, lipids and proteins
9. Qualitative tests for Carbohydrates, lipids and proteins

Course outcome: After completion of this course student can understand The application of Biochemical techniques and calculations to understand better metabolism

.

CH20.113 Chemistry I 4-0-0-4

Course Objective: To learn basic of chemical sciences applicable in Biotechnology field

Atomic Structure and Chemical Bonding: Bohr's theory and its limitations, atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, Valence bond Theory and its limitations, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, percentage ionic character, radius ratio effect and coordination number, lattice energy and Born Haber cycle, polarizing power and polarisability of ions, Fajan's rule. [11]

Chemical Kinetics, Catalysis and Electrochemistry: Rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo [10]

order and half-life. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, collision theory, transition state theory.

Catalysis & types of catalysis, Mechanism of catalysis, Enzyme catalysis.

Specific and equivalent conductance, migration of ions and Kohlrausch law, SHE , reference electrodes, standard electrode potential, Nernst equation, electrochemical series and its significance. Electrolytic and Galvanic cells, conductometric and potentiometr

Fundamentals of Organic Chemistry and Stereochemistry: Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Reactive intermediates - carbocations, carbanions and free radicals. [10]

Optical Isomerism-Elements of symmetry, molecular chirality, enantiomers, optical activity, chiral and achiral molecules with two stereogeniccentres, diastereomers, resolution of enantiomers, inversion, retention. Sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature. Conformational isomerism: Conformational analysis of ethane and n-butane by the Newman projection

Hydrocarbons

Preparation and reactions of alkanes, alkenes and alkynes. Special emphasis tocatalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction), cis-addition to alkenes (alk. KMnO4)and trans-addition (bromine), Markownikoff's and anti-Markownikoff's rule. Acidity of alkynes, hydroboration-oxidation, metal-ammonia reduction, and polymerization of alkynes. Preparation and reactions of alkyl halides. Williamson's ether synthesis: Mechanisms of nucleophilic substitution SN^1 and SN^2 [13]

Arenes and Aromaticity: Structure of benzene:Kekule structure, resonance structure, MO picture. Aromaticity: Huckel's rule, Aromatic electrophilic substitution: Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction.

Ultraviolet and Infrared spectroscopy: Electromagnetic radiation,Absorption laws (Beer Lambert Law), types of electronic [8]

transitions, Concept of chromophore and auxochrome. Types of shifts, Application of Woodward Rules for calculation of λ_{max} for conjugated dienes: homoannular and heteroannular, Extended conjugated systems.Molecular vibrations, fundamental bands, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

Course outcome: After completion of this course the student will be able use chemistry principles for biotechnological applications

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.
2. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.
4. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
5. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
4. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).
5. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

7.P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.

8. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.

CH20.115 Chemistry Laboratory I **0-0-4-2**

Course Objective: To learn basic of chemical sciences experiments applicable in Biotechnology field

Practicals

1. Purification of a given organic sample solid/liquid through crystallization.
2. Preparation of standard solutions of different Molarity/Normality of titrants.
3. Determination of the melting points of organic compounds
4. Determination of optical activity by using polarimeter
5. To determine the specific reaction rate of the hydrolysis of methyacetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
6. To determine the viscosity of a given liquid.
7. To determine the λ max of $KMnO_4$ solution using colorimeter.
8. To perform pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

Course outcome: After completion of this course the student will be able use chemistry laboratory sklills for biotechnological applications

BS20.113 Biotechnology and Human Welfare 4-0-0-4

Course Objective: To introduce the subject and its applications in real world

Industrial Biotechnology

Biocatalysts and Biotransformation in Industry: protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation. [15]

Agricultural Biotechnology

Agriculture: N2 fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; Transgenic Plants, qualitative improvement of livestock. [10]

Environmental Biotechnology

Environments: e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB. [10]

Forensic Biotechnology [08]

Forensic science: e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA finger printing

Medical Biotechnology

Importance if Biotechnology in Health: e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in *E.coli*, human genome project. [09]

Course Outcome: After completing this course the student will be able to know the importance of Biotechnology in current scenario.

Text Books:

1. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
2. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.
3. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition, Benjamin Co.
4. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd edition)

Reference Books:

1. Sateesh MK (2010) Bioethics and Biosafety, I. K. International
2. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BS20.115 Biotechnology Laboratory 0- 0- 4-2

Course Objective: To learn basic experiments of Biotechnology

Practicals **[10]**

1. Perform of ethanolic fermentaion using Baker's yeast
2. Study of a plant part infected with a microbe
3. To perform quantitative estimation of residual chlorine in water samples
4. Estimation of DO in water and calculation of BOD
5. Isolation and analysis of DNA from minimal available biological samples
6. Isolation of plant growth promoting rhizobacteria and study of their traits

Course Outcome: After completion of this course student can learn how to do biotechnological experiments

EL20.109 Foundation Course in English 2-0-0-2

Objective: Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct)	5
Articles: Definite and Indefinite & omission of articles	
Transformation of Sentence Structure: Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	5
Correct Usage of Language: Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need)	6
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	
Writing Skills: Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing	6
Reading Comprehension: Efficient reading and note taking	4

Course Outcome: The student will be able to:

1 Learn the essentials of English Grammar.
2 Apply the rules of grammar to use flawless English in speech and writing.
3 Analyze, identify and rectify the common errors in speech and writing.
4 Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.
5 Evaluate a piece of writing keeping in mind all the rules of grammar studied.
6 Read and comprehend English

Text Books:

1 Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
2 Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.

Reference Books:

1 Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
2 Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3 Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
4 Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

BS20.102 Genetics 4-0-0-4

Course Objective: To understand how gene and characters are transmitted in future generaration

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. [10]

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics : Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. [12]

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA.

Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities– Aneuploidy and Euploidy. [10]

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance. [10]

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.

Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. [10]

Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

Course Outcome**:** After completion of this course student can understand and structure and function of genetic system

Text Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.

Reference Books:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
2. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
3. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

BS20.104 Genetics Laboratory 0-0-4-2

Course Objective: To learn and understand the characters transmission in future generation

Practicals

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body -*Rhoeo* translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

Course outcome: After completion of this course the student can be able to understand genetics and functioning of gene

BS20.106 General Microbiology 4-0-0-4

Course Objective: To give the knowledge of microorganisms structure and fucntions to undergraduate students

Introduction and Historical Aspects

Fundamentals, History and Evolution of Microbiology.

Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. [10]

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

Microbial Isolation and Identification

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation. [10]

Microbial Growth and Metabolism

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. [20]

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

Microbes in Environment [06]

Control of Microorganisms: By physical, chemical and chemotherapeutic

Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: [06]
Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.

Course Outcome: After completion of this course the student can learn the physiology of microorganism.

Text Books:

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.

Reference Books:

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
3. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

BS20.108 General Microbiology Laboratory 0-0-4-2

Course Objective: To get acquainted for application of experiments of Microbiology in biotechnology and other applied research fields

Practical [10]

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.

4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

Course Outcome: After completion of this course the student can be able to work with microorganism and its concerned experiments

CH 20.114 Chemistry II **4-0-0-4**

Course Objective: To learn basic of chemistry useful for Biotechnology students

Unit-I

Periodic Properties, Coordination Compounds and Acid-Base Concept: Atomic and ionic radii, ionization energy, electron affinity and electronegativity. Properties of s, p, d and f block elements. Werner's coordination theory effective atomic number concept and isomerism in coordination compounds. Arrhenius, Bronsted-Lowry, and Lewis concepts of acids and bases. [10]

Unit-II

Thermodynamics, Equilibrium and Photochemistry: Concept of heat, q, work, w, internal energy, U, and statement of first law, Second Law: Concept of entropy. Free energy change in a chemical reaction. Thermodynamic derivation of the law of mass action. Le Chatelier's principle. Strong, moderate and weak electrolytes, pH scale, common ion effect and Buffer solutions. [12]

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Jablonski diagram, description of fluorescence, phosphorescence, photochemistry of carbonyl compounds, Norrish type-I and Norrish type II cleavage examples, quantum efficiency and quantum yield.

Unit-III Functional groups

(i) Alcohols: Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Reactions: With sodium, HX (Lucas test), esterification and oxidation. [20]

(ii) Phenols: Preparation: from Cumene hydroperoxide method and diazonium salts. Comparative acidic strength of alcohols and phenols, Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Mechanisms of Fries rearrangement, Claisen rearrangement and Reimer Tiemann reaction.

(iii) Aldehydes and Ketones: Synthesis of aldehydes and ketones from acid chlorides and nitriles.Reactions: with HCN, $NaHSO_3$ and NH_2-G derivatives. Aldol Condensation, Cannizzaro's reaction, Clemensen reduction and Wolff Kishner reduction.

(iv) Carboxylic acids and their derivatives: Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction. **Carboxylic acid derivatives:** Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids. Reactions: Comparative study of nucleophilicity of acyl derivatives.

(v)Amines and Diazonium Salts: Amines: Preparation from Hofmann Bromamide reaction. Reactions: Carbylamine test, Hinsberg test, with HNO2.

Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol and dyes.

Unit-IV

^{1}HNMR Spectroscopy and Mass Spectrometry: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant, Interpretation of NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. [10]

Mass Spectrometry:Basic principle, Instrumentation, Ion production (EI and CI techniques), molecular ion peak, base peak, nitrogen rule, McLafferty rearrangement, modes of fragmentation, metastable peak.

Course Outcome: After completion of this course the student can have basic of chemistry for better understanding of subject

Suggested Readings:

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.
2. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.
4. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
5. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

6. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.

7. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
8. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
9. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).
10. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
11. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India

Edition, 2013.

12. P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.
13. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.

BS20.116 Chemistry Laboratory II 0-0-4-2

Course Objective: To learn basic experimentation skills I chemistry useful for Biotechnology students

Section A: Physical Chemistry

1. Study of the solubility of benzoic acid in water and determination of H.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Inorganic Chemistry

4. Preparation of hexamminenickel(II)chloride
5. Preparation of Potassium tris-oxalatoferrate(III)
6. Preparation of potassium-chromium alum, $KCr(SO_4)2•12H_2O$
7. Preparation of coordination compound, $[Ni(NH_3)_6]I_2$

Section C: Organic Chemistry

8. Systematic Qualitative organic analyses of organic compounds possessing monofunctional groups (Alcohols, Phenols, Carbonyl, -COOH) and preparation of one suitable derivative.
9. Separation of a Two Component Mixture Using Extraction Techniques
10. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
    (a)Bromination of Phenol/Aniline
    (b)Benzoylation of amines/phenols
    (c)Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Course Outcome: After completion of this course the student can utilize acquired laboratory skills in the field of biotechnology for better understanding of experimentation part.

BS20.114 IPR, Bioethics and Biosafety 4-0-0-4

Course Objective: To create awareness in students about patenting, bioethics and biosafety

Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO). TrademarksObjectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.Geographical Indications: Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position. [12]

Industrial Designs and plant varieties protection

Objectives, Rights, Assignments, Infringements, Defences of Design Infringement.Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers.National gene bank, Benefit sharing.Protection of Plant Varieties and Farmers' Rights Act, 2001. [12]

Protection of Traditional Knowledge

Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protectability, needfor a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library. [13]

Information Technology Related Intellectual Property Rights

Computer Software and Intellectual Property, Database and Data Protection, Biotechnology and Intellectual Property Rights Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

Bioethics – Necessity of Bioethics, different paradigms of Bioethics – National & International. Ethical issues against the molecular technologies. [08]

Biosafety– Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level and Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP). [07]

Course Outcoem: After completion of this course the student will do experiments by keeping in mind the ethical and safety issues of industrial applications of Biotechnology.

Text Books:

1. N.S. Gopalakrishnan & T.G. Agitha, (2009) Principles of Intellectual Property Eastern Book Company, Lucknow.
2. Kerly's Law of Trade Marks and Trade Names (14th Edition) Thomson, Sweet & Maxweel.

Reference Books:

3. Ajit Parulekar and Sarita D' Souza, (2006) Indian Patents Law – Legal & Business Implications; Macmillan India Ltd.
4. B.L.Wadehra (2000) Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India.
5. P. Narayanan (2010) Law of Copyright and Industrial Designs; Eastern law House, Delhi.
6. Entrepreneurship: New Venture Creation : David H. Holt
7. Patterns of Entrepreneurship : Jack M. Kaplan
8. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.
9. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.
10. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age international publishers

BS20.116 IPR, Bioethics and Biosafety Laboratory 0-0-4-2

Course Objective: To give the practical knowledge of filing patents and bioethics and biosafety issues

Practicals

1. Proxy filing of Indian Product patent
2. Proxy filing of Indian Process patent
3. Planning of establishing a hypothetical biotechnology industry in India
4. A case study on clinical trials of drugs in India with emphasis on ethical issues.
5. Case study on women health ethics.
6. Case study on medical errors and negligence.
7. Case study on handling and disposal of radioactive waste

Course outcome: After completing this course the student can become able to file patent

Text Books:

1. Gopalan C and Kaur S (Eds.) (1993). Towards Better Nutrition, Problems and Policies, Nutrition Foundation of India.
2. Tovel AP (1984). Standardising Food Service for Quality and Efficiency. AVI Publishing Company INC.

Reference Books:

1. Dept. of WCD, Govt. of India. (1993): National Nutrition Policy.
2. Food and Nutrition Board, Dept. of WCD, Govt. of India (1995): National Plan of Action on Nutrition.
3. Roday S (1999). Food Hygiene and Sanitation, 1st Edition, Tata McGraw Hill, New Delhi.

4. Diehl JF (1995). Safety of Irradiated Foods Marcel Dekker Inc, New York.
5. Raheena Begum: A textbook of food, nutrition and dietetics Sterling Publishers, New Delhi.

EV20.102 Environmental Studies **4-0-0-4**

To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.

Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	**9**
Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**

	Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	**7**
	Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	**6**
	Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	**5**
Course Outcome	After completion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.	

Suggested Readings
Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.

6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Refence Books:

1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
2. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
3. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
4. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
5. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
6. www.nacwc.nic.in 22.www.opcw.org

BS20.201 Molecular Biology 4-0-0-4

Course Objective: To get hold of basic familiarity of molecular biology for application in biotechnology

DNA structure and replication: DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication. [10]

DNA damage, repair and homologous recombination: DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism. [10]

Transcription : RNA structure and types of RNA,Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains [04]

RNA processing: Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA:5'cap formation, polyadenylation, splicing, rRNA and tRNA [10]

splicing.

Regulation of gene expression and translation: Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Post translational modifications of proteins. Trafficking mechanism [18]

Course Outcome: After completion of the course, students would be able to apply the knowledge of molecular biology in sciences and applied sciences.

Text Books:

1. Karp,G.(2010).Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P.and De Robertis, E.M.F.(2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

1. Karp,G.(2010).Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P.and De Robertis, E.M.F.(2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker,W.M.,Kleinsmith, L.J., Hardin .J.and Bertoni,G.P. (2009).The World of the Cell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R.,(2008) Molecular Biology of the Gene (VI Edition.).Cold Spring Harbour Lab. Press, Pearson Pub.

BS20.203 Molecular Biology Laboratory 0-0-4-2

Course Objective: To get acquainted for application of experiments of molecular biology in biotechnology and other applied research fields

Practicals

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA.
5. Preparation of restriction enzyme digests of DNA samples.
6. Demonstration of AMES test or reverse mutation for carcinogenicity

Course outcome: After completion of the course, students would be able to apply the knowledge of conduction of successful laboratory experiments.

BS20.205 Immunology 4-0-0-4

Course Objective: To become proficient in the knowledge of basic immunological cells and molecules required in different fields of science.

Immune Response: An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses. [10]

Immune Cells: T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination [10]

Regulation of Immuno globulin gene expression–clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germline & somatic mutation), antibody diversity [12]

Major Histocompatibility complexes– class I & class II MHC antigens, antigen processing. Immunity to infection– immunity to different organisms, pathogen defense strategies, avoidance of recognition. Auto immune diseases, Immunodeficiency- AIDS. [10]

Vaccines & Vaccination– adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to their infectious agents, passive & active immunization. Introduction to immunodiagnostics– RIA, ELISA. [10]

Course Outcome: After completion of the course, students would be able to apply the knowledge of immunology in sciences and medical sciences

Text Books:

1. Abbas A K, Lichtman A H, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt I M. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.

Reference Books:

1. Goldsby R A, Kindt T J, Osborne B A. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, NewYork.
2. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology.7th edition Garland Science Publishers, New York.
3. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Living stone Publishers, Edinberg.
4. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

BS20.207 Immunology Laboratory 0-0-4-2

Course Objective: To become familiar with the different experiments of immunology.

Practicals

1. To determine differential leucocytes count
2. To determine total leucocytes count
3. To determine total RBC count
4. To perform Haemagglutination assay
5. To perform Haemagglutination inhibition assay
6. To perform separate serum from blood
7. To perform Double immuno diffusion test using specific antibody and antigen.
8. To perform ELISA.

Course Outcome: After completion of the course, students would be able to apply the laboratory skills of immunology laboratory in sciences and applied sciences

BS20.209 Developmental Biology 4-0-0-4

Course Objective: To learn and get the knowledge of the development of various living organisms required for the further applications.

Development and morphology of gametophyte – formation of vegetative and generative cells, microsporogenesis, organization of mature pollen grain, types of ovules, integument, nucellus, megasporogenesis, types of embryo sacs. [10]

Pollination and fertilization – Pollen transfer, artificial pollination, pollen germination, double fertilization, self-incompatibility. Endosperm – development, cytology and functions of endosperm [10]

Embryo – Zygote, Embryogeny, Polyembryony. Seed – Development, classification, dispersal and dormancy [6]

Animal Developmental Biology

History and scope of animal developmental biology. Gametogenesis – Spermatogenesis and Oogenesis – vitellogenesis, types of eggs. Fertilization – mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, parthenogenesis. Cleavage – Planes and patterns of cleavage, significance of cleavage [10]

Embryonic development – Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, concept of fate maps (w.r.t. frog and chick). [10]

General concepts of Differentiation, Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing. [06]

Course Outcome: After completion of the course, students would be able to apply the knowledge of developmental behaviour of organisms

Text Book

1. Sastry & Shukla; Development Biology; Rastogi Publication, Meerut
2. Bhojwani & Bhatnagar; The Embryology of Angiosperms; Vikas Publishing House, New Delhi
3. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi

Reference Book

4. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi
5. Berrill N. J; Developmental Biology; Mc Graw Hill, New York
6. Sastry K.V., and Shukla V; Developmental Biology; Rastogi Publications, Meerut.

BS20.211 Developmental Biology Laboratory 0-0-4-2

Course Objective: To become proficient in the experiments related to the developmental studies.

Practicals

Developmental biology Laboratory

1. Study of the microspore and megaspore
2. Study of different types of ovules
3. Study of germination tube
4. Study of different part of the seed
5. Study of seed compatibility and viability
6. Study of permanent slides: Frog: egg, blastula, gastrula, neurula, different stages of tadpole larva; Chick: egg, different stages of chick embryo development; Mammals: testis, ovary, T.S. Placenta.
7. Permanent slide preparation: Developmental stages of chick embryo.
8. Study of various foetal envelopes in a 10-12 day old chick embryo (amnion, chorion, allantois yolk sac).
9. Urine analysis for pregnancy in mammal (Demonstration only).

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of developmental biology laboratory.

BS20.225 Enzymology 2-0-0-2

Course Objective: To become familiar about the basic knowledge of the enzymes and calculation of substrate and reaction requirement of the industry.

Introduction: Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin). [02]

Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation,

Enzyme Kinetics: Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy. [04]

Reaction Mechanism: Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor. [10]

Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action

chemical modification of active site groups, specific examples-: chymotrypsin, Iysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase.

Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. [06]

Industrial Applications: Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes. [04]

Course Outcome: After completion of the course, students would be able to apply the knowledge of enzyme in Industrial transformation process

Text Books:

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.

Reference Books:

1. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999
2. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004
3. Practical Enzymology Hans Bisswanger Wiley–VCH 2004

4. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002

BS20.202 Mammalian Physiology 3-0-0-3

Course Objective: To get the knowledge of the physiology related information of the mammals.

Digestion and Respiration: Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. [05]

Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift. [04]

Circulation: Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood.
Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heartbeat. [10]

Muscle physiology and osmoregulation: Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. [10]
Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

Nervous and endocrine coordination: Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands–Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. [10]

Course Outcome: After completion of the course, students would be able to apply the knowledge of mammalian Physiology

SUGGESTED READING

Text Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot

Reference Book

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd./W.B. Saunders Company.
2. Tortora, G.J. & Grabowski,S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc

BS20.204 Mammalian Physiology Laboratory 0-0-4-2

Course Objective: To get hands on training of the physiology of the different organisms.

Practicals

1. Finding the coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.

4. Determination of TLC and DLC.
5. Demonstration of action of an enzyme.
6. Determination of Haemoglobin.

Course outcome: After completion of the course, students would be able to apply the experimental knowledge of Mammalian Physiology Laboratory.

BS20.206 Plant Physiology 3-0-0-3

Course Objective: To get basic knowledge of the physiological processes of the all the members of kingdom plantae

Plant water relations and micro & macronutrients: Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing. Micro & macronutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport. [10]

Carbon and nitrogen metabolism: Photosynthesis-Photosynthesis pigments, concept of two photosystems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation point. [10]

Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants. [09]

Growth and development: Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, Abscisic acid, ethylene). Physiological role and mode of action, seed dormancy and seed germination,concept of photo-periodism and vernalization. [10]

Course Outcome: After completion of the course, students would be able to apply the knowledge of plant Physiology.

SUGGESTED READING

Text Book:

1. Salisbury, F.B. and Ross, C.W. (1991) Plant Physiology, Wadsworth Publishing Co. Ltd.

Reference Book

1. Dickinson,W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K.1977. Anatomy of Seed Plants.Wiley Publishers.
3. Fahn, A.1974. Plant Anatomy. Pergmon Press, USA and UK.

BS20.208 Plant Physiology Laboratory 0-0-4-2

Course Objective: To get hands on training about the experiments related to plants.

Practicals

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of Plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata.
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of plant Physiology Laboratory

BS20.210 Entrepreneurship Development 3-0-0-3

Course Objective: To get familiar about the knowledge of the entrepreneurship required for future start-up related activities.

Introduction
Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship. [10]

Establishing an enterprise [04]
Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility.

Financing the enterprise [05]
Importance of finance/ loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capitalist sources and how to move for loans, Inventory direct and indirect raw materials and its management.

Marketing management
Meaning and Importance, Marketing-mix, product management–Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management. [10]

Entrepreneurship and international business
Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports. [10]

MS20.214 Mathematics and Statistics for Biology 3-0-0-3

Objective: To acquire fundamental knowledge of algebra, calculus, statistics with correlation and regression.

Algebra: Number system, Permutations and Combinations, Basics of probability theory, Baye's theorem, Basics of matrix and determinants, types of matrices, properties of **09**

determinants.

Calculus: Functions, Logarithms, Derivative of standard function, Successive Differentiation, basics rules of differentiations. **08**

Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration. **08**

Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Elementary ideas of Binomial, Poisson and Normal Distributions. **08**

. **Correlation and Regression:** Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression. **06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of algebra, calculus, statistics with correlation and regression sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Fundamental of Mathematical Statistics by Gupta and Kapoor, SCS Publisher, 2002.
2. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson.

Reference Books:

1. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.
2. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
3. Ramana B.V (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

BS20.218 Molecular Diagnostics 2-0-0-2

Course Objective: To get the information of the molecular level diagnostic techniques related to biomedical tests and equipments.

Introduction: Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting. Enzyme immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in enzymes immuno assays. [10]

Applications of enzyme immunoassays in diagnostic microbiology

Molecular methods in clinical microbiology: [05]

Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology

Laboratory tests in chemotherapy

Susceptibility tests: Micro-dilution and macro-dilution broth procedures. Susceptibility tests:Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests. [05]

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Antiidiotypes and molecular mimicry and receptors. [03]

Advance Techniques: GLC, HPLC, Electron microscopy, flowcytometry and cell sorting. [03]

Course Outcome: After completion of the course, students would be able to apply the knowledge of molecular level diagnostic techniques foe the field of hospital and biomedical area of research.

Text Books:

1. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe,Kluwer Academic
2. Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.

Reference Books:

3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.
4. Joklik WK, Willett HP and Amos DB (1995). Zinsser Microbiology. 19th edition. Appleton- Centuary-Crofts publication.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
6. Microscopic Techniques in Biotechnology, Michael Hoppert

BS20.301 Recombinant DNA Technology 3-0-0-3

Course Objective: To get the knowledge of the latest technology required for the discovery of the value added products and organisms related to human welfare.

Molecular tools and applications- Restriction enzymes, ligases, polymerases, alkalinephosphatase. Gene Recombination and Genetransfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication. [10]

Principle and application of Polymerase chain reaction (PCR)-primer-design and RT-(Reversetranscription)PCR. [04]

Restriction and modification system, restriction mapping. [10]

Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reversetranscription. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cell singene targeting in mice, Therapeutic products produced by genetic engineering- blood proteins, human hormones, immune modulators and vaccines (one example each).

Random and site- directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (anytwo). [10]

Genetic engineering in plants: Use of *Agro-bacterium tumefaciens* and *A.rhizogenes*, Ti- plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors. [05]

Course Outcome: After completion of the course, students would be able to apply knowledge of Recombinant DNA Technology for future research and studies.

Text Books:

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5thedition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ.(2009).Biotechnology- Applying the Genetic Revolution. Elsevier Academic Press, USA

Reference Books:

1. Glick,B.R.,Pasternak,J.J.(2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington
2. Primrose SB and Twyman RM.(2006). Principles of Gene Manipulation and Genomics,7th edition. Blackwell Publishing, Oxford,U.K.
3. Sambroo kJ, Fritsch EF and ManiatisT.(2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

BS20.303 Recombinant DNA Technology Laboratory 0-0-4-2

Course Objective: To get hands on training for the handling of DNA and other related molecules for development of the different products

Practicals

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of Recombinant DNA Technology Laboratory

BS20.305 Bioprocess Technology 4-0-0-4

Course Objective: To get the basic information of the different mathematical models required for smooth functioning of the industrial processes.

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. [07]

Types of microbial culture and its growth kinetics– Batch, Fed-batch and Continuous culture. [05]

Design of bioprocess vessels-Significance of Impeller, Baffles, Sparger; Types of culture / production vessels-Airlift; Cyclone Column; Packed Tower and their application in production processes. [10]
Principles of upstream processing Media preparation, Inocula development and sterilization.

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control. [15]

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins. [15]

Text Book:

1. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

Reference Book

2. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
3. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of

Fermentation Technology. 2nd edition, Elsevier Science Ltd.

BS20.307 Bioprocess Technology Laboratory 0-0-4-2

Course Outcome: After completion of the course, students would be able to apply knowledge of Bioprocess Technology for future research and studies

Practicals

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

RM20.301 Research Methodology 2-0-0-2

Objective: To acquire fundamental knowledge research methodology and apply in liberal arts, sciences and applied sciences.

Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation - Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**

Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report. **05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of research methodology in liberal arts, sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Suggested Readings:

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

BS20.311 Environmental Biotechnology 4-0-0-4

Course Objective: To get familiar about the importance of different aspects of the environmental biotechnology

Conventional fuels and their environmental impact Firewood, Plant, Animal, Water, Coal and Gas. [09]

Modern fuels and their environmental impact–Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol [10]

Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents. Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms-degradation aromatic and chlorinates hydrocarbons and petroleum products. [20]

Treatment of municipal waste and Industrial effluents. Bio-fertilizers Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM). [10]

Enrichment of ores by microorganisms (Gold, Copper and Uranium). [10]

Environmental significance of genetically modified microbes, plants and animals.

Course Outcome: After completion of the course, students would be able to apply knowledge of Environmental Biotechnology for research and studies

Text Books:

1. Waste Water Engineering, Metcalf and Eddy, Tata McGrawhill
2. Agricultural Biotechnology, S.S.Purohit

Reference Books:

1. Environmental Biotechnology– Concepts and Applications, Hans-Joachim Jordening and Jesef Winter.
2. Environmental Microbiology: Methods and Protocols, Alicia L. RagoutDeSpencer, John
3. F.T.Spencer
4. Introduction to Environmental Biotechnology, Milton Wainwright
5. Principles of Environmental Engineering, Gilbert Masters
6. Waste water Engineering– Metcalf & Eddy

BS20.313 Environmental Biotechnology Laboratory 0-0-4-2

Course Objective: To gain the access of different tools and experiments related to the environmental biotechnology.

Practicals

1. Calculation of Total Dissolved Solids (TDS) of water sample.
2. Calculation of BOD of water sample.
3. Calculation of COD of water sample.
4. Bacterial Examination of Water by MPN Method.
5. Isolation of Coliforms from faecal water sample
6. Determination of Chlorine in water sample
7. Isolation of epi and endophytes for Biofertlizer development
8. Isolation of microorganisms for degradation of xenobiotics

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of Environmental Biotechnology Laboratory

BS20.315 Bioinformatics 4-0-0-4

Course Objective: To gain the knowledge of different programmes and software required for database management

History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web. [10]

Protein Information Sources, PDB, SWISSPROT, TREMBL, [10]

Understanding the structure of each source and using it on the web.

Introduction of Data Generating Techniques and Bioinformatics problem posed by them-Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry. [10]

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis. [12]

Searching Databases: SRS, Entrez, Sequence similarity Searches- BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools. [10]

Course Outcome: After completion of the course, students would be able to apply the Bioinformatics for research and future career

Text Book

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.

Reference Book

2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.

3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings

BS20.317 Bioinformatics Laboratory 0-0-4-2

Course Outcome: To get the expertise on the databases and programmes.

Practicals

1. Sequence information resource
2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)
3. Understanding and using: PDB, Swissprot, TREMBL
4. Using various BLAST and interpretation of results.
5. Retrieval of information from nucleotide databases.
6. Sequence alignment using BLAST.
7. Multiple sequence alignment using Clustal W

Course Outcome After completion of the course, students would be able to apply the experimental knowledge of Bioinformatics Laboratory.:

BS20.302 Genomics and Proteomics **3-0-0-3**

Course Objective: To gain the knowledge of the genome and protein details.

Introduction to Genomics, DNA sequencing methods–manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical (clone contig) methods, Computer tools for sequencing projects: Genome sequence assembly software [10]

Managing and Distributing Genome Data: Web based servers and softwares For genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases. [10]

Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, vanderwaal interactions, hydrogen bonds, Hydrophobic interactions. Determination of sizes (Sedimentation analysis, Gel filteration, SDS-PAGE); Native PAGE, Determination of Covalent structures–Edman degradation. [10]

Introduction to Proteomics, Analysis of proteomes. 2D-PAGE. Sample preparation, solubilization, reduction, resolution. [06]

Reproducibility of 2D PAGE. Mass spectrometry based methods for protein identification. Denovo sequencing using mass spectrometric data. [06]

Course Outcome: After completion of the course, students would be able to apply genomics and proteomics tool for research purpose.

Text Books:

1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.
2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing,1987.
3. MolecularBiotechnology:PrinciplesandApplicationsofRecombinantDNA,4th Edition,
4. B.R. Glick, J.J. Pasternakand C.L. Patten, 2010.
5. Molecular cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol.I to III, 1989.

Reference Books:

1. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
2. Russell, P.J. (2009). *i*Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
3. Glick, B.R., Pasternak ,J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington.
4. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley & Sons.

BS20.304 Genomics and Proteomics Laboratory 0-0-4-2

Course Objective: To get familiarity about the experiments of proteomics and genomics.

Practicals

1. Use of SNP databases at NCBI and other sites
2. Use of OMIM database
3. Detection of Open Reading Frames using ORF Finder
4. Proteomics 2 DPAGE database
5. Softwares for Protein localization.
6. Hydropathy plots
7. To perform Native PAGE
8. To perform SDS-PAGE

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of Genomics and Proteomics Laboratory

BS20.306 Bio-Analytical Tools 4-0-0-4

Course Objective: To gain the knowledge of tools and techniques related to different analytical techniques of applied science field

Microscopy: Simple microscopy, phase contrast microscopy, florescence and Electron microscopy (TEM and SEM), pH meter, absorption and Emission spectroscopy [10]

Spectroscopy: Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible,UV,infra-red), centrifugation, cell fractionation techniques, Isolation of sub-cellular organelles and particles. [10]

Centrifugation techniques, cell fractionation techniques, Isolation of sub-cellular organelles and particles. [05]

Chromatography: Introduction to the principle of chromatography. Paper chromatography, Thin layer chromatography, column chromatography: silica and gel filtration, Affinity and ion exchange chromatography, gas chromatography, HPLC. [14]

Electrophoresis: Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gelelectrophoresis, pulse field Gel electrophoresis, immuno-electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology And their applications**.** [20]

Course Outcome: After completion of the course, students would be able

to apply the knowledge of Bio-Analytical Tools subject to accomplish future career goals

Text Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. DeRobertis, E.D.P. and DeRobertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

1. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Becker, W.M., Kleinsmith, L.J.,Hardin. J. and Bertoni, G.P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

BS20.308 Bio-Analytical Tools Laboratory 0-0-4-2

Course Objective: To learn about the working principle of various laboratory equipment to be used in basic and applied sciences

Practicals

1. Native gel electrophoresis of proteins
2. SDS-polyacrylamide slab gel electrophoresis of protein sunderreducing
3. conditions.
4. Preparation of the sub-cellular fractions of rat liver cells.
5. Preparation of protoplasts from leaves.
6. Separation of amino acids by paper chromatography.
7. To identify lipids in a given sample by TLC.
8. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of Bio-Analytical Tools Laboratory.

BS20.310 Project work 0-0-4-2

Course Objective: To accomplish a minor project so that student can learn and think about research work

Students are required to do project/dissertation work under the supervision of assigned faculty member and will submit a report at the end of semester. She will also give a presentation of the research work done and her evaluation will be based work and done and viva voce.

Course outcome: To gain the knowledge to accomplish the research in different laboratories.

BS20.312 Animal Biotechnology 4-0-0-4

Course Objective: To acquire the knowledge of the animal cell behaviour and latest techniques of animal cell culture.

Gene transfer methods in Animals– Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer. [10]

Introduction to transgenesis. Transgenic Animals–Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology–Foot-and mouth disease, Coccidiosis, Trypanosomiasis, The ileriosis. [10]

Animal propagation– Artificial insemination, Animal Clones. [10]

Conservation Biology–Embryo transfer techniques. Introduction to Stem Cell Technology and its applications. [10]

Genetic modification in Medicine- gene therapy, types of gene therapy, vectors in gene therapy, molecular engineering, human genetic engineering, problems & ethics. [12]

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of Animal Biotechnology to apply in future studies

Text Books:

1. Brown, T.A. (1998). Molecular biology LabfaxII: Gene analysis. II Edition. Academic Press, California, USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Biosscientific publishers.

Reference Books:

1. Glick, B.R. and Pasternak, J.J. (2009).Molecular biotechnology-Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
2. Griffiths, A.J.F., J.H.Miller, Suzuki,D.T., Lewontin,R.C. and Gelbart,W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
3. Watson, J.D., Myers,R.M., Caudy,A.and Witkowski,J.K. (2007).Recombinant DNA-genes and genomes- A short course. III Edition. Freeman and Co.,N.Y., USA.

BS20.314 Animal Biotechnology Laboratory 0-0-4-2

Course Objective: To gain the acquaintance of laboratory technology of the animal cell culture.

Practicals

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. DNA isolation from animal tissue
7. Quantification of isolated DNA.

8. Resolving DNA on Agarose Gel.

Course outcome: After completion of the course, students would be able to apply the experimental knowledge of Animal Biotechnology Laboratory

BS20.316 Plant Biotechnology 4-0-0-4

Course objective: To learn the importance of different agriculture field's latest technologies to be applied in the fields.

Introduction, Cryo and organogenic differentiation, Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropropagation. [10]

In vitro haploid production Androgenic methods: Anther culture, Micro spore culture and ogenesis Significance and use of haploids, Ploidy level and chromosome doubling, diplodization, Gynogenic haploids, Factors effecting gynogenesis, chromosome elimination techniques for Production of haploids in cereals. [10]

Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and Selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. [10]

Somaclonal variation Nomenclature, methods, applications basis and disadvantages. [10]

Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens, Growth promotion by free-living bacteria. [10]

Course outcome: After completion of the course, students would be able to apply the experimental knowledge of plant biotechnology for applied research

Text Books:

1. Bhojwani,S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Brown, T.A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.
3. Gardner, E.J. Simmonns, M.J.Snustad, D.P.2008 8th edition Principles of Genetics. Wiley India.

Reference Books:

4. Raven,P.H., Johnson, GB., Losos,J.B. and Singer,S.R.2005 Biology. Tata MC Graw Hill.
5. Reinert,J. and Bajaj,Y.P.S. 1997 Applied and Fundamental Aspects of Pla Cell, Tissue and Organ Culture. Narosa Publishing House.
6. Russell,P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjami
7. Sambrook & Russel. Molecular Cloning: A laboratory manual. (3rd editio
8. Slater,A., Scott,N.W. & Fowler,M.R. 2008 Plant Biotechnology: The

Genetic Manipulation of Plants, Oxford University Press.

BS20.318 Plant Biotechnology Laboratory 0-0-4-2

Course outcome: To get hands on training of technology of plant modification by using molecular approaches

Practicals

1. Preparation of simple growth nutrient (knop'smedium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. To selection, Prune, sterilize and prepare an explants for culture.
4. Significance of growth hormone sinculture medium.
5. To demonstrate various steps of Micropropagation.

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of plant biotechnology Laboratory.

Mody University of Science and Technology
Lakshmangarh-332311, Rajasthan

School of Liberal Arts and Sciences
Department of Chemistry

Bachelor of Science (Hons) Chemistry

(w.e.f. Academic Year 2020-21)

B.SC. (Hons) Chemistry W.e.f. academic session 2020-21
Programme Level: Undergraduate **Duration:**Three Years (Six Semesters) **No. of Seats:** 30
Affiliation: Mody University of Science and Technology
Objective: To impart world class teaching in Chemistry at undergraduate level
Scope: Employability in various Chemistry Laboratories and Chemistry research institutions across India
Input Qualification:10+2 with science stream
Evaluation Procedure: All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of Mody University shall be followed.

Vision: To educate the students for professional knowledge in the area of chemical sciences and to prepare them for higher studies
Mission: ▪ Provide excellent undergraduate education in state-of-the-art laboratories, classrooms, preparing students for advanced research. ▪ Provide them quality education and fosters advanced research experience in national and international labs. ▪ Support students for their career development, professional growth and to sustain in continuous lifelong learning.
Program Educational Objectives(PEOs):
Graduates will develop

PEO1	Graduates are prepared to be employed in industry, academia and research laboratories and by providing expected domain knowledge.
PEO2	Graduates are provided with practical training, hands-on and project experience to meet the industrial needs.
PEO3	Graduates are motivated in career and entrepreneurial skill development to become global leaders.
PEO4	Graduates are trained to demonstrate creativity, develop innovative ideas and to work in teams to accomplish a common goal.
PEO5	Graduates are addressed with social issues and guided to operate problems with solutions.

Program Outcomes (POs)	
At the end of the B.Sc.(Chemistry) Program, graduates will be able to-	
PO1	Critical Thinking: Apply knowledge of chemical field to identify, analyze problems of society and to provide effective solution.
PO2	Employability Skills: Inculcate skills to excel in the fields of chemistry in Government and Private sectors in academia and research industries.
PO3	Ethics: Instill ethical responsibilities, human and professional values and make their contribution to the society.
PO4	Self-Directed and Life-long Learning: Engaged in lifelong learning to equip them to the changing environment and be prepared to take-up entrepreneurship skills.
PO5	To understand the application of chemistry education in chemical industries.
PO6	Improving their knowledge in higher education and to produce students who have experience in proposing, planning, executing and reviewing scientific work in the office and the laboratory.
PO7	Plan and conduct scientific experiments and record the results of such experiments.
PO8	To develop the student's ability to communicate their scientific work effectively, both orally and in written form.
Program Specific Outcomes (PSOs):	
PSO1	To integrate the knowledge of chemistry for developing technologies for chemical industries.
PSO2	To impart knowledge for understanding of legal issues affecting chemical industries.
PSO3	To enhance expertise in tools and techniques in applied fields of chemistry.
PSO4	Plan and conduct scientific experiments and record the results of such experiments.
PSO5	Chemical investigation and analysis.
PSO6	Sample characterization techniques.
PSO7	Safety in laboratory.
PSO8	Record keeping and managing the records.
PSO9	Questioned documents examination and comparative analysis.
PSO10	Critical thinking of a problem.
PSO12	Understanding the need of modern tools in chemical sciences
PSO13	Laboratory techniques and instrumentation in Chemical science.
PSO14	Ethically improves the environment clean by disposing the hazardous chemical in a systematic way.

B.Sc. (Hons) Chemistry
Three Year Programme: Curriculum Structure
2020-21 and onwards
FIRST YEAR: Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	CH 20.101	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 20.103	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 20.105	Analytical Chemistry	3	-	-	3	3	25	25	50
	CH 20.107	Physical Chemistry and Molecular Spectroscopy	3	-	-	3	3	25	25	50
	CH 20.109	Analytical and Physical Chemistry Laboratory	-	-	4	2	4	25	25	50
	CH 20.111	Inorganic and Organic Chemistry Laboratory -I	-	-	2	1	3	25	25	50
	Generic Elective Courses (Select any one Subject Papers)									
	Students Passed XII with Mathematics Group									
	MS20.101	Differential and Integral Calculus	5	1	-	6	3	25	25	50
	PH20.103	Mechanics	4	-	-	4	3	25	25	50
	PH20.105	Physics Laboratory I	-	-	4	2	4	25	25	50
	Students Passed XII with Biology Group									
	BS20.117	Plant Diversity	4	-	-	4	3	25	25	50
	BS20.119	Plant Diversity Laboratory	-	-	4	2	4	25	25	50
	BS20.121	Animal Diversity	4	-	-	4	3	25	25	50
	BS20.123	Animal Diversity Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Foreign Language-I	3	-	-	3	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EL20.109	Foundation Course in English	2	-	-	2	3	25	25	50
		Total Credits Main	**25**with Math Group				**25**with Bio Group			
	SF 101	Personal Grooming and Fine Dining (Non-credit)	-	-	-	1	-	-	-	-

FIRST YEAR: Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	CH20.102	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH20.104	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH20.106	Pharmaceutical and Photochemistry	3	-	-	3	3	25	25	50
	CH20.108	Separation and spectroscopic Techniques	3	-	-	3	3	25	25	50
	CH20.110	Separation Techniques and Pharmaceutical Chemistry Laboratory	-	-	4	2	4	25	25	50
	CH20.112	Inorganic and Physical Chemistry Laboratory-I	-	-	2	1	3	25	25	50
	Generic Elective Courses(Select any one Subject Papers)									
	Students Passed XII with Mathematics Group									
	MS20.102	Group Theory	5	1	–	6	3	25	25	50
	PH20.102	Electricity and Magnetism	4	-	-	4	3	25	25	50
	PH20.106	Physics Laboratory II	-	-	4	2	4	25	25	50
	Students Passed XII with Biology Group									
	BS20.118	Plant Ecology and Taxonomy	4	-	-	4	3	25	25	50
	BS20.120	Plant Ecology and Taxonomy Laboratory	-	-	4	2	4	25	25	50
	BS20.122	Genetics and Evolutionary Biology	4	-	-	4	3	25	25	50
	BS20.124	Genetics and Evolutionary Biology Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Foreign Language-II	3	-	-	3	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EV20.102	Environmental Studies	3	1	-	4	3	25	25	50
		Total Credits Main	**27** with Math Group				**27** with Bio Group			
	SF 102	Social Grooming, Home & Decor and Business Communication (Non-Credit)	-	-	-	1	-	-	-	-

SECOND YEAR: Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
	Core Courses									
	CH20.201	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH20.203	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH20.205	Advance Spectroscopy	3	-	-	3	3	25	25	50
	CH20.207	Bio-inorganic Chemistry and inorganic polymers	3	-	-	3	3	25	25	50
	CH20.209	Bio-inorganic Chemistry Laboratory	-	-	4	2	4	25	25	50
	CH20.211	Organic and Physical Chemistry-I	-	-	2	1	3	25	25	50
	Generic Elective Courses(Select any one Subject Papers)									
	Students Passed XII with Mathematics Group									
	MS20.201	Differential Equations	5	1	–	6	3	25	25	50
	PH20.209	Thermal Physics and Statistical Mechanics	4	-		4	3	25	25	50
	PH20.207	Physics Laboratory III	-	-	4	2	4	25	25	50
	Students Passed XII with Biology Group									
	BS20.221	Plant Anatomy and Embryology	4	-	-	4	3	25	25	50
	BS20.223	Plant Anatomy and Embryology Laboratory	-	-	4	2	4	25	25	50
	BS20.217	Animal Anatomy and Embryology of Vertebrates	4	-	-	4	3	25	25	50
	BS20.219	Animal Anatomy and Embryology Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Foreign Language-III	3	-	-	3	3	25	25	50
	Ability Enhancement Elective Courses									
		Mody University Elective-I	3	-	-	3	-	-	-	-
		Total Credits Main	**26**with Math Group				**26**with Bio Group			
	SF 201	Personal Grooming, Fine Dining and Home Safety (Non-Credit)	-	-	-	1	-	-	-	-

Autumn Semester

SECOND YEAR: Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	CH20.202	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH20.204	Organic Chemistry-III	3	-	-	3	3	25	25	50
	CH20.206	Chemistry of Cosmetics and Nanomaterials	3	-	-	3	3	25	25	50
	CH20.208	Quantum chemistry and Ionic equilibrium	3	-	-	3	3	25	25	50
	CH20.210	Cosmetics and Nanomaterial's Laboratory	-	-	4	2	4	25	25	50
	CH20.212	Inorganic and Organic chemistry Laboratory –II	-	-	2	1	3	-	-	-
	Generic Elective Courses(Select any one Subject Papers)									
	Students Passed XII with Mathematics Group									
	MS20.202	Real Analysis	5	1	-	6	3	25	25	50
	PH20.204	Wave and Optics	4	-	-	4	3	25	25	50
	PH20.208	Physics Laboratory IV	-	-	4	2	4	25	25	50
	Students Passed XII with Biology Group									
	BS20.212	Plant Physiology and Metabolism	4	-	-	4	3	25	25	50
	BS20.208	Plant Physiology Laboratory	-	-	4	2	4	25	25	50
	BS20.214	Animal Physiology and Biochemistry	4	-	-	4	3	25	25	50
	BS20.216	Animal Physiology and Biochemistry Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Foreign Language-IV	3	-	-	3	3	25	25	50
	Ability Enhancement Elective Courses									
		Mody University Elective-II	3	-	-	3	-	-	-	-
	CH20.214	Basic Mathematics*	2	-	-	2	3	25	25	50
		Total Credits Main	**26**with Math Group				**28**with Bio Group			
	SF 202	Social Grooming and Professional Skills (Non-Credit)	-	-	-	1	-	-	-	-

*****For Students Passed XII with Biology Group

THIRD YEAR: Autumn Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	CH20.301	Inorganic Chemistry-IV	3	-	-	3	3	25	25	50
	CH20.303	Physical Chemistry –III	2	-	-	2	3	25	25	50
	CH20.305	Organometallic Chemistry	3	-	-	3	3	25	25	50
	CH20.307	Heterocycles and Natural Products	3	-	-	3	3	25	25	50
	CH20.309	Organometallic and Natural Products Laboratory	-	-	4	2	4	25	25	50
	CH20.311	Inorganic and Physical chemistry Laboratory –II	-	-	2	1	4	25	25	50
	Discipline Specific Elective Courses: (Choose 12 Credits from DSE groups I or II*									
	CH20.313	Instrumental Methods and Advanced Materials	4	-	-	4	3	25	25	50
	CH20.315	Reagents & Reactions	4	-	-	4	3	25	25	50
	CH20.317	Instrumental Methods Laboratory	-	-	4	2	4	25	25	50
	CH20.319	Applications of Computers in Chemistry	2	-	-	2	3	25	25	50
	CH20.321	Molecular Modeling and Drug Design	4	-	-	4	3	25	25	50
	RM20.301	Research Methodology	2	-	-	2	3	25	25	50
	Skill Enhancement Courses									
		Foreign Language-V	3	-	-	3	3	25	25	50
		Total Credits Main	**29** with Math Group				**29**with Bio Group			
	GE20.301	Proficiency (Non-Credit)	-	-	-	1	-	-	-	-

***DSE-I**			***DSE-II**		
Course Code	**Course Title**	**Credits**	**Course Code**	**Course Title**	**Credits**
CH20.313	Instrumental Methods and Advanced Materials	4	CH20.319	Applications of Computers in Chemistry	2
CH20.317	Instrumental Methods Laboratory	2	CH20.321	Molecular Modeling and Drug Design	4
CH20.315	Reagents & Reactions	4	CH20.315	Reagents & Reactions	4
RM20.301	Research Methodology	2	RM20.301	Research Methodology	2
Total Credits		**12**	Total Credits		**12**

THIRD YEAR: Spring Semester

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	CH20.302	Organic Chemistry-IV	3	-	-	3	3	25	25	50
	CH20.304	Physical Chemistry –IV	2	-	-	2	3	25	25	50
	CH20.306	Chemistry of Polymers & Petrochemicals	2	-	-	2	3	25	25	50
	CH20.308	Inorganic Materials of Industrial Importance	4	-	-	4	3	25	25	50
	CH20.310	Inorganic Materials of Industrial ImportanceLaboratory	-	-	4	2	4	25	25	50
	CH20.312	Organic and Physical chemistry Laboratory –II	-	-	2	1	3	25	25	50
	Discipline Specific Elective Courses (Choose 12 Credits from DSE groups III or IV*									
	CH20.314	Green and Environmental Chemistry	2	-	-	2	3	25	25	50
	CH20.316	Organic Reaction Dynamics & Reactive Intermediates	2	-	-	2	3	25	25	50
	CH20.318	Green Chemistry Laboratory	-	-	4	2	4	25	25	50
	CH20.320	Polymer Chemistry	2	-	-	2	3	25	25	50
	CH20.322	Industrial Chemicals	2	-	-	2	3	25	25	50
	CH20.324	Project[$]	-	-	-	6	-	-	-	100
	Skill Enhancement Courses									
		Foreign Language-VI	3	-	-	3	3	25	25	50
		Total Credits Main	**29**with Math Group				**29**with Bio Group			
	GE20.302	Proficiency (Non-Credit)	-	-	-	1	-	-	-	-

CW: Course Work; **MTE:** Mid Term Examination; **ETE:** End Term Examination
Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.
Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.
$ Evaluation of project would comprise project report and viva-voce.

***DSE-III**			***DSE-IV**		
Course Code	**Course Title**	**Credits**	**Course Code**	**Course Title**	**Credits**
CH20.314	Green and Environmental Chemistry	2	CH20.320	Polymer Chemistry	2
CH20.318	Green Chemistry Laboratory	2	CH20.322	Industrial Chemicals	2
CH20.316	Organic Reaction Dynamics & Reactive Intermediates	2	CH20.316	Organic Reaction Dynamics & Reactive Intermediates	2
CH20.324	Project[$]	6	CH20.324	Project[$]	6
Total Credits		**12**	Total Credits		**12**

Credit Summary (With Mathematics & Physics)

Yr	Sem	Credits					Non-Credits Compulsory	Total
		Core Courses	**Discipline Specific Elective Courses**	**Generic Elective Courses**	**Ability Enhancement Compulsory Courses**	**Skill Enhancement Courses**	**SEFS/ Proficiency**	
I	Autumn	14	---	6	2	3	1	**25**
	Spring	14	---	6	4	3	1	**27**
II	Autumn	14	---	6	3	3	1	**26**
	Spring	14	---	6	3	3	1	**26**
III	Autumn	14	12	---	---	3	1	**29**
	Spring	14	12	---	---	3	1	**29**
Total		**84**	**24**	**24**	**12**	**18**	**6**	**162 Credits + 6 Non-Credits)**

Credit Summary (Botany & Zoology)

Yr	Sem	Credits					Non-Credits Compulsory	Total
		Core Courses	**Discipline Specific Elective Courses**	**Generic Elective Courses**	**Ability Enhancement Compulsory Courses**	**Skill Enhancement Courses**	**SEFS/ Proficiency**	
I	Autumn	14	---	6	2	3	1	**25**
	Spring	14	---	6	4	3	1	**27**
II	Autumn	14	---	6	3	3	1	**26**
	Spring	14	---	6	5	3	1	**28**
III	Autumn	14	12	---	---	3	1	**29**
	Spring	14	12	---	---	3	1	**29**
Total		**84**	**24**	**24**	**14**	**18**	**6**	**164 credits + 6 Non-Credits)**

CH 20.101	Inorganic Chemistry-I	2-0-0-2
Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, normal and orthogonal wave functions, quantum numbers and their significance, sign of wave functions, radial and angular wave function, radial probability distribution curves, shapes of s, p, d and f orbitals, Aufbau's principle and its limitations, Pauli's exclusion principle, Hund's rule of maximum multiplicity, variation of orbital energy with atomic number, electronic configurations of the elements and ions.		**[7]**
Chemical Bonding: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicentric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories.		**[7]**
Chemistry of *s*- Block Elements: Electronic configurations, diagonal relationships, solvation and complexation tendencies including their functions in biosystems.		**[4]**
Periodicity of p-block elements: Periodicity in properties of p-block elements, some important compounds of p-block elements: hydrides of boron, diborane and higher boranes, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitrides, basic properties of halogens, interhalogens and polyhalides.		**[4]**
Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds (XeF_2, XeF_4, XeF_6, $XeOF_4$, XeO_2F_2, XeO_3). Weak Interactions: Hydrogen bonding, Vander Waals forces.		**[4]**
Suggested Readings: **Text Books:** 1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD. **Reference Books:** 1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience. 2. J.D. Lee*Concise Inorganic Chemistry* ELBS, 1991. 3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd		

CH 20.103	Organic Chemistry-I	3-0-0-3

Fundamentals of Organic Chemistry: Hybridization, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance, Hyperconjugation, charge-transfer compounds and field effects. Cleavage of Bonds: Homolysis and Heterolysis, Nucleophiles and electrophiles, shape and stability order of reactive intermediates: Carbocations, Carbanions and free radicals.Strength of organic acids and bases: Comparative study with emphasis on factors affectingpK_a values.	**[7]**
Stereochemistry: Conformations with respect to ethane, n-butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality and Elements of symmetry. Configuration: Geometrical and Optical isomerism; Enantiomerism,Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S and E / Z nomenclature.	**[8]**
Chemistry of Alkanes and Alkenes: Preparation,Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.	**[8]**
Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization.	**[8]**
Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction.	**[8]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

4. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
5. A. Bahl and B. S. Bahl, Advanced Organic Chemistry, 19th Ed. 2005.
6. John E. McMurry,Fundamentals of Organic Chemistry, 7th Ed. 2013, Cengage Learning India.

CH 20.105	Analytical Chemistry	3-0-0-3
Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of theirexpression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and test, rejection of data, and confidence intervals.		**[7]**
Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.		**[6]**
Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation(Choice of source, monochromator, and detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitativeestimation of trace level of metal ions from water samples.		**[10]**
Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrumentation techniques for quantitative estimation of Ca and Mg from their mixture.		**[6]**
Electro-analytical methods: Classification of electro analytical methods, basic principle of pH metric andconductometric titrations. Techniques used for the determination of equivalence points.Techniques used for the determination of pK_a values.		**[10]**

Suggested Readings:

Text Books:

1. H.H. Willard, Instrumental Methods of Analysis, 7th Edition, 1988, Wadsworth Publishing Company.
2. G.D. Christian, Analytical Chemistry, 6th Edition, 2004 John Wiley & Sons, NY.

Reference Books:

1. D. C. Harris, Quantitative Chemical Analysis, 6th Edition, 2007, W.H. Freeman and company.
2. S. M. Khopkar, Basic Concepts of Analytical Chemistry, 2008, New Age International Publisher.
3. D. A. Skoog, F. J. Holler. T.A. Nieman , Principles of Instrumental Analysis, 5th Edition , 2005, Thomson Asia Pvt. Ltd.

CH 20.107	Physical Chemistry and Molecular Spectroscopy	3-0-0-3

Chemical Thermodynamics: First law: Concept of heat, q, work, w, internal energy, U, and statement of first law, Second Law: Concept of entropy and Third Law: Concept of residual entropy. **Chemical Energetics:** Important principles and definitions of thermo-chemistry. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. **Chemical Equilibrium:** Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases and concept of fugacity. **Liquid state:** Qualitative treatment of the structure of the liquid state, Radial distribution function, physicalproperties of liquids, Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. **Solid state:** Nature of the solid state, Miller indices, Defects in crystals. Glasses and liquid crystals, qualitative idea of point and space groups.	**[15]**
Molecular Spectroscopy: Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution. Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches. Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model. Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor Precession, chemical shift and low resolution spectra, different scales, spin-spin coupling andhigh resolution spectra. Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.	**[24]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B.Sc. Part III, 2009, RBD.
2. K. R. Genwa, Physical Chemistry B.Sc. Part III, 2004, RBD.

Reference Books:

1. P.W. Atkins, The elements of Physical Chemistry, 7th Ed. 2003, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 7th Ed. 2009, Vishal Publishing Co.
3. R. L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.
4. A.O. Thomas, Practical Chemistry, 8th Ed. 2008, Geethanjali Offset Prints, Calicut.

5. A. Peter and J. De. Paula, Physical Chemistry 10th Ed., 2014, Oxford University Press.
6. G. W. Castellan, Physical Chemistry 4th Ed., 2004, Narosa
7. C. N. Banwell & E. M. McCash, Fundamentals of Molecular Spectroscopy4th Ed. 2006,Tata McGraw-Hill: New Delhi

CH 20.109	Analytical and Physical Chemistry Laboratory	0-0-4-2

Perform any EIGHT experiments from the below list.

1. Determination of pK_a values of indicator using spectrophotometry.
2. Determination of dissolved oxygen in water.
3. Determination of chemical oxygen demand (COD).
4. Determination of Biological oxygen demand (BOD).
5. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
6. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
7. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values.
8. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
9. Study the kinetics of iodination of propanone in acidic medium.
10. Determine the amount of iron present in a sample using 1,10-phenanthroline.
11. Determine the dissociation constant of an indicator (phenolphthalein).
12. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
13. Analysis of the given vibration-rotation spectrum of HCl(g)

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham,Vogel's Quantitative Chemical Analysis, 6th Ed.,2009, Pearson Education.

CH 20.111	Inorganic and Organic Chemistry Laboratory-I	0-0-2-1

Perform any EIGHT experiments from the below list.

1-4.To analyze the given mixture containing four radicals (two acidic and two basic) including interfering acid radicals- fluoride, borate, oxalate, phosphate and excluding insoluble. (Four mixture)

5. Preparation of standard solutions of different Molarity/Normality of titrants.
6. Purification of a given organic sample solid/liquid through crystallization or distillation and

ascertaining their purity through melting point or boiling point.

7. To study the process of sublimation of camphor and phthalic acid.
8. Systematic identification-I (detection of extra elements, functional groups: To determine the functional group of the given organic compound through element detection and functional group analysis: Carboxylic Acid, alcoholic, phenolic, ester, aldehydic, ketonic, carbohydrate, amide, anilide, nitro and hydrocarbon.

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry:Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

MS20.101	**Differential and Integral Calculus**	**5-1-0-6**
Objective: To acquire fundamental knowledge of differential calculus and integral calculus and apply in sciences and applied sciences.		
1. Differential Calculus I: Functions, Types of functions, Limits and continuity ($\epsilon - \delta$ definition),Types of discontinuities, Higher order derivatives, Indeterminate forms, L-Hospital's rule, Leibniz rule , Points of extreme, Concavity and inflection points, Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series, Jacobeans, interdisciplinary applications.		[13]
2. Differential Calculus II :Parallel and oblique asymptotes in Cartesian and Polar coordinates, Intersection of a curve with its asymptotes, application of differentiation in curve sketching/tracing in cartesian and polar coordinates, Tangent and normal-Introduction,Equation of tangent and normal,Angle of intersection of two curves, Suntangent and subnormal,Polar subtangent and subnormal,Pedal equation;Curvature and Evolutes-Introduction, Center and radius of curvature in Cartesian and polar forms,Pedal curve,Tangential polar formula,Chord of curvature,Evolutes and involutes,Newtonian method.		[13]
3. Integral Calculus I: Review as a limiting sum of areas and the anti-derivative/ indefinite integral, the fundamental theorem of Calculus, Reduction formulae and its derivation and illustration for the type $\int \sin^n(x)dx$, $\int \cos^n(x)dx$, $\int \tan^n(x)dx$, $\int \sin^n(x)\cos^n(x)dx$, $\int sinnxdx$, $\int cosnxdx$, $\int tannxdx$, $\int secnxdx$, $\int (logx)^n dx$ etc.		[13]
4. Integral Calculus II:Computing volumes by slicing, disk and washer method, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, area of surface of revolution Surface areas and volumes using Pappus-Guldinus theorems(with proof) and solid of revolution.		[13]
5. Conic Section and Vector Functions:Techniques ofsketching conics, reflection properties of		

conics, rotation of axes and second degree equations, classification of conics using the discriminate, polar equation of conics, Triple product, introduction, operations of vector functions, limit, continuity, differentiation and integration of vector functions, tangent and normal form of acceleration, modeling ballistics and planetary motion, Kepler's second law with interdisciplinary applications.	[13]
Course Outcome: After completion of the course, students would be able to apply the knowledge of differential calculus and integral calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.	
Text Books: 1. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson. 2. Dennis G. Zill and Warren S. Wright (2011), Single Variable Calculus, 4/e, Jones and Bartlett Learning.	
Reference Books: 1. Mittal P.K. (2016), Mathematics for Degree Students, S. Chand and Company Pvt. Ltd. 2. Ramana B.V (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi. 3. Jain and Iyengar (2004) Advanced Engineering Mathematics, Narosa Publishing House. 4. Mendelson (2016), Schaum's outline of Beginning Calculus, McGraw Hill Education.	

PH20.103	**Mechanics**	**4-0-0-4**
Course Objective: The objective of the course is to enhance the understanding of the basics of mechanics with the review of Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations.		
Course Outcome: The student will be able to: *CO1:* Describe relative motion, Inertial and non-inertial reference frames. *CO2:* Articulate and describe parameters defining the motion of mechanical systems *CO3:* Study of the interaction of forces between solids in mechanical systems. *CO4:* Articulate and describe centre of mass of mechanical systems. *CO5:* Articulate and describe laws of motion and conservation principles.		
Unit-I Fundamentals of Dynamics: Reference frames, Inertial frames, Galilean transformations, Galilean invariance, Review of Newton's Laws of Motion. Momentum of variable mass system: motion of rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D). **Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable, unstable and neutral equilibrium. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. **Collisions:** Elastic (1-D and 2-D) and inelastic collisions. Centre of Mass and Laboratory frames.		[12]
Unit-II Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia, theorem of parallel and perpendicular axes. Determination of moment of inertia of discrete and continuous objects [1-D, 2-D & 3-D (rectangular, cylindrical and spherical)]. Kinetic energy of		[10]

rotation. Motion involving both translation and rotation.	
Unit-III Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. **Motion of a particle under a central force field:** Two-body problem, its reduction to one-body problem and its solution. Reduction of angular momentum, kinetic energy and total energy. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit, Geosynchronous orbits.	[10]
Unit-IV Oscillations: Idea of SHM. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Compound pendulum. Damped oscillation. Forced oscillations: Transient and steady states, sharpness of resonance and Quality Factor. **Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications**.**	[10]
Unit-V Special Theory of Relativity: Outcomes of Michelson-Morley Experiment. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity, Length contraction, Time dilation. Relativistic transformation of velocity, acceleration, frequency and wave number. Mass of relativistic particle. Mass-less Particles. Mass-energy Equivalence. Relativistic Doppler effect (transverse and longitudinal). Relativistic Kinematics (decay problems, inelastic collisions and Compton effect). Transformation of Energy and Momentum.	[10]

Text Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Reference Books:

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education.

PH20.105	**Physics Laboratory-I**	**0-0-4-2**

1. To determine the moment of inertia of a flywheel about its own axis of rotation.
2. To determine the value of modulus of rigidity of a given wire by Maxwell needle.
3. To determine the value of Poisson’s ratio for the material of given wire using Searl’s method.
4. To determine the Young’s modulus of material of a rectangular bar by bending.
5. To determine the viscosity of glycerin by Stoke’s Law.
6. To convert a galvanometer into voltmeter of given range.
7. To determine the specific resistance of a given wire by using the Carey Foster’s bridge.

**Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may*

BS20.117	Plant Diversity	4-0-0-4

Objective: To familiarize the students to special group of bacteria, algae and fungi and analyse the relationship between them.

Unit-1 Microbes: Viruses:Discovery,generalstructure,replication(generalaccount),DNAvirus(T-phage); Lyticandlysogeniccycle, RNA virus(TMV); Economic importance; Bacteria–Discovery, General characteristics and cell structure; Reproduction–vegetative, asexualandrecombination(conjugation,transformationandtransduction);Economicimportance.	**9**
Unit-2 **Algae:** General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life. Cycles of the following: *Nostoc*, *Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia*. Economic importance of algae.	**10**
Unit-3 **Fungi:** Introduction-General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi-General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria*(Ascomycota), *Puccinia*,*Agaricus*(Basidiomycota);SymbioticAssociations-Lichens:Generalaccount,reproductionandsignificance;Mycorrhiza:ectomycorrhizaandendomycorrhizaandtheirsignificance	**10**
Unit-4 Bryophytes & Pteridophyte: Generalcharacteristics,adaptationstolandhabit,Classification,Rangeofthallusorganization.Classification(uptofamily),morphology,anatomyandreproductionof*Marchantia*and*Funaria*.(Developmentaldetailsnottobeincluded).Ecologyandeconomicimportanceofbryophyteswithspecialmentionof*Sphagnum*. General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.	**16**
Unit-5 Gymnosperm & Archegoniate: Generalcharacteristics,classification.Classification(uptofamily),morphology,anatomyandreproductionof*Cycas*and*Pinus*.(Developmentaldetailsnottobeincluded).Ecologicalandeconomicalimportance.Unifyingfeaturesofarchegoniates,Transitiontolandhabit,Alternationofgenerations.	**7**
Course Outcome After completion of the course, students would be able to understand, appreciate and apply the economic, ecological and pathological importance of various microbes	

SuggestedReadings

Text Books:

1. Kumar,H.D. (1999).Introductory Phycology. AffiliatedEast-West. Press Pvt. Ltd. Delhi 2nd edition.
2. Sethi,I.K.andWalia,S.K.(2011).Text book of Fungi &Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
3. Parihar,N.S.(1991).An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Vashishta,P.C.,Sinha,A.K.,Kumar,A.,(2010).Pteridophyta,S.Chand.Delhi,India.
5. Bhatnagar,S.P.andMoitra,A.(1996).Gymnosperms. New Age International(P) Ltd Publishers, New Delhi, India.

Refence Books:

6. Raven,P.H.,Johnson,G.B.,Losos,J.B.,Singer,S.R.,(2005).Biology.TataMcGrawHill,Delhi,India.
7. Tortora,G.J.,Funke,B.R.,Case,C.L.(2010).Microbiology:AnIntroduction,PearsonBenjaminCummings,U.S.A.10th edition.

8. Alexopoulos,C.J.,Mims,C.W.,Blackwell,M.(1996).IntroductoryMycology,JohnWileyandSons(Asia),Singapore.4th edition.

BS20.119	**Plant DiversityLaboratory**	**0-0-4-2**
Objective	To acquaint the students with external and internal basic structure and cellularcomposition of the Bacteria, Viruses, Fungi, Bryophytes and Pteridophytes and Gymnosperms.	

1. EMs/Modelsofviruses–T-PhageandTMV,Linedrawing/PhotographofLyticandLysogenicCycle.
2. TypesofBacteriafromtemporary/permanentslides/photographs;EMbacterium;BinaryFission;Conjugation;Structureofrootnodule.
   Gram staining
3. Studyofvegetativeandreproductivestructuresof*Nostoc*,*Chlamydomonas*(electronmicrographs),*Oedogonium*,*Vaucheria*,*Fucus*andPolysiphonia*throughtemporarypreparationsandpermanentslides.(**Fucus*-Specimenandpermanentslides)
4. *RhizopusandPenicillium*:Asexualstagefromtemporarymountsandsexualstructuresthroughpermanentslides.
5. *Alternaria:*Specimens/photographsandteasemounts.
6. *Puccinia*:HerbariumspecimensofBlackStemRustofWheatandinfectedBarberryleaves;section/teasemountsofsporesonWheatandpermanentslidesofboththehosts.
7. *Agaricus*:Specimensofbuttonstageandfullgrownmushroom;Sectioningofgillsof *Agaricus*.
8. Lichens:Studyofgrowthformsoflichens(crustose,folioseandfruticose)
9. Mycorrhiza:ectomycorrhizaandendomycorrhiza(Photographs)
10. ***Marchantia***-
    morphologyofthallus,w.m.rhizoidsandscales,v.s.thallusthroughgemmacup,w.m.gemmae(alltemporaryslides),v.s.antheridiophore,archegoniophore,
    l.s.sporophyte(allpermanentslides).
11. ***Funaria***-
    morphology,w.m.leaf,rhizoids,operculum,peristome,annulus,spores(temporaryslides);permanentslidesshowingantheridialandarchegonialheads,l.s.capsuleandprotonema.
12. ***Selaginella***-
    morphology,w.m.leafwithligule,t.s.stem,w.m.strobilus,w.m.microsporophyllandmegasporophyll(temporaryslides),l.s.strobilus(permanentslide).
13. ***Equisetum***-morphology,t.s.internode,l.s.strobilus,t.s.strobilus,w.m.sporangiophore,
    w.m.spores(wetanddry)(temporaryslides);t.srhizome(permanentslide).
14. ***Pteris***-
    morphology,t.s.rachis,v.s.sporophyll,w.m.sporangium,w.m.spores(temporaryslides),t.s.rhizome,w.m.prothalluswithsexorgansandyoungsporophyte(permanentslide).
15. ***Cycas***-morphology(coralloidroots,bulbil,leaf),t.s.coralloidroot,t.s.rachis,v.s.leaflet,
    v.s.microsporophyll,w.m.spores(temporaryslides),l.s.ovule,t.s.root(permanentslide).
16. ***Pinus***-
    morphology(longanddwarfshoots,w.m.dwarfshoot,maleandfemale),w.m.dwarfshoot,t.s.needle,t.s.stem,,l.s./t.s.malecone,w.m.microsporophyll,w.m.microspores(temporaryslides),l.s.femalecone,t.l.s.&r.l.s.stem(permanentslide).

BS20.121	Animal Diversity	4-0-0-4
Objective	To identify different characteristics and classification of various phyla's.	
Unit-1 Kingdom Protista: Generalcharactersandclassificationuptoclasses;LocomotoryOrganellesandlocomotioninProtozoa		**4**
Unit-2 PhylumPorifera, Cnidaria, Platyhelminthes & Nemathelminthes: Generalcharactersandclassificationuptoclasses;CanalSysteminSycon,Generalcharactersandclassificationuptoclasses; PolymorphisminHydrozoa, Generalcharactersandclassificationuptoclasses;LifehistoryofTaeniasoliumGeneralcharactersandclassificationuptoclasses;LifehistoryofAscarislumbricoidesanditsparasiticadaptations.		**12**
Unit-3 Phylum Annelida, Arthropoda, Mollusca&Echinodermata Generalcharactersandclassificationuptoclasses;MetamerisminAnnelida; Generalcharactersandclassificationuptoclasses; VisioninArthropoda,MetamorphosisinInsects. Generalcharactersandclassificationuptoclasses;Torsioningastropods.General characters and classification up to classes; Water-vascular system in Asteroidea.		**14**
Unit-4 General features and Phylogeny of Protochordata: General features of Agnatha and classification of cyclostomes up to classes, General features and Classification up to orders; Osmoregulation in Fishes, General features and Classification up to orders; Parental care, General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes.		**14**
Unit-5 Aves & Mammals: GeneralfeaturesandClassificationuptoorders;Flightadaptationsinbirds, Classificationuptoorders;Originofmammals		**8**
Note:ClassificationofUnit1-9tobefollowedfrom"Barnes,R.D.(1982).*InvertebrateZoology*,VEdition"		
Course Outcome: After completion of the course, students would be able to apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.		

SUGGESTED READINGS

Text Books:

1. RuppertandBarnes,R.D.(2006).*InvertebrateZoology*,VIIIEdition.HoltSaundersInternationalEdition.
2. Young,J.Z.(2004).*TheLifeofVertebrates*.IIIEdition.Oxforduniversitypress.
3. PoughH.*Vertebratelife*,VIIIEdition,PearsonInternational.

Reference Books:

1. Barnes,R.S.K.,Calow,P.,Olive,P.J.W.,Golding,D.W.andSpicer,J.I.(2002).*TheInvertebrates:ANewSynthesis*,IIIEdition,BlackwellScience.
2. HallB.K.andHallgrimssonB.(2008).*Strickberger'sEvolution*.IVEdition.JonesandBartlettPublishersInc.

BS20.123	Animal diversity Laboratory	0-0-4-2
Objective: To identify anatomical and physiological attributes of each animal group.		
1. Studyofthefollowingspecimens: *Amoeba,Euglena,Plasmodium,Paramecium,Sycon,Hyalonema,*and*Euplectella,Obelia, Physalia, Aurelia, Tubipora,Metridium, Taeniasolium,*Maleand female *Ascarislumbricoides, Aphrodite,Nereis,Pheretima,Hirudinaria,Palaemon,Cancer,Limulus,Palamnaeus,Scolopendra,J*		

*ulus,Periplaneta,Apis,Chiton,Dentalium,Pila,Unio,Loligo,Sepia,Octopus,Pentaceros,Ophiura,Echinus,Cucumaria*and*Antedon,Balanoglossus,Herdmania,Branchiostoma,Petromyzon,Sphyrna,Pristis,Torpedo,Labeo,Exocoetus,Anguilla,Ichthyophis/Ureotyphlus,Salamandra,Bufo,Hyla,Chelone,Hemidactylus,Chamaeleon,Draco,Vipera,Naja,Crocodylus,Gavialis,*Anysixcommonbirdsfrom differentorders,*Sorex*,Bat,*Funambulus,Loris*

2. Studyofthefollowingpermanentslides:
   T.S.andL.S.of*Sycon*,Studyoflifehistorystagesof*Taenia*,T.S.ofMaleandfemale *Ascaris*
3. KeyforIdentificationofpoisonousandnon-poisonoussnakes An "**animalalbum**" containingphotographs,cutouts,withappropriatewriteupabouttheabovementionedtaxa.Differenttaxa/topicsmaybegiventodifferentsetsofstudentsforthispurpose.

Course Outcome: After completion of the course, students would be able to understand animal interactions with the environment and identify the major groups of organisms with an emphasis on animals and classify them within a phylogenetic framework.

EL20.109	**Foundation Course in English**	**2-0-0-2**
Objective:	Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.	
Unit-1 **Sentence Structure:** Elements of a sentence (Subject, verb, object, complement and adjunct) **Articles:** Definite and Indefinite & omission of articles.		[5]
Unit 2 **Transformation of Sentence Structure:** Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative).		[5]
Unit 3 **Correct Usage of Language:** Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need) **Common Errors in Effective Communication:** How to avoid common sentence – structural errors, vocabulary and pronunciation.		[6]
Unit 4 **Writing Skills:** Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing.		[6]
Unit 5 **Reading Comprehension:** Efficient reading and note taking.		[4]
Course Outcome: The student will be able to:		
1. Learn the essentials of English Grammar. 2. Apply the rules of grammar to use flawless English in speech and writing. 3. Analyze, identify and rectify the common errors in speech and writing. 4. Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing. 5. Evaluate a piece of writing keeping in mind all the rules of grammar studied. 6. Read and comprehend English		

Text Books:

1. Wren & Martin: English Grammar & Composition, S. Chand & Co, Delhi (Latest edition)
2. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.

Reference Books:

1. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
4. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

CH20.102	Inorganic Chemistry-II	2-0-0-2
Chemistry of Elements of First Transition series: Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.		**[5]**
Chemistry of Elements of Second and Third Transition Series:General characteristics, comparative treatment with their 3d- analogues in respectof ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.		**[4]**
Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.		**[7]**
Chemistry of Lanthanide and Actinide Elements: Electronic configuration, oxidation states and ionic, atomic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. Preparation of transuranic elements, Chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.		**[10]**

Suggested Readings:

Text Books:

1. P.L. Soni, Text Book of Inorganic Chemistry, 1999, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

3. F.A. Cotton. G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry 5rd Ed. 2005, Wiley Interscience.
4. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 18th Ed. 2009, S. Chand & Co. Ltd.

D.F. Shriver & P.W. Atkins, *Inorganic Chemistry*, 5rd Ed. 2005, Oxford University Press.

CH20.104	Physical Chemistry-I	3-0-0-3
Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular		**[9]**

velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule-Thomson effect).	
Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholesteric phases.	**[6]**
Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).	**[7]**
Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore.	**[4]**
Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counters, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state.	**[3]**
Spectroscopy: Electromagnetic radiation of the spectrum, basic features of different spectrometers, Rotational Spectrum -Diatomic molecules, idea of vibrational frequencies of different functional groups. Raman Spectrum concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules.	**[4]**
Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grotthuss–Draper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).	**[6]**

Suggested Readings:

Text Books:

1. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, 2011, RBD.
2. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

1. P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
3. G.M. Barrow, Physical Chemistry, 2007,Tata McGraw-Hill.
4. G.W. Castellan, Physical Chemistry, 2004,4th Ed. Narosa.

CH20.106	**Pharmaceutical and Photochemistry**	**3-0-0-3**
Introduction: Concept of drug, Structure activity relationship (SAR), quantitative structure-activity relationship (QSAR); Factors affecting bioactivity – resonance, inductive effect, isosterism, bio-isosterism, spatial considerations; Theories of drug activity – occupancy theory, rate theory, induced fit theory Concept of drug receptors-elementary treatment of drug-receptor		**[11]**

interactions; Factors affecting modes of drug administration, absorption, metabolism and elimination; Significance of drug metabolism in medicinal chemistry.	
Synthesis and SAR mode of action of following: **Antibiotics:** Penicillins, Amoxicillins, Streptomycin, Tetracyclines and Chloroamphanicol. **Analgesics agents, Antipyretic agents and Antiinflammatory:** synthesis, SAR and mode of action of following: Aspirin, Paracetamol and Ibuprofen. **Antibacterial and Antifungal agents**: synthesis, SAR and mode of action of following: Sulphonamides, Sulphanethoxazol and Sulphacetamide. **Central Nervous System agents**: Phenobarbital and Diazepam. **Cardiovascular**: Glyceryl trinitrate.	**[16]**
Photochemistry: Basic principle, electron excitation, modes of dissipation of energy, jablonski diagram, photochemistry of olefins, dienes, carbonyl compounds, Norrish type-I and Norrish type II cleavage, Paterno-Buchi reaction, photo reduction. Photo-Fries rearrangement, ethers, nitriles, pyridinium ylides, quantum efficiency and quantum yield.	**[12]**

Suggested readings:

Text Books:

1. G. L.Patrick, An introduction to medicinal chemistry, Oxford press, 4th Ed. 2013.
2. J. Singh, Photochemistry and Pericyclic reactions, 3rd Ed. 2012, New Age International.

Reference Books:

3. Donald J. Abraham, Burger's Medicinal Chemistry; Drug discovery and development, 7th Ed. Wiley Interscience Publications.
4. D. Lednicer and L.A. Mitscher, TheOrganic Chemistry of Drug Synthesis; Vol. Ist, 2008, Wiley Interscience**Publications.**
5. Ashutosh Kar, Medicinal Chemistry, 2005, New Age International.
6. H. Singh, V. K. Kapoor, **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan, Pitampura, New Delhi, 2012.
7. W.O. Foye, T.L. Lemke, D.A. William, Principles of Medicinal Chemistry, 4th Ed., B.I. Waverly Pvt. Ltd. New Delhi.

CH20.108	**Separation and Spectroscopic Techniques**	**3-0-0-3**
Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique.Mechanism of extraction: extraction by solvation and chelation.Technique of extraction: batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions fromaqueous solution, extraction of organic species from the aqueous and nonaqueous media.Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange.Development of chromatograms: frontal, elution and displacement methods.Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC,TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation		

ofEnantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination ofenantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).Role of computers in instrumental methods of analysis.	**[20]**
Spectroscopic Techniques: Mass Spectrometry:Basic principle, Instrumentation,, Ion production (EI and CI techniques), molecular ion peak, base peak, ion analysis, ion abundance, McLafferty rearrangement, modes of fragmentation, metastable peak, Retro-Diels Alder reaction, double charged ion, nitrogen rule, double bond equivalent, mass spectral fragmentation of organic compounds (Spectra-alkanes, alkenes, arenes, alcohols, aldehydes, ketones, acids and phenols). Basic Principles, instrumentation and applications of Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique). Photoelectron and Mossbauer spectroscopy.	**[19]**
Suggested Readings: **Text Books:** 1. J. Mendham, Vogel's Quantitative Chemical Analysis 6th Ed., 2009 Pearson Education 2. H. H. Willard, et al.: Instrumental Methods of Analysis, 7th Ed. 1988,WardsworthPublishing Company, Belmont, California, USA. 3. G.D. Christian, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004. 4.D.C. Harris,Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016. 5.S.M. Khopkar, Basic Concepts of Analytical Chemistry. New Age International. **Reference Book:** 6. W. Kemp Organic Spectroscopy, 3rd Ed., Palgrave publication. 7. Lampman, Pavia, Kriz, Vyvyan, Spectroscopy, Cengage learning India private limited. 8. J.R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall, 1965 9. Y.R. Sharma , Elementary Organic Spectroscopy – Principles and Chemical applications, S.Chand,1992 10. P. S. Kalsi ,Spectroscopy of Organic Compounds, 7th Ed. 2009 , New Age International.Publisher.	

CH20.110	**Separation Techniques and Pharmaceutical Chemistry Laboratory**	**0-0-4-2**

Perform any EIGHT experiments.

1. Preparation of Aspirin and its analysis.
2. Preparation of magnesium bisilicate (Antacid).
3. Understand the role of drugs in the healthcare system.
4. Preparation of Aspirin and its analysis.
5. Preparation of Acetaminophen.
6. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
7. Separate a mixture of Sudan Yellow and Sudan Red by TLC technique and identify them on the

basis of their Rf values.

8. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC.
9. Determination of exchange capacity of cation exchange resins and anion exchange resins.
10. Separation of metal ions from their binary mixture.
11. Determination of pH of soil.

Suggested Readings:

Text Books:

1. J. Mendham, Vogel's Quantitative Chemical Analysis 6th Ed., 2009 Pearson Education
2. H. H. Willard, et al.: Instrumental Methods of Analysis, 7th Ed. 1988,WardsworthPublishing Company, Belmont, California, USA.
3.G. L. Patrick, An introduction to medicinal chemistry, Oxford press, 4th Ed. 2013.
4.H. Singh, V. K. Kapoor, **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan, Pitampura, New Delhi, 2012.
5. W.O. Foye, T.L. Lemke, D.A. William, Principles of Medicinal Chemistry, 4th Ed., B.I. Waverly Pvt. Ltd. New Delhi.

Reference Books:

1.G. L.Patrick, An introduction to medicinal chemistry, Oxford press, 4th Ed. 2013.
2.H. Singh, V. K. Kapoor, **Medicinal and Pharmaceutical Chemistry**, Vallabh Prakashan, Pitampura, New Delhi, 2012.
3. G.D. Christian, Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

CH20.112	Inorganic and Physical Chemistry Laboratory-I	0-0-2-1

Perform any EIGHT experiments.

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
3. Determination of Hardness of water by EDTA method.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
6. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
7. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
8. To determine the surface tension of a given liquid by drop number method.
9. To determine the viscosity of a given liquid.
10. To determine the specific refractivity of a given liquid.

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry: Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.

5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education
6. G.D. Christian, Analytical Chemistry, 6th Ed. 2004, John Wiley & Sons, New York,

MS20.102	Group Theory	5-1-0-6

Objective: To acquire fundamental knowledge of group theory and apply in sciences and applied sciences.

1. Preliminaries: Sets, Subsets, Relations,Equivalence classes,Functions,Equality and composition of mappings,Binary compositions,Permutations,Cyclic permutations,Cycles of a permutation,Disjoint permutations, Some results from number theory(Euclid's theorem and Basis representationtheorem),The greatest common divisor, Prime numbers,Congruences, Chinese reminder theorem, proof of all properties and applications.	[13]
2. Group-I: Algebraic Structure, Symmetries of a square, Dihedral groups, Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups, Order of an element of a group, proof of all properties and applications.	[13]
3. Group-II: Subgroups and examples of subgroups, Theorems on subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups with theorems related to centralizer,normalizer, and center of a group, proof of all properties and applications.	[13]
4. Cyclic Group and Cosets-I: Properties of cyclic groups, Classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, Even and odd permutations, proof of all properties and applications.	**13**
5. Cyclic Group and Cosets-II: Alternating group, Definition and properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, proof of all properties and applications.	[13]

Course Outcome: After completion of the course, students would be able to apply the knowledge of group theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vashistha A.R. and Vashistha A.K (2015), Modern Algebra, Krishna Educational Publisher.
2. John B. Fraleigh (2014), A First Course In Abstract Algebra, Seventh Edition, Pearson.

Reference Books:

1. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.
2. Khanna and Bhambri(2016), A Course in Abstract Algebra, Fifth Edition, Vikas Publishing House Pvt. Ltd.
3. Michael Artin (2015), Algebra, Second Edition, Pearson.
4. Herstein I.N. (2006), Topics in Algebra, Second Edition, John Wiley and Sons.

PH20.102	Electricity and Magnetism	4-0-0-4

Course Objective: The objective of the course is to expose the student to electrostatics and magnetostatics including Boundaryvalue problems, the principles of electromagnetic induction. The student will be able to appreciate Maxwell's equations and analyze electrical circuits using network theorems.

Course Outcome: The student will be able to:

CO1: Understand the relationship between electrical charge, electrical field, electrical potential, and magnetism.

CO2: Calculate the magnitude and direction of the magnetic field for symmetric current distributions using the Law of Biot-Savart and Ampere's Law.

CO3: Understand the various network theorems.

CO4: Define the magnetic field and magnetic flux, solve technical problems.

CO5: Understand the Maxwell's equation and its application in confinement and propagation of EMW.

Unit-I Electric Field and Electric Potential Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.	[15]
Unit-II Magnetic Field: Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop.Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid.Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.	[10]
Unit-III Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.	**10**
Unit-IV Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.	**7**
Unit-V Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.	**10**

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
4. Electricity and Magnetism, J.H.Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
5. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw.

PH20.106	Physics Laboratory-II	0-0-4-2

1. To plot graph showing the variation of magnetic field with distance along the axis of a circular coil carrying current and to estimate the radius of the coil.
2. To study the Faraday Law by determination of induced emf as a function of velocity of the magnet through a coil.
3. To determine the ballistic constant using the ballistic galvanometer.
4. To determine the Mutual Inductance using ballistic galvanometer.
5. To convert a galvanometer into an ammeter of a given range.
6. To determine the resolving power of a telescope.
7. To plot V-I Characteristics of PN Junction/ Zener Diode and find cut-in Voltage, static and dynamic resistances in both forward and reverse biased conditions.

**Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.*

BS20.118	Plant Ecology and Taxonomy	4-0-0-4

Objective: To learn and gain knowledge about ecology and taxonomic evidences of plants.

Unit-1 Ecological factors: Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.	**8**
Unit-2 Plant communities: Characters; Ecotone and edge effect; Succession; Processes and types.	**8**
Unit-3 Ecosystem & Phytogeography: Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and PhosphorousPrinciple biogeographical zones; Endemism.	**12**
Unit-4 Introduction to plant taxonomy, Identification, Taxonomic evidences & hierarchy: Identification, Classification, Nomenclature.Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-accessTaxonomic evidences from palynology, cytology, phytochemistry and molecular data.Ranks, categories and taxonomic groups.	**12**
Unit-5 Botanical nomenclature, Classification and Biometrics, numerical taxonomy and cladistics: Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).	**12**

Course Outcome: Use knowledge, understanding and skills for critical assessment of wide range of ideas and problems in the field of Plant Ecology and Taxonomy.

Suggested Readings:

Text Books:

1. Sharma,P.D.(2010)EcologyandEnvironment.RastogiPublications,Meerut,India.8th edition.
2. Singh,G.(2012).*PlantSystematics:*TheoryandPractice.Oxford&IBHPvt.Ltd.,NewDelhi.3rd edition.

Reference Books:

1. Kormondy,E.J.(1996).ConceptsofEcology.PrenticeHall,U.S.A.4th edition.
2. Simpson,M.G.(2006).*PlantSystematics.*ElsevierAcademicPress,SanDiego,CA,U.S.A.

BS20.120	Plant Ecology and Taxonomy Laboratory	0-0-4-2

Objective: To identify anatomical and physiological attributes of each plant group.

1. Studyofinstrumentsusedtomeasuremicroclimaticvariables:Soilthermometer,maximumandminimumthermometer,anemometer,psychrometer/hygrometer,raingaugeandluxmeter.
2. DeterminationofpH,andanalysisoftwosoilsamplesforcarbonates,chlorides,nitrates,sulphates,organic matterandbasedeficiencybyrapidfieldtest.
3. Comparisonofbulkdensity,porosityandrateofinfiltrationofwaterinsoilofthreehabitats.
4. (a)Studyofmorphologicaladaptationsofhydrophytesandxerophytes(foureach).(b)Studyofbioticinteractionsofthefollowing:Stemparasite(*Cuscuta),*Rootparasite(Orobanche),Epiphytes,Predation(Insectivorousplants)
5. Determinationofminimalquadratsizeforthestudyofherbaceous vegetationinthe collegecampusbyspeciesareacurvemethod.(speciestobelisted)
6. Quantitativeanalysisofherbaceousvegetationinthecollegecampusforfrequencyandcomparisonwith Raunkiaer'sfrequencydistributionlaw
7. Studyofvegetativeandfloralcharactersofthefollowingfamilies(Description,V.S.flower,sectionofovary,floraldiagram/s,floralformula/eandsystematicpositionaccordingtoBentham&Hooker'ssystemofclassification):Brassicaceae-*Brassica,Alyssum/Iberis;*Asteraceae-*Sonchus/Launaea,Vernonia/Ageratum,Eclipta/Tridax;*Solanaceae-*Solanumnigrum,Withania;*Lamiaceae-*Salvia,Ocimum*;Liliaceae-*Asphodelus/Lilium/Allium.*
8. Mountingofaproperlydriedandpressedspecimenofanywildplantwithherbarium label(tobesubmittedintherecordbook).

Course Outcome: Students will be able to demonstrate the experimental techniques and methods of the subject learnt and will be able to address the practical problems

BS20.122	Genetics and Evolutionary Biology	4-0-0-4

Objective: The course gives students a very basic overview of some principles behind these very fundamental areas of biology.

Unit-1 Introduction to Genetics, Mendelian Genetics and its Extension: Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co- dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal	**8**

inheritance.	
Unit-2 Linkage, Crossing Over and Chromosomal Mapping: Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference andcoincidence, Somatic cell genetics - an alternative approach to gene mapping.	**6**
Unit-3 Mutations &Sex Determination: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations.Chromosomal mechanisms, dosage compensation.	**8**
Unit-4 History of Life, Introduction to Evolutionary Theories, Direct Evidences of Evolution & Processes of Evolutionary Change: Major Events in History of Life, Lamarckism, Darwinism, Neo-Darwinis, Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection.	**16**
Unit-5 Species Concept, Macro-evolution & Extinction: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)Macro-evolutionary Principles (example: Darwin's Finches). Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution.	**14**
Course Outcome: Students will be able to explain and apply the learnt principles and fundaments of genetics.	
Suggested Readings: **Text Books:** 1. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings. 2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings. 3. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press. 4. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press. Reference Books: 1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India. 2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc. 3. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. 4. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co. 5. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing 6. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.	

BS20.124	**Genetics and Evolutionary Biology Laboratory**	**0-0-4-2**
Objective: To understand the basic scientific methods, including data analysis, used in these fields, and be able to carry out simple analyses using empirical population genetics and quantitative genetics data.		
1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test. 2. Study of Linkage, recombination, gene mapping using the data. 3. Study of Human Karyotypes (normal and abnormal). 4. Study of fossil evidences from plaster cast models and pictures		

5. Study of homology and analogy from suitable specimens/ pictures
6. Charts:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

Course Outcome

Student will be able to combine this knowledge to interpret results from studies in population and quantitative genetics.

EV20.102	**Environmental Studies**	**4-0-0-4**
Objective: To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.		
Unit1 Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.		**[9]**
Unit2 Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).		**[10]**
Unit3 Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.		**[8]**
Unit 4 Biodiversity and Conservation: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.		**[8]**
Unit 5 Environmental Pollution: Environmental pollution: types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.		**[8]**
Unit 6 Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.		**[7]**

Unit 7 Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	**6**
Unit 8 Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	**5**

Course Outcome: After completion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.

Suggested Readings

Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Reference Books:

9. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.

10. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.

11. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.

12. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.

13. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.

14. www.nacwc.nic.in 22.www.opcw.org

CH 20.201	Organic Chemistry-II	3-0-0-3
Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π^* and n-π^* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic		**[6]**

shifts, UV spectra of conjugated dienes and enones.	
Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds.	**[5]**
Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2.	**[5]**
Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC.	**[5]**
Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol.	**[5]**
Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction.	**[5]**
Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.	**[4]**
Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers.	**[4]**
Suggested Readings: **Text Books:** 1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd. 2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International. 3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD. **Reference Books:** 4. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall. 5. A. Bahl and B. S. Bahl, Advanced Organic Chemistry, 19th Ed. 2005.	

CH20.203	**Physical Chemistry-II**	**2-0-0-2**
Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. Definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their		

relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition.	**[7]**
Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, Kirchoff's equation. Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Nernst heat theorem, concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.	**[8]**
Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects.	**[11]**
Suggested Readings: **Text Books:** 1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD. 2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD. **Reference Books:** 3. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford. 4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co. 5. Giri, Bajpai and Pandey, Practical Chemistry Reprint 2009, S. Chand & Co. Ltd	

CH20.205	**Advance Spectroscopy**	**3-0-0-3**
Nuclear magnetic resonance spectroscopy (NMR): Chemical shift, measurement of spectra, intramolecular and intermolecular factors affecting the chemical shift Local diamagnetic shielding, The coupling constant, Proton coupled 13C NMR spectra- spin-spin coupling of 13C signals, Proton-decoupled 13C spectra, Nuclear Overhauser Enhancement (NOE). Cross polarization. Problems with integration in 13C, Molecular relaxation process, DEPT 135, DEPT 90, Measuring coupling constant from first-order spectra and Second-order spectra, COSY and NOSY spectra.		**[12]**
UV and Visible Spectroscopy: Hetero-aromatic systems, effect of steric hindrance to co-planarity and study of charge transfer complexes.		**[3]**

Infra red and Raman Spectroscopy: Dispersive IR, Fourier Transform Spectrometer, Correlation chart and tables, Application-Interpretation of spectra. Raman Spectroscopy: Principle and applications.	**[8]**
Mass and Mossbauer Spectroscopy: Ionization methods, EI, CI, FAB, LD, ESI Mass analyzer, Fragmentation pattern, MS data system. ESR: Principle and applications. Mossbauer Spectroscopy: Principle and applications.	**[10]**
Photoelecron Spectroscopy (PES): Concept & applications; Combined structure problems in Spectroscopy.	**[6]**

Text books

1. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed., Tata McGraw-Hill Publishing Company Limited.

Reference Books;

2. W. Kemp. Organic Spectroscopy, 3rd Ed., Palgrave publication.
3. H. Gunther NMR Spectroscopy, Basic principles, Concepts and Applications in Chemistry, 3rd Ed,, Wiley.
4. Lampman, Pavia, Kriz, Vyvyan, Spectroscopy, Cengage learning India private limited.
5. J.R. Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall, 1965
6. Y.R. Sharma , Elementary Organic Spectroscopy – Principles and Chemical applications, S.Chand,1992
7. P. S. Kalsi , Spectroscopy of Organic Compounds, 7th Ed. 2009 , New Age International Publisher.

CH20.207	**Bio-inorganic Chemistry and inorganic polymers**	**3-0-0-3**
Essential and trace metal ions in biology: A brief introduction to bioinorganic chemistry. Essential and trace metal ions in biological system. Deficiency/ excess of Mn, Co, and Zn metal ions.		[5]
Metalloporphyrins and Metalloenzymes Chlorophyll Hemoglobin and myoglobin structure and function of hemoglobin, Cytochromes, Enzyme action-inhibition and restoration. Carboxy peptidase-A, Vitamin B12 and B12 coenzymes. Copper containing oxidase.		[9]
Metal ions in biology: Alkali and alkaline earth metal ions in biology. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).		[9]
Iron proteins Iron-sulfur proteins, nitrogen fixation. Iron enzymes-catalase and peroxidase. Rubridoxin Ferrodoxins – HIPIP		[6]
Inorganic Polymers: Definition, Types of inorganic polymers, Characteristics of inorganic polymers, comparison with organic polymers, Sulfur based polymers, synthesis, structural aspects and applications of silicones and siloxanes, Borazines, silicates, phosphazenes, and, nature of bonding in triphosphazenes.		[10]

Suggested Books:

Text Books:

1. W. Kaim, B. Schwederski, Bioinorganic Chemistry: Inorganic elements in the Chemistry of life: An introduction and guide,1991,VCH
2. D. Rehder, Introduction to Bioinorganic Chemistry - University of Lund, 2008. Lecture notes
3. Bertini, Gray, Lippard and Valentine, Bioinorganic Chemistry, University Science Books, Mill Valley, California, 1994

Reference Books:

4. Steven S. Zumdahl. Chemistry-Houghton Mifflin Company 2009, Boston New York
5. S. J. Lippard & J.M Berg, Principles of Bioinorganic Chemistry, University science books, Mill Valley, 1994, California.
6. R. J. P. Williams & F. R. De Salvia, Biological Chemistry of the Elements, 1991, Oxford University Press.
7. F.A. Cotton &G. Wilkinson Advanced Inorganic Chemistry, 1999, Wiley, VCH.
8. G.E. Rodger, Inorganic and Solid State Chemistry, 20028, Cengage Learning India Edition,

CH 20.209	Bioinorganic Chemistry Laboratory	0-0-4-2

Perform minimum eight experiments

1. Determination of Chloride in Biological Fluids by Thermometric Titrimetry
2. Atomic Absorption Analysis of Manganese and Zinc in Leaves
3. The Determination of Calcium and Magnesium in Fruit Juice
4. Estimation of lithium in Drinking Water
5. The Preparation, Characterisation and Screening of Pharmaceutically Active Metal Complexes
6. Nickel(II)-Glycine Interactions Studied by pH Potentiometry
7. Stereochemistry of Co(III)(trien)X2, and Reaction of Coordinated Glycine Esters
8. Effects of Axial Ligands on Tetragonal Metal Complexes related to Haemoglobin, etc.
9. Interaction of Pyrophosphate with Metal Ions
10. Metal Ion-Protein Interactions
11. Haemoglobin-Oxygenation, and Magnetic and Spectroscopic Studies
12. The Effects of Metal Ions on Polynucleotides (DNA)
13. Computer Simulations of Complexing Systems in vivo

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

CH 20.211	Organic and Physical Chemistry Laboratory-I	0-0-2-1

Perform any EIGHT experiments.

1. Systematic identification-II: To identify the given organic compound through element detection, functional group analysis and confirmative test and preparation of at least one pure solid derivative.Any six organic compounds may be identified, like Naphthalene, m-dinitrobenzene, resorcinol, α-naphthol, β-naphthol, benzophenone, benzaldehyde, benzoic acid, salicyclic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline, glucose.
2. To determine the CST of phenol –water system.
3. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process.
4. To determine the enthalpy of neutralization of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
5. To determine the enthalpy of solution of solid calcium chloride.
6. To study the distribution of iodine between water and CCl_4.

Suggested Readings:

1. **Text Book:**

1. Giri, Bajpai and Pandey, Practical Chemistry Reprint 2009, S. Chand & Co. Ltd.

2.R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

MS20.201	Differential Equations	5-1-0-6

Objective: To acquire fundamental knowledge of differential equations and apply in sciences and applied sciences.

1. First Order Differential Equations-I: Basic concepts of differential equations,Definition, Order and degree of differential equation, general, particular, explicit, implicit and singular solution of differential equation, standard form, equations in which variables are separable, homogeneous and reducible to homogeneous differential equations, linear and reducible to linear (Bernoulli) differential equations, exact and reducible to exact differential equations, different methods of finding integrating factor of equation, equations of first order but not of the first degree, equations solvable for p, y and x , Clairaut's and Lagrange's equations.	[13]

2. First Order Differential Equations-II: Existence and uniqueness theorm for first –order differential equations,Lipschitz condition and examples,Gronwall's inequality, continuous dependence and initial conditions, Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting. Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.	[13]
3. Second and Higher Order Differential Equations: Linear differential equations with constant and variable coefficients (Euler Cauchy equation), different forms of complimentary functions and particular integrals, equations reducible to homogeneous liner form, change of independent variables, normal form and method of variation of parameters with proofs of all results.	13
4. Differential Equation of other Types:Introduction, Equation of the type $\frac{d^n y}{dx^n} = f(x)$, Equation of the type $\frac{d^n y}{dx^n} = f(y)$, Equations which do not contain y directly, Equations which do not contain x directly, Equations whose solution is known, Normal form (removable of first derivative), Method of solving linear differential equations by changing the independent variable,Method of variation of parameters, Method of undetermined coefficients.	13
5. Power Series Solution: Introduction, Review of power series, Ordinary and singular points of a differential equation, Power series solution about an ordinary point, Frobenius method series solution about a regular singular point.	13
Course Outcome: After completion of the course, students would be able to apply the knowledge of differential equations in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.	
Text Books: 1. Sundarapandian (2012), Ordinary and Partial differential Equations, McGraw Hill Education. 2. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations, 18th Edition, S. Chand Limited.	
Reference Books: 1. Nagle, Saff and Snider (2016), Fundamental of Differential Equations, 8th Edition, Pearson. 2. Simmons (2016), Differential Equations with Applications and Historical Notes, McGraw Hill Education. 3. Ramana B.V. (2007), Higher Engineering Mathematics, 2nd Edition, McGraw-Hill Publishing Company Limited, New Delhi. 4. Dennis G. Zill and Michael R Cullen (2009), Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.	

PH20.209	**Thermal Physics and Statistical Mechanics**	**4-0-0-4**
Course Objective: The objective of this course is to understand basics of thermodynamic laws and entropy and Maxwell's thermodynamic equations using thermodynamic potentials and to understand the basics of statistical laws and Planck's quantum theory.		
Course Outcome: The student will be able to *CO1: Define thermodynamic laws and various terminologies efficiently.*		

CO2: Understand second law of thermodynamics with Carnot's cycle and entropy.
CO3: Apply Maxwell equations for different problems.
CO4: Illustrate basics of Statistical mechanics and postulate.
CO5: Acquaint with Planck's explanation of Blackbody radiation.

Unit-I Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.	[10]
Unit-II Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot‟s Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot‟s Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **Entropy:** Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.	[20]
Unit-III Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb‟s Free Energy. Their Definitions **Maxwell's Thermodynamic Relations**: Derivation of Maxwell‟s thermodynamic Relations and their applications, Maxwell's Relations:(1) ClausiusClapeyron equation, (2) Value of Cp-Cv, (3) Tds Equations, (4) Energy equations.	[6]
Unit-IV Foundation of Statistical Mechanics: Macrostate& Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law,Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox.	[8]
Unit-V Blackbody Radiation: Spectral Distribution of Black Body Radiation. Failure of classical statistics, Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3)Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.	[8]

Text Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Fundamentals of Statistical and Thermal Physics, Frederick Reif, 2009, Waveland Press

Reference Books:

1. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
2. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
3. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger,1988,Narosa.
4. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press.

PH20.207	Physics Laboratory III	0-0-4-2

1. To determine the specific heat capacity of copper.
2. To determine the temperature coefficient of resistance of copper wire.
3. To measure the thermal relaxation time constant of a serial light bulb.
4. To determine the Stefan's law using a bulb.
5. To determine the capacitance of ceramic capacitor.
6. To determine the high resistance by the method of leakage of a condenser with the help of ballistic galvanometer.
7. To verify that impedance of a capacitance c varies as $Z_c = {}^{1}/_{2\pi fc}$ and to measure the value of the capacitance.

**Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.*

BS20.217	Animal Anatomy and Embryology of Vertebrates	4-0-0-4
Objective: To understand the fascinating world of vertebrates and their embryology.		
Unit1:	**Integumentary and Skeletal System** Derivatives of integument w.r.t. glands and digital tips Evolution of visceral arches	**7**
Unit2	**Digestive, Respiratory and Circulatory System** Brief account of alimentary canal and digestive glands Brief account of Gills, lungs, air sacs and swim bladder Evolution of heart and aortic arches	**13**
Unit3	**Urinogenital, Nrevous System and Sense Organs** Succession of kidney, Evolution of urinogenital ducts Comparative account of brain and Types of receptors	**10**
Unit 4:	**Early Embryonic Development** Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	**12**
Unit 5	**Late Embryonic Development & Control of Development** Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation. Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death	**18**
Course Outcome: After completion of the course, students would be able to apply the knowledge of developmental behaviour of animal anatomy and vertebrate's embryology in research.		

Suggested Readings:

Text Books:

1. Walter,H.E.andSayles,L.P;*BiologyofVertebrates*,KhoslaPublishingHouse.
2. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
3. Kardong,K.V.(2005)*Vertebrates'ComparativeAnatomy,FunctionandEvolution*.IVEdition.McGraw-HillHigherEducation.
4. Kent,G.C.andCarrR.K.(2000).*ComparativeAnatomyoftheVertebrates*.IXEdition.TheMcGraw-HillCompanies.

Reference Books:

1. Hilderbrand,MandGaslowG.E.*AnalysisofVertebrateStructure*,JohnWileyandSons.
2. Gilbert,S.F.(2006).DevelopmentalBiology,VIIIEdition,SinauerAssociates,Inc.,Publishers, Sunderland,Massachusetts,USA.
5. Balinsky,B.I.(2008).AnintroductiontoEmbryology,InternationalThomsonComputerPress.

BS20.219	**Animal Anatomy and Embryology Laboratory**	**0-0-4-2**

Objective: To become proficient in the experiments related to animal anatomy and embryology.

1. Osteology:
   a) Disarticulated skeleton of fowl and rabbit
   b) Carapace and plastron of turtle /tortoise
   c) Mammalian skulls: One herbivorous and one carnivorous animal.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
4. Study of placental development in humans by ultrasound scans.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of animal anatomy and embryology.

BS20.221	**Plant Anatomy and Embryology**	**4-0-0-4**

Objective: Understand the basics of systematics by learning the diagnostic and general characters of various groups.

Unit1:	**Meristematic and permanent tissues** Root and shoot apical meristems; Simple and complex tissues.	7
Unit2	**Organs and Secondary Growth** Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).	10

Unit3	**Adaptive and protective systems** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.	7
Unit 4:	**Structural organization of flower, Pollination and fertilization** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.	16
Unit 5	**Embryo, Endosperm, Apomixis and polyembryony** Endosperm types, structure and functions; Dicot and monocot embryo; Embryo-endosperm relationship. Definition, types and practical applications.	12
Course Outcome: After completion of the course, students would be able to apply the knowledge of plant anatomy and embryology in different research domains.		

Suggested Readings:

Text Books:

1. Bhojwani, S.S. &Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt.Ltd. NewDelhi.5th edition.

Reference Books:

Mauseth,J.D.(1988).Plant Anatomy.The Benjamin/Cummings Publisher,USA.

BS20.223	**Plant Anatomy and Embryology Laboratory**	**0-0-4-2**

Objective: To become proficient in the experiments related to plant anatomy and embryology.

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril,

caruncle) (Photographs and specimens). 12. Dissection of embryo/endosperm from developing seeds. 13. Calculation of percentage of germinated pollen in a given medium.	
Course Outcome: After completion of the course, students would be able to apply the knowledge of plant Anatomy and embryology in research fields.	

CH20.202	**Inorganic Chemistry-III**	**2-0-0-2**
Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.		**[4]**
Hard and Soft Acids and Bases (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.		**[8]**
Oxidation and Reduction: Oxidation and reduction potential, applications of electrochemical series. Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements.		**[9]**
Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.		**[5]**
Suggested Readings: **Text Books:** 1. P. L.Soni, Text Book of Inorganic Chemistry, 2005, S. Chand & Co. Ltd. 2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2004, RBD. **Reference Books:** 3. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 4th Ed. 2005, Wiley Interscience. 4. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd. 5. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2003, S. Chand & Co. Ltd. **6.** Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co.Ltd.		

CH 20.204	**Organic Chemistry-III**	**3-0-0-3**
Nuclear magnetic resonance (NMR) spectroscopy: Proton magnetic resonance (^{1}H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.		**[9]**
Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen,		**[10]**

Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones.	
Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids).	**[10]**
Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic).	**[6]**
Organic Synthesis via Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate; the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes. Alkylation and acylation of enamines.	**[4]**
Suggested Readings: **Text Books:** 1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd. 2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International. 3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD. **Reference Books:** 4. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall. 5. B. S. Bahal and Arun Bahl, Advanced organic chemistry; 2002, S. Chand and Co. Ltd.	

CH 20.206	**Chemistry of Cosmetics and Nanomaterials**	**3-0-0-3**
Cosmetics and Perfumes: A general study including preparation and uses of the following: Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.		**[18]**
Introduction to Nano-Chemistry: Nanoscale, nano particles, Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only). Preparation methods: Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling and Colloidal routes.		**[9]**
Nanomaterials: Overview of nanostructures and nanomaterials: classification.Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-controlof nanoarchitecture-one		

dimensional control. Carbon nanotubes and inorganic nanowires.Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials,bionano composites. Efficiency of nanoparticles as catalysts.	**[12]**
Reference Books: 1. E. Stocchi, Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK 1990. 2. P.C. Jain, & M. Jain, Engineering Chemistry Dhanpat Rai & Sons, Delhi. 3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut 1996. 4. C.P. Poole, &F.J. Owens, Introduction to Nanotechnology John Wiley & Sons, 2003. 5. Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. Introduction to Nanoscience. CRC Press, 2008.	

CH20.208	**QuantumChemistry and Ionic Equilibrium**	**3-0-0-3**
Quantum Chemistry Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation andits application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy. Angular momentum: Commutation rules, quantization of square of total angular momentumand z-component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom). Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localized and non-localized molecular orbitals treatment of triatomic (BeH_2, H_2O) molecules. Qualitative MO theory and its application to AH_2 type molecules.	**[24]**
Ionic equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree ofionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for differentsalts. Buffer solutions; derivation of Henderson equation and its	**[15]**

applications; buffer capacity,buffer range, buffer action and applications of buffers in analytical chemistry andbiochemical processes in the human body.
Solubility and solubility product of sparingly soluble salts–applications of solubility productprinciple. Qualitative treatment of acid – base titration curves (calculation of pH at variousstages). Theory of acid–base indicators; selection of indicators and their limitations.

Suggested Readings:

1. A. K. Chandra, Introductory Quantum Chemistry, 2001, Tata McGraw-Hill
2. J. E. House, Fundamentals of Quantum Chemistry 2nd Ed. 2004, Elsevier: USA
3. J. P. Lowe, & K. Peterson,Quantum Chemistry, 2005, Academic Press
4. G.M. Barrow, Physical Chemistry, 2007,Tata McGraw-Hill
5. G.W. Castellan, Physical Chemistry 4th Ed., 2004, Narosa

CH 20.210	Cosmetics and Nanomaterial'sLaboratory	0-0-4-2

Experiments based on the contents of CH 20.232 and CH 20.242.

1.Preparation of talcum powder.
2.Preparation of shampoo.
3.Preparation of enamels.
4.Preparation of hair remover.
5.Preparation of face cream.
6.Preparation of nail polish and nail polish remover.
7.Synthesis of nano-particles of metal oxides (ZnO, CuO,Fe_2O_3).

Reference Books:

1. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990).
2. Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi.
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

Reference Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

CH20.212	Inorganic and Organic Chemistry Laboratory-II	0-0-2-1

1. Estimation of Ni(II) using dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN.
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
4. Quantitative estimation of copper-Zinc of the following mixture by volumetric and gravimetric methods
5. Quantitative estimation of Zinc-nickel of the following mixture by volumetric and gravimetric methods
6. Steam distillation (non evaluative) Naphthalene from its suspension in water Separation of o- and p-nitrophenols
7. Column chromatography (non evaluative) Separation of fluorescein and methylene blue. Separation of leaf pigments from spinach leaves.
8. Determination of Rf values and identification of organic compounds.
9. Separation of green leaf pigments (spinach leaves may be used) by paper chromatographic method (b) Separation of a mixture of coloured organic compounds using common organic solventsby TLC.

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry: Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

MS20.202	Real Analysis	5-1-0-6

Objective: To acquire fundamental knowledge of real analysis and apply in sciences and applied sciences.

1. The Real Numbers: Introduction,The set N of natural numbers,The set Z of Iintegers, The set Q of rational numbers, The set of real numbers R as a complete ordered field, Closed,open,semi-closed and semi-open intervals, Set bounded above, set bounded below, supremum and infimum of a set, the greatest and smallest members of a set, bounded and unbounded sets,Order-completeness of the set of real numbers, Equivalent description of the order-completeness, property of the set of real numbers, Explicit statement of the properties of the set of real numbers as a complete ordered field,Some important properties of the set of real numbers,The denseness property, the modulus, Principal of mathematical induction, Bernoulli's inequality.	[13]

2. Neighborhoods and Limit Points: Introduction and properties of nbd,Limit points of a set and its properties,Properties of closed and open sets, properties of interior, exterior,and boundary points , properties of a closure of a set, Dense and perfect sets, compact sets, Countability of sets.	[13]
3. Sequences: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.	[13]
4. Infinite Series with Positive Terms: Infinite series, its convergence and sum,A necessary condition for the convergence of an infinite series,Cauchy's general principle of convergence of series,General test for the convergence of positive term series,convergence of geometric series and generalized harmonic series,Comparision tests for the convergence of positive term series,Comparison tests of first type,Practical comparision tests of the first type,Comparision tests of the second type: D'Alembert's ration test,Cauchy's nth root test,Rabbe's Test,Logarithmic test,DeMorgan's and Bertrand's test,Second logarithmic test,Kummer's test,Gauss's test,Cauchy's integral test,Cauchy's condensation test, auxiliary series.	[13]
5. Infinite Series with Positive and Negative Terms: Introduction,Absolute convergenceand conditional convergence,Cauchy principle of convergence for a series,Dirichlet's theorem,Abel's theorem,Re-arrangements of series,Re-arrangements of a conditional convergent series,Sauchy product of two infinite series.	[13]
Course Outcome: After completion of the course, students would be able to apply the knowledge of real analysis in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.	
Text Books: 1. Gerald G. Bilodeau, Thie P. R., and Keough G.E. (2010), An Introduction to Analysis, 2nd Ed., Jones & Bartlett. 2. Malik S.C. and Arora S. (2010), Mathematical Analysis, 4th Edition New Age International Ltd. **Reference Books:** 1. Royden H.L. (2017), Real Analysis, 2nd Edition, PHI. 2. Charles G. Denlinger (2014), Elements of Real Analysis, Jones and Bartlett Learning. 3. Apostle (1997), Mathematical Analysis, 2nd Edition, Narosa Publishing House. 4. Bartle R.G. and Sherbert D. R. (2002), Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.	

PH20.204	**Wave and Optics**	**4-0-0-4**
Course Objective: The objective of the course is to acquaint the student with ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.		
Course Outcome: The student will be able to: CO1: Understand Simple harmonic oscillation and superposition principle. CO2: Understand different types of waves and their velocities: Plane, Spherical, Transverse,		

Longitudinal.
CO3: Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.
CO4: Understand Interference as superposition of waves from coherent sources derived from same parent source.
CO5: Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand
Fraunhoffer and Fresnel Diffraction.

Unit-I Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses.	[10]
Unit-II Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves **Velocity of Waves:** Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.	[10]
Unit-III Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String:Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves	[10]
Unit-IV Wave Optics: Electromagnetic nature of light. Definition and properties of wave front.Huygens Principle. Temporal and Spatial Coherence. **Interference:** Division of amplitude and wavefront. Young's double slit experiment.Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment.Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings:Measurement of wavelength and refractive index. **Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	[11]
Unit-V Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit. **Fraunhofer diffraction**: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **Fresnel Diffraction**: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.	[11]

Text Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Optics, AjoyGhatak, 2008, Tata McGraw Hill

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
4. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

PH20.208	**Physics Laboratory-IV**	**0-0-4-2**

1. To determine the dispersive power of the material of a prism for violet and yellow colours of mercury light with the help of a spectrometer.
2. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
3. To determine the wavelength of sodium light with the help of Newton's ring experiment.
4. To determine the wavelength of the prominent lines of Mercury by plane diffraction grating.
5. To study the resonance in Series/ Parallel LCR circuits and determine its Q factor
6. To measure the period of oscillation of pendulum by changing the angle using the vibrational g pendulum.
7. To determine the specific rotation of a solution of cane sugar using Polarimeter.

**Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.*

BS20.212	Plant Physiology and Metabolism	4-0-0-4
Objective	To acquire the knowledge of the cellular behaviour of plant and its metabolism.	
Unit1	**Plant-water relations** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.	
Unit2	**Mineral nutrition&Translocation in phloem** Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.	
Unit3	**Photosynthesis and Plant response to light and temperature** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration. Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.	
Unit 4	**Respiration and Enzymes** Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway. Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.	
Unit 5	**Nitrogen Metabolism and Plant growth regulators** Biological nitrogen fixation; Nitrate and ammonia assimilation. Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.	
Course Outcome	Students would be able to apply their insight of various metabolic processes in designing their experiments.	
	Suggested Readings: **Text Books:** 1. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi. **Reference Books:** 1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition. 2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.	

BS20.208	Plant Physiology Laboratory	0-0-4-2
Objective	To get acquainted with the experiments on cellular behaviour of plant and its metabolism.	

1. Determinationofosmoticpotentialofplantcellsapbyplasmolyticmethod.
2. Tostudytheeffectoftwoenvironmentalfactors(lightandwind)ontranspirationby excisedtwig.
3. Calculationofstomatalindexandstomatalfrequencyofamesophyteandaxerophyte.
4. DemonstrationofHillreaction.
5. Demonstratethe activity of catalase and studythe effect of pH and enzymeconcentration.
6. TostudytheeffectoflightintensityandbicarbonateconcentrationonO_2evolutioni nphotosynthesis.
7. Comparisonoftherateofrespirationinanytwopartsofaplant.
8. Separationofaminoacidsbypaperchromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Course Outcome	Students would be able to apply hands on expertise on physiological detections in plants.	

BS20.214	Animal Physiology and Biochemistry	4-0-0-4
Objective: To acquire the knowledge of the animal cell behaviour.		
Unit1:	**Nerve and muscle** Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction	**7**
Unit2	**Digestion Respiration & Excretion** Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipidsPulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in bloodStructure of nephron, Mechanism of Urine formation, Counter-current Mechanism	**16**
Unit3	**Cardiovascular system Reproduction and Endocrine Glands** Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cyclePhysiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycleStructure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal	**14**
Unit 4:	**Carbohydrate, Lipid & Protein Metabolism** Glycolysis, Kreb's cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain	**8**
Unit 5	**Enzymes**	**7**

	Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	
Course Outcome	After completion of the course, students would be able to apply the knowledge of biochemical and physiological aspects of animals in practical field.	

Suggested Readings:

Text Books:

1. Murray,R.K., Granner,D.K.,Mayes,P.A.and Rodwell, V.W.(2009). *Harper'sIllustratedBiochemistry*.XXVIIIEdition.LangeMedicalBooks/McGraw3Hill.
2. Guyton,A.C.andHall,J.E.(2011). T*extbookof Medical Physiology*,XII Edition,HarcourtAsiaPvt.Ltd/W.B.SaundersCompany

Reference Books:

1. Tortora,G.J.andDerrickson,B.H.(2009).*PrinciplesofAnatomyandPhysiology*,XIIEdition,JohnWiley&Sons,Inc.
2. Widmaier,E.P., Raff,H.and Strang,K.T.(2008)*Vander's HumanPhysiology*, XIEdition.,McGrawHill
3. Berg,J.M.,Tymoczko,J.L.andStryer,L.(2006).*Biochemistry*.VIEdition.W.HFreemanandCo.
4. Nelson,D.L.,Cox,M.M.andLehninger,A.L.(2009).*PrinciplesofBiochemistry*.IVEdition.W.H.FreemanandCo.

BS20.216	**Animal Physiology and Biochemistry Laboratory**	**0-0-4-2**
Objective	To gain the acquaintance of latest laboratory technology towards cell animal physiology and biochemistry.	

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)

2. Estimation of total protein in given solutions by Lowry's method.

Study of activity of salivary amylase under optimum conditions.

Course Outcome

After completion of the course, students would be able to apply the knowledge of conduction of successful laboratory experiments.

CH20.214	**Basic Mathematics**	**2-0-0-2**
Functions and Coordinate Geometry: Basics of Logarithmic Function, Log Tables, Antilogarithm, Use of Logarithms, Trigonometric Function; Basics of Coordinate Geometry, Curve Sketching, Linear Graphs and Calculation of Slopes, Equation of Straight Lines.		[4]

Differentiation: The Derivative of a Function, Differentiation Formulas, Maxima and Minima, Basic Partial Differentiation, Cyclic Rule, **Exact** First-Order Differential Equations, Homogenous, Exact and Linear Equations, Applications to Chemical Kinetics, Secular Equilibrium, Quantum Chemistry Etc, Second Order Differential Equation and Solutions.	[6]
Integration: Methods of Integration, Basic Integration Formulas, Evaluation of Integrals, Basic Rules for Integration, Integration by Parts, Partial Fraction and Substitution. Reduction Formulae, Applications of Integral Calculus. Functions of Several Variables.	[5]
Statistics and Probability: Basics of Permutations and Combinations, Fundamental of Probability and Probability Theorems without Proof, Average, Root Means Square and most Probable Errors, Examples from the Kinetic Theory of Gases etc., Basics of Curve Fitting (including least squares fit etc) with a General Polynomial Fit.	[6]
Vectors and Matrix Algebra: Vectors, dot, cross and triple products etc., Basics of Matrices, Determinants and Complex number, Stir ling approximation.	[5]

Suggested Books:

Text Books:

1. P.K. Mittal, Mathematics for Degree Students I Year, S.Chand, Year 2016.
2. Mendelson, Schaum's Outlines of Beginning Calculus, McGraw Hill Education, Year 2016.

Basic Mathematics for Chemists, Tebbutt, Wiley.

Reference Books:

1. Applied Mathematics for Physical Chemistry, J.R. Bararnte, Prentice Hall.
2. Mathematical preparation for Physical chemistry: F. Daniels, Mc. Graw Hill.
3. Ramana B.V., Higher Engineering Mathematics, TMH, 2006.

CH20.301	Inorganic Chemistry-IV	3-0-0-3
Thermodynamic and Kinetic Aspects of Metal Complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, determination of composition of complex by Job's method and mole ratio method substitution reactions of square planar complexes.		**[7]**
Metal-ligand Bonding in Transition Metal complexes: Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal-field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters. Magnetic Properties of Transition Metal Complexes, Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.		**[10]**
Electron Spectra of Transition Metal Complexes: Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.		**[8]**

Volumetric Estimation: Theory of oxidation-reduction titrations and complexometric titrations.	**[3]**
Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds, applications of alkyls and aryls of Li, Al, Hg, Sn and Ti and the nature of bonding in metal carbonyls.	**[4]**
Bioinorganic Chemistry: Essential and trace elements to Biological processes, metalloporphyrins. Biological role of alkali and alkaline earth metal ions.Nitrogen fixation.	**[4]**
Silicones and Phosphazenes: Silicones and phosphazenes as examples of inorganic polymers.	**[3]**
Suggested Readings: **Text Books:** 1. P. L. Soni, Text Book of Inorganic Chemistry, 2008, S. Chand & Co. Ltd. 2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2009, RBD. **Reference Books:** 1. F.A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry 3rd Ed. 1995, Wiley Interscience. 2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd. 3. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2009, S. Chand & Co. Ltd. 4. Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co. Ltd.	

CH20.303	**Physical Chemistry-III**	**2-0-0-2**
Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3-H_2O$) and ($CuSO_4-H_2O$) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-$HCl-H_2O$ and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine-water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications.		**[10]**
Chemical and ionic Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. Strong, moderate and weak electrolytes, degree of ionization, pH scale, common ion effect, Buffer solutions and applications of solubility product principle.		**[6]**

Elementary Quantum Mechanics: Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids,Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, basic ideas-criteria for forming M.O. from A.O., construction of M.O.'s by LCAO-H_2^+ ion, calculation of energy levels from wave functions, Hybrid orbitals-sp, sp^2, sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals.	**[5]**
Physical Properties and Molecular Structure: Optical activity, polarization-(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment- temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism.	**[5]**

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B.Sc. Part III, 2009, RBD.
2. K. R. Genwa, Physical Chemistry B.Sc. Part III, 2008, RBD.
3. P.W. Atkins, The elements of Physical Chemistry, 5th Ed. 2004, Oxford.
4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
5. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co
6. Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co. Ltd.

CH20.305	**Organometallic Chemistry**	**3-0-0-3**

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. **Metal carbonyls:** 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison ofsynergic effect with that in carbonyls. **Metal Alkyls:** Important structural features of methyl lithium (tetramer) and trialkylaluminium (dimer), concept of multicentre bonding in these compounds. Role oftriethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium. **Ferrocene:** Preparation and reactions (acetylation, alkylation, metallation, MannichCondensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.	**[22]**
Reaction Mechanism: Introduction to inorganic reaction mechanisms. Trans-effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes. Mechanism of substitution in octahedral complexes.	**[7]**
Catalysis by Organometallic Compounds Study of the following industrial processes and their mechanism:	

1. Alkene hydrogenation (Wilkinsons Catalyst) 2. Hydroformylation (Co salts) 3. Wacker Process 4. Synthetic gasoline (Fischer Tropsch reaction) 5. Synthesis gas by metal carbonyl complexes	**[10]**
Suggested Books: **Text Books:** 1. R.B. King, Transition metal organometallic Chemistry, 1995, Academic Press, 2. R.C. Mehrotra and A. Singh, Organo-metallic Chemistry, A Unified Approach, 2000, New Age Publisher. 3. B D Gupta and A J Elias, Basic Organometallic Chemistry: Concepts, Synthesis and Applications, 2010, University Press (India) Pvt. Ltd. 4. Powell, P. Principles of Organometallic Chemistry, 1988, Chapman and Hall.. **Reference Books:** 1. K.F. Purcell and J.C. Kotz, WB Saunders, Inorganic Chemistry, 1997, Philadelphia. 2. D.F. Shriver, P.W. Atkins and C.H. Langford, Inorganic Chemistry, 1990, Oxford Univ. press. 3. H. Kurosawa and A. Yamamoto, Fundamentals of Molecular catalysis, 2003, Ed. Elsevier 4. Robert H. Crabtree, The Organometallic Chemistry of the Transition Metals. 2000, John Wiley New York.	

CH20.307	**Heterocycles and Natural Products**	**3-0-0-3**
Heterocyclic Compounds: Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered ringscontaining one heteroatom; Synthesis, reactions and mechanism of substitution reactions of:Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole,Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline andisoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-Fritschreaction Derivatives of furan: Furfural and furoic acid.		**[22]**
Alkaloids Natural occurrence, General structural features, Isolation and their physiological action Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Ephedrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Morphine and Reserpine.		**[9]**
Terpenes Occurrence, classification, isolation, isoprene rule; Elucidation of stucture and synthesis of Citral, Geraniol, α-terpineol and menthol.		**[8]**
Reference Books: 1. R. T. Morrison& R. N. Boyd, Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Pearson Education.		

2. I. L. Finar, Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. I. L. Finar, Organic Chemistry (Volume 2), Stereochemistry and the Chemistry of Natural Products, Dorling Kindersley (India) Pvt. Ltd. Pearson Education.
4. R.M. Acheson, Introduction to the Chemistry of Heterocyclic compounds, 1976, John Welly & Sons
5. Graham,T.W. Solomons, Organic Chemistry, John Wiley & Sons, Inc.
6. J.E. McMurry, Fundamentals of Organic Chemistry,7th Ed. 2013, Cengage Learning India Edition,
7. P. S. Kalsi, Textbook of Organic Chemistry 1st Ed., New Age International (P) Ltd. Pub.
8. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.
9. J. Singh, S.M. Ali&J. Singh, Natural Product Chemistry, 2010, Pragati Parakashan.

CH20.309	Organometallic and Natural products Laboratory	0-0-4-2

1. Synthesis of metal complexes with Schiff bases
2. Gravimetric estimation of zinc as zinc ammonium phosphate
3. Gravimetric estimation of silver as silver chloride
4. Estimation of copper and zinc in a mixture by gravimetry
5. Estimation of silver and nickel in a mixture by gravimetry
6. Synthesis of Prussian blue
7. Piperine from black pepper
8. Hesperidin from orange peel.
9. Strychnine from Nux vomica seeds.
10. Curcumin from turmeric powder.
11. Lycopene from tomatoes.
12. Isolation of casein from milk.

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry: Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

CH 20.311	Inorganic and Physical Chemistry Laboratory-II	0-0-2-1

1. Preparationofsodiumtrioxalatoferrate(III)$Na_3[Fe(C_2O_4)_3]$.
2. PreparationofNi-DMGcomplex $[Ni(DMG)_2]$.
3. Preparationofcoppertetraamminecomplex $[Cu(NH_3)_4]SO_4 \cdot H_2O$.
4. Preparationofcis-andtrans-bisoxalate diaquachromate(III)ion.
5. PreparationofPyridine complex of copper.
6. To determine the CST of phenol – water system.
7. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process
8. To determine the enthalpy of neutralization of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base
9. To determine the enthalpy of solution of solid calcium chloride
10. To study the distribution of iodine between water and CCl_4.

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry: Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

CH20.313	Instrumental Methods and Advanced Materials	4-0-0-4

Chromatography: Theory, Behavior of solutes, Column efficiency and band broadening, Resolution,Column process, Reduced variable, Time of analysis, Qualitative & quantitative analysis, Problems.Gas Chromatography:Optimization of experimental condition, Retention time and Retention volume, Detectors: Thermionic, Flame photometric, Helium and Coulson conductivity detectors, Supercritical fluid chromatography, Qualitative and Quantitative analysis, Problems.Liquid Column Chromatography: Introduction, Solvent delivery system, Sample injection, Separation, columns detectors, Optimization of column performance, Problems.High Performance Liquid Chromatography: Adsorption HPLC, Partition HPLC, Ion Exchange HPLC, Exclusion HPLC, Problems**.** Ion Chromatography:Introduction, Technique and Applications.	**[14]**
Other Separation Methods: Ultracentrifugation-Principle, sedimentation constant, sedimentation equilibrium, sedimentation velocity, methodology and applications.	**[5]**
Electroanalytical Methods: Potentiometry & Voltammetry	**[4]**
X-ray analysis and electron spectroscopy (surface analysis)	**[4]**

Organic Electronic Materials: Applications of Organic Electronics, electronic structure and electrical properties of materials electrically conducting polymers, concepts of polarons and solitons, Theory of charge transport and mobility in organic materials, basic electronic devices: organic solar cells, Organic Electro Chemical Transistors (OECTs), Organic Field Effect Transistors (OFETs). Organic semiconductors, organic light-emitting diodes, flexible organic light emitting diode (OLED).	**[14]**
Inorganic solids of technological importance: Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white andblack pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensionalmetals, molecular magnets, inorganic liquid crystals.	**[11]**

Suggested Readings:

Text Books:

1. B. K. Sharma, Instrumental methods of chemical analysis, 2008, Goel Publishing House.
2. B. Sivasankar, Instrumental methods of analysis, 2012, Oxford higher education.

Reference Books:

1. Mendham, Denney, Barnes, Thomas and Sivasankar, Vogel's: Textbook of quantitative Chemical Analysis; 2009, Pearson.
2. G. W. Ewing, Instrumental methods of Chemical analysis, 2003, Tata Mc-Graw Hill.
3. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structuralchemistry. 1974. John Wiley & Sons.

CH20.315	**Reagents and Reactions**	**4-0-0-4**
Reagents: Introduction, Fenton's Reagent, Gilman'sreagent, Wilkinson's catalyst, Lindlar catalyst, Adams' catalyst**,** Lithium aluminium hydride, Sodium borohydride, Anhydrous aluminium chloride, Dicyclohexylcarbodiimide, N-Bromosuccinimide, Lead tetra acetate, Osmium tetroxide, Perbenzoic acid,Periodic Acid, Raney nickel, selenium dioxide, 1,3-Dithiane (Umpolung reagent), Liquid ammonia, Boron Trifluoride, Sodium amide.		**[20]**
Reactions: Introduction, A detailed study of the following reactions: Aldol condensation, Arndt-Eistert, Birch Reduction, Cannizzaro, Claisen condensation, Clemmensen reduction, Curtius, Diel's Alder, Favorskii, Friedel-Crafts, Heckreaction, Hell-Volhard-Zelinsky, Knoevenagel, Mannich, Michael, Perkin, Reformatsky, Reimer-Tiemann, Schmidt, Shapiro reaction, Wolf-Kishner Reduction.		**[20]**
Rearrangement: Introduction, nature of migration, migratory aptitude. A detailed study of the following rearrangements: Allylic , Baeyer-Villiger, Beckmann, Benzil – Benzillic , Claisen, Demjanov, Favorskii, Fries, Hofmann, Pinacol-pinacolone, Wagner-Meerwein, Wolff.		**[12]**
Text Books: 1. Michael B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, 8th Edition, ISBN: 978-1-119-37179-3 November 2019,WILEY, 2144 Pages **Reference Books:** 2. R.O.C. Norman and J.M. Coxon, Principles of Organic synthesis, Blackie Academic		

&Professional, 3rd Edition, Springer, ISBN-13: 978-0751401264 ISBN-10: 0751401269
3. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part B. Plenum Press, Springer 2007

CH20.317	Instrumental Methods Laboratory	0-0-4-2

Perform any EIGHT experiments.

1. Separation of mixtures by paper chromatography and reporting the Rf values:
   (i) Co^{2+} and Ni^{2+}.
   (ii) Amino acids present in the given mixture.
2. Solvent Extractions
   (i) To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+} DMG complex in chloroform, and determine its concentration by spectrophotometry.
3. Analysis of soil:
   (i) Determination of pH of soil.
   (ii) Total soluble salt
   (iii) Estimation of calcium and magnesium
   (iv) Qualitative detection of nitrate and phosphate
4. Ion exchange:
   (i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
   (ii) Separation of amino acids from organic acids by ion exchange chromatography.
5. Spectrophotometry
   (i) Verification of Lambert-Beer's law and determination of concentration of a coloured species ($CuSO_4$, $KMnO_4$, $CoCl_2$, $CoSO_4$)
   (ii) Determinationofconcentrationofcolouredspeciesviafollowingmethods;
      (a) Graphical method,
      (b) Epsilon method,
      (c) Ratio method,
      (iv) Standard addition method

Suggested Readings:

Text Book:

1. Giri, Bajpai and Pandey, Practical Chemistry: Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

CH20.319	Applications of Computers in Chemistry	2-0-0-2
Basic Computer system (in brief)-Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII); Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN and C++); Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.		**[13]**
Use of Programming Language for solving problems in Chemistry Computer Programming Language- QBASIC, (for solving some of the basic and in turn complicated chemistry problems). QB4 version of QBASIC can be used. Programming Language – QBASIC; Commands: INPUT and PRINT Commands; GOTO, If, ELSEIF, THEN and END IF Commands; FOR and NEXT Commands; Library Functions (ABS, ASC, CHR$, EXP,INT, LOG, RND, SQR, TAB and trigonometric Functions), DIM, READ, DATA, REM, RESTORE, DEF FNR, GOSUB, RETURN, SCREEN, VIEW, WINDOW, LINE, CIRCLE. LOCATE, PSET Commands.		**[13]**

Suggested Readings:

Text Books:

1. McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).
2. Mortimer, R. Mathematics for Physical Chemistry. 3rd Ed. Elsevier (2005).
3. Steiner, E. The Chemical Maths Book Oxford University Press (1996).

Reference Books:

1. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
2. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis,
3. Cambridge Univ. Press (2001) 487 pages.
4. Noggle, J. H. Physical Chemistry on a Microcomputer. Little Brown & Co. (1985)
5. Yates, P. Chemical Calculations. 2nd Ed. CRC Press (2007)

CH20.321	Molecular Modelling & Drug Design	4-0-0-4
Introduction to Molecular Modelling: Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy. Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature.		**[20]**

Force Fields: Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.	**[10]**
Energy Minimization and Computer Simulation: Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.	**[8]**
Molecular Dynamics & Monte Carlo Simulation: Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers.	**[8]**
Structure Prediction and Drug Design: Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.	**[6]**

Suggested Readings:

Text Books:

1. S. P. Gupta, QSAR and Molecular Modeling, Springer, 2008, Anamaya Publishers.

Reference Books:

1. A.R. Leach, Molecular Modelling Principles and Application, 2001, Longman.
2. J.M. Haile, Molecular Dynamics Simulation Elementary Methods, 1997, John Wiley and Sons

RM20.301	Research Methodology	2-0-0-2

Objective: To acquire fundamental knowledge research methodology and apply in liberal arts, sciences and applied sciences.

1. Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
2. Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
3. Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
4. Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode, Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation -Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test.	**06**
5. Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of research methodologyin liberal arts, sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyze, evaluate and create.

Suggested Readings:

1. Aczel and Sounderpandian, Complete Business Statistics, 2008, Tata-McGraw Hill. India.
2. Anderson, Sweeney, William and Cam, Statistics for Business and Economics, 2014, Cengage Learning. India
3. R. Cooper Donald and S. Schindler Pamela, Business Research Methods. 2006, Tata McGraw-Hill Education. India
4. S. L. Gupta and H. Gupta, SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), 2011, New Delhi.
5. S. P. Gupta, Statistical Methods. 2014 Sultan Chand and Sons. India
6. O. R.Krishnaswami, M. Ranganatham, Methodology of Research in Social Sciences. 2011, Himalaya Publishing House. India
7. C. R. Kothari, Research Methodology: Methods and Techniques, 2004, New Age International (P) Publisher. New Delhi

CH20.302	Organic Chemistry-IV	3-0-0-3

Heterocyclic Compounds: Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Only one method of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Comparison in basicity of pyridine, piperidine and pyrrole. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis.	**[7]**
Organometallic and Organosulphur Compounds: Organomagnesium Compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions Organosulphur: Nomenclature, structural features. Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.	**[6]**
Amines: *Preparation*: from Gabriel's Phthalimide synthesis, Hofmann Bromamidereaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, Schotten – Baumann Reaction and formation of diazonium salts.	**[4]**
Carbohydrates: Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharide. Erythro and threo diastereomers. Conversion of glucose into mannose. Cyclic structure of D (+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.	**[7]**
Amino Acids, Peptides, Proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids: Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.	**[7]**
Fats, Oils, Detergents and Synthetic Dyes: Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value, soaps, synthetic detergents, alkyl and aryl sulphonates. Dyes: Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.	**[8]**

Suggested Readings:

Text Books:

1. P. L. Soni and H.M. Chawla, Text Book of Organic Chemistry, 28th Ed.1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.

Reference Books:

3. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
4. A. Bahl and B. S. Bahl, Advanced Organic Chemistry, 19th Ed. 2005.
5. Giri, Bajpai and Pandey, Practical Chemistry, reprint, 2005, S. Chand & Co. Ltd.

CH20.304	Physical Chemistry-IV	2-0-0-2
Colloidal State: Definition, classification of colloids. Solids in liquids (sols): properties-kinetic, optical and electrical; stability of colloids, protective action. Hardy-Schulze law, gold number. Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids. Liquids in liquids (emulsions): types of emulsions, preparation, emulsifier.		**[6]**
Solutions: Dilute Solutions and Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.		**[8]**
Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes.		**[12]**
Suggested Readings: **Text Books:** 1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD. 2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD. 3. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford. 4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co. 5. Giri, Bajpai and Pandey, Practical Chemistry Reprint 2009, S. Chand & Co. Ltd		

CH20.306	Chemistry of Polymers and Petrochemicals	3-0-0-3

Polymers: Monomers, functionality, degree of polymerization, classification, polymerization methods: addition and condensation; mechanism and their kinetics, metallocene polymers and other newer techniques of polymerization, copolymerization, fire retarding polymers, electrically conducting polymers, biopolymers, contact lens, dental polymers, artificial heart. Organic Polymers: Condensation polymers- Polyesters, Polyamides, Phenol-formaldehyde resin, Urea-formaldehyde resin, Epoxy resins, Polyurathanes.	**[12]**
Techniques of Polymerization: Bulk polymerization, solution polymerization, suspension and emulsion polymerization. Molecular weights of polymers: Number average and weight average. Determination of molecular weight of polymers by Viscometry, Osmometry and light scattering methods. Glass Transition temperature (Tg)factor and its determination.	**[7]**
Petroleum: Origin, formation and composition of petroleum: Introduction, Occurrence, Composition of Petroleum, Properties of Paraffins, Olefins, Naphthalene, Aromatics and Inorganic impurities (sulphur, nitrogen, chlorine) Exploration of Petroleum by gravity, Magnetic and Seismic Method, refining and reforming, synthetic petrol, Octane and Cetane rating -Refineries & its capacity in India	**[8]**
Evaluation of petroleum properties: Evaluation of Petroleum, U.O.P Characterization factor, Correlation Index - TBP Apparatus and its necessity in Refinery - Testing methods and its importance – ASTM Distillation, Reid vapor pressure, Oxidation stability, Smoke Point, Aniline Point - Carbon residue by Rams bottom method, Copper Corrosion test and Softening point Test - Refinery Products and its uses - Definition of- Heat of Combustion, Specific heat, Latent Heat of fusion, Latent heat of Vaporization, Viscosity index.	**[12]**
Suggested Readings: **Text Books:** 1. J. G. Speight, The Chemistry and technology of petroleum, 2007, CRC Press. 2. G. S. Mishra, Introductory polymer Chemistry, 2005, New Age International. **Reference Books:** 1. D. S. G. Jones, Handbook of petroleum processing, 2006, Springer. 2. J. W. Nicholson, The Chemistry of polymers, 4th Edition, RSC Publications. 3. R.B. Seymour, &C.E. Carraher, Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981. 4. G. Odian, Principles of Polymerization, 4th Ed. Wiley, 2004.	

CH20.308	Inorganic Materials of Industrial Importance	3-0-0-3

Silicate Industries *Glass:* Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass. Composition and properties of the following types ofglasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass,fluorosilicate, coloured glass, photosensitive glass. *Ceramics:* Important clays and feldspar, ceramic, their types and manufacture. Hightechnology ceramics and their applications, superconducting and semiconducting oxides,fullerenes carbon	**[16]**

nanotubes and carbon fibre. *Cements:* Classification of cement, ingredients and their role, Manufacture of cement and thesetting process, quick setting cements.	
Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammoniumnitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate,compound and mixed fertilizers, potassium chloride, potassium sulphate.	**[8]**
Batteries: Primary and secondary batteries, battery components and their role, Characteristics ofBattery. Working of following batteries: Pb acid, Li-Battery, Solid-state electrolyte battery.Fuel cells, Solar cell and polymer cell.	**[6]**
Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements inalloys. Manufacture of Steel (removal of silicon decarbonization, demanganization,desulphurization dephosphorisation) and surface treatment (argon treatment only). Composition and properties of different types of steels.	**[6]**
Catalysis: General principles and properties of catalysts, Phase transfer catalysts and application of zeolites as catalysts.	**[3]**

Text Books:

1.E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
7. Sharma, B.K. & Gaur, H. Industrial Chemistry, 1996, Goel Publishing House, Meerut.

CH20.310	**Inorganic Materials of Industrial Importance Laboratory**	**0-0-4-2**

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).

Reference Books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.

2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley, Publishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
7. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).

CH 20.312	Organic and Physical Chemistry Laboratory-II	0-0-2-1

Perform any EIGHT experiments

1. Synthesis of the following organic compounds:

(a) To prepare o-chlorobenzoic acid from anthranilic acid.

(b) To prepare p-bromoaniline from p-bromoacetanilide.

(c) To prepare m-nitroaniline from m-dinitrobenzene.

(d) To prepare S-Benzyl-iso-thiouronium chloride from thiourea.

2. To determine the strength of the given acid solution (mono and dibasic acid) conductometrically.
3. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
4. To determine the strength of given acid solution (mono and dibasic acid)/$KMnO_4$ – Mohr salt potentiometrically.
5. To determine the molecular weight of a non-volatile solute by Rast method.
6. To standardize the given acid solution (mono and dibasic acid) pH metrically.

Suggested Readings:

Text Book:

2. Giri, Bajpai and Pandey, Practical Chemistry: Reprint 2009, S. Chand & Co. Ltd.
3. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
5. J. Mendham, Vogel's Quantitative Chemical Analysis, 6th Ed., 2009, Pearson Education

CH 20.314	Green and Environmental Chemistry	2-0-0-2
Atmosphere: Structure and composition of Atmosphere, Earth's radiation balance, Particles, Ion and Radicals in the atmosphere, Stratospheric chemistry: Ozone formation and destruction, Global Climate Change and Global warming, Acid Rain. Hydrosphere: Natural water and its distribution, Water cycle, Chemical composition and nutrients in natural water, Physicochemical properties of water, Complex formation in natural water, Wastewater and wastewater treatment, Eutrophication. Lithosphere: Terrestrial environment, Soil formations, Soil properties (physical/chemical), Composition (micro and macro nutrients), Acid-base and Ion-exchange properties, Biogeochemical cycles: Carbon, Nitrogen, Sulphur and Phosphorus, Soil Pollution.		**[15]**
Green Chemistry: Principles of Sustainable and Green Chemistry: Waste Minimisation and Atom Economy, Reduction of Materials Use, Reduction of Energy Requirement, Reduction of Risk and Hazard, Green Catalysts and Green reagents for Industry, Supercritical CO2 as a Replacement for Organic Solvents, Microwave and Ultrasound assisted synthesis, Fuel Cell Electrochemistry.		**[11]**

Suggested Readings;

1. Anastas, P. and Warner, J. (1998). Green chemistry: theory and practice, Oxford University Press.
2. Baird, C. and Cann, M. (2012). Environmental chemistry. New York: W.H. Freeman.
3. Doxsee, K. and Hutchison, J. (2004). Green organic chemistry: strategies, tools, and laboratory experiments, Thomson-Brooks/Cole.
4. Girard, J. (2013). Principles of environmental chemistry, Jones & Bartlett Learning.
5. Hanrahan, G. (2012). Key concepts in environmental chemistry, Academic Press.
6. James H. Clark and Duncan Macquarrie (2002). Handbook of Green Chemistry and Technology, Blackwell Science Ltd.
7. Jeffrey S. Gaffney and Nancy A. Marley (2020). Chemistry of Environmental Systems: Fundamental Principles and Analytical Methods, John Wiley & Sons Ltd.
8. VanLoon, G. and Duffy, S. (2017). Environmental chemistry: A global perspective, Oxford University Press.

CH20.316	Organic Reaction Dynamics & Reactive Intermediates	2-0-0-2
Unit-I: Organic Reaction Dynamics: General methods for the determination of reaction mechanism including energetics, energy profile diagrams, detection of intermediates, reaction kinetics and thermodynamics, substituent, solvent and isotope effects and stereochemical evidences.		[8]
Unit-II: Structure and Reactivity: Effect of structure on reactivity – resonance and fields		

effects, steric effects, quantitative treatment – the Hammett equation and linear free energy relationship, substituent and reaction constant, Taft equation. Thermodynamic and kinetic requirements for reactions, thermodynamic and kinetic control reactions.	[10]
Unit-III: Reactive Intermediates: Classical and non-classical carbocations, carbanions, free radicals, arenes, carbenes, nitrenes and benzyne.General methods of generation, structure, stability and reactivity of these reactive intermediates.	[8]
Suggested Readings: **Text Books:** 1. B. S. Bahal and Arun Bahl, Advanced organic chemistry; 2002, S. Chand and Co. Ltd. **Reference Books:** 1. Jerry March, Advanced organic Chemistry, 2000, Wiley Interscience 2. Morrison and Boyd, Organic chemistry, 6th Edition, Pearson. 3. A. C. Francis, Organic chemistry, 2000, Mc-Graw Hill.	

CH20.318	**Green Chemistry Laboratory**	**0-0-4-2**

Perform any EIGHT experiments.

1. Understand the role of drugs in the healthcare system.
2. Preparation of Aspirin and its analysis.
3. Preparation of Acetaminophen
4. Preparation of Sulfanilimide
5. Isolation of Citric Acid from Lemon
6. Preparation of Hippuric acid
7. Preparation of Phenytoin
8. Preparation of Paracetamol
9. Preparation of Benzyl
10. Preparation of Dihydropyrimidinones (DHPM)
11. Purify all the prepared drugs through crystallization

Reference Books:

1. G.L. Patrick, Introduction to Medicinal Chemistry, Oxford University Press, UK.
2. Hakishan, V.K. Kapoo, Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
2. William O. Foye, Thomas L., Lemke, David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.

CH20.320	**Polymer Chemistry**	**2-0-0-2**
Introduction and history of polymeric materials: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.		**[5]**

Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.	**[6]**
Crystallization and crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.	**[4]**
Determination of molecular weight of polymers: (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.	**[5]**
Properties of Polymers: (Physical, thermal, Flow & Mechanical Properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].	**[6]**
Reference Books: **Text Books:** 1. M. Dekker Seymour's Polymer Chemistry, Inc. 2. G. Odian: Principles of Polymerization, John Wiley. **Reference Books:** 3. F.W. Billmeyer: Text Book of Polymer Science, John Wiley. 4. P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill. 5. R.W. Lenz: Organic Chemistry of Synthetic High Polymers.	

CH20.322	**Industrial Chemicals**	**2-0-0-2**
Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.		[8]
Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.		[10]
Industrial Metallurgy Preparation of metals (ferrous and nonferrous) and ultrapure metals for		[5]

semiconductortechnology.	
Biocatalysis Introduction to biocatalysis: Importance in ―Green Chemistry‖ and Chemical Industry.	[3]

Reference Books:

Text Books:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New

Reference Books:

5. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
6. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
7. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi. Sharma, B.K. & Gaur, H. Industrial Chemistry, 1996, Goel Publishing House, Meerut.

CH20.324	**Project[$]**	**0-0-0-6**
	$ Evaluation of project would comprise project report and viva-voce.	

Mody University of Science & Technology

B.Sc. (Chemistry, Botany, Zoology)
Session 2020-2021 onwards

Curriculum Structure

(Effective from Academic Year 2020-21)

B.Sc. (Chemistry, Botany, Zoology)
Session 2020-2021 onwards

Programme	**Level:**	**No. of Seats:** 15	**Duration: Three Years (Six Semesters)**
Undergraduate			

Affiliation: The proposed programme shall be governed by the Department of Biosciences, SLAS, MUST, Lakshmangarh.

Programme Educational Objectives:

The graduate will

PEO1 Graduates are prepared and developed their mind for professional outlook.

PEO2 Graduates are addressed with social issues and guided to operate problems with solutions.

PEO3 Graduates are provided with practical training, hands-on and project experience to meet the industrial needs.

PEO4 Graduates are trained to develop creative and innovative ideas and to work in teams to accomplish a common goal.

PEO5 Graduates are motivated to take up the new tasks to become entrepreneurs and global leaders.

Programme Outcome:

At the end of the **B.Sc. (Chemistry, Botany, Zoology)** Programme, graduates will be able to

PO1 **Field specialization:** Scholars are specialized with the basic knowledge of chemistry, botany and zoology.

PO2 **Employability Skills:** Prepare students for prominent carrier in Government and Private sectors in academia and research industries.

PO3 **Ethics**: Instill ethical responsibilities, human and professional values and make their contribution to the society.

PO4 **Self-Directed and Life-long Learning:** Developing new and enhancing conversational skills that lead to not only to good communication but also to the excellent drafting abilities linked with technical reports and presentations and be a global entrepreneur.

Programme Specific Outcome:

PSO 1 To amalgamate the knowledge of chemitrsy, botany and zoology for developing technologies for food science industries, medicine, health, agriculture and pharmaceutical.

PSO 2 To enhance expertise in taxonomic details and apply in various fields.

Scope:

B.Sc. is Bachelor of Science and it is an undergraduate level degree course in the field of science for 3 years (six semesters). Among the different B.Sc. course, B.Sc. (Chemistry, Botany, Zoology)

is one of them. Chemistry, Botany, and Zoology, is a combined course which gives the basic idea about all the three subjects. This course covers all the aspects of these three fields making the students understand the structural and functional basis of life. Chemistry makes the candidates learn about its composition, structure, behaviour, properties, and the changes it undergoes during any chemical reaction. They also learn about plant biology which includes study about algae, fungi, their growth, reproduction, development, chemical properties, structure, metabolism, etc. as a part of Botany. The Zoology branch of the course deals with the study of animals, their structure, embryology, classification, evolution, etc for both living and extinct animals.

Input Qualification:

Candidate should have passed 10+2 from a recognized Board with proficiency in Science. The candidates should have studied Chemistry, Botany and Zoology at 10+2 or equivalent stage.

Programmed and Teaching Methodology

The teaching methods include lectures, practical's, field visits, workshops, seminars, field visits, guest lectures etc.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [5] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation: Year up-gradation of the student will be as per the University ordinance.

Session 2020-2021 onwards										
Name of the Programme: B.Sc. CBZ									**Year: First**	
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Autumn Semester										
	Core Courses									
	BS20.117	Plant Diversity	4	-	-	4	3	25	25	50
	BS20.119	Plant Diversity Laboratory	-	-	4	2	4	25	25	50
	BS20.121	Animal Diversity	4	-	-	4	3	25	25	50
	BS20.123	Animal Diversity Laboratory	-	-	4	2	4	25	25	50
	CH 20.101	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH 20.103	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 20.111	Inorganic and Organic chemistry Laboratory -I	-	-	2	1	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EL20.109	Foundation Course in English	2	–	–	2	3	25	25	50
	Skill Enhancement Courses									
	FL-1	Foreign Language-I	3	-	-	3	3	25	25	50
		Sub Total				**23**				
	SF 101	Personal Grooming, Fine Dining (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Core Courses									
	BS20.118	Plant Ecology and Taxonomy	4	-	-	4	3	25	25	50
	BS20.120	Plant Ecology and Taxonomy Laboratory	-	-	4	2	4	25	25	50
	BS20.122	Genetics and Evolutionary Biology	4	-	-	4	3	25	25	50
	BS20.124	Genetics and Evolutionary Biology Laboratory			4	2	4	25	25	50
	CH20.102	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH20.104	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH20.112	Inorganic and Physical Chemistry Laboratory-I	-	-	2	1	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EV20.102	Environmental Studies	4	-	-	4	3	25	25	50
	Skill Enhancement Courses									
	FL-II	Foreign Language-II	3	-	-	3	3	25	25	50
		Sub Total				**25**				

	SF 102	Social Grooming, Home & Decor and Business Communication (Non credit)				1				

Year: Second

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Autumn Semester										
	Core Courses									
	BS20.221	Plant Anatomy and Embryology	4	-	-	4	3	25	25	50
	BS20.223	Plant Anatomy and Embryology Laboratory	-	-	4	2	4	25	25	50
	BS20.217	Animal Anatomy and Embryology of Vertebrates	4	-	-	4	3	25	25	50
	BS20.219	Animal Anatomy and Embryology Laboratory	-	-	4	2	4	25	25	50
	CH20.201	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH20.203	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH20.211	Organic and Physical Chemistry-I	-	-	2	1	3	25	25	50
	Skill Enhancement Courses									
		Mody University Elective (any course from the list)	3	-	-	3	3	20	80	
	FL-III	Foreign language-III	3	–	–	3	3	25	25	50
	BS20.229	Ethanobotany	2	-	-	2	3	25	25	50
		Sub Total				**26**				
	SF 201	Personal Grooming, Fine Dining and Home Safety (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Core Courses									
	BS20.212	Plant Physiology and Metabolism	4	-	-	4	3	25	25	50
	BS20.208	Plant Physiology Laboratory	-	-	4	2	4	25	25	50
	BS20.214	Animal Physiology and Biochemistry	4	-	-	4	3	25	25	50
	BS20.216	Animal Physiology and Biochemistry Laboratory	-	-	4	2	4	25	25	50
	CH20.202	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH20.204	Organic Chemistry-III	3	-	-	3	3	25	25	50
	CH20.212	Inorganic and Organic chemistry Laboratory –II	-	-	2	1	3	-	-	-
	Skill Enhancement Courses									
		Mody University Elective (any course from the list)	3	-	-	3		20	80	
	FL-IV	Foreign language-IV	3	–	–	3	3	25	25	50
	BS20.220	Aquatic Biology	2	-	-	2	3	25	25	50
		Sub Total				**26**				
	SF 202	Social Grooming and Professional Skills (Non credit)				1				

										Year: Third
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Autumn Semester										
	Discipline Specific Elective Courses									
	BS20.319	Cell and Molecular Biology	4	-	-	4	3	25	25	50
	BS20.321	Cell and Molecular Biology Laboratory	-	-	4	2	4	25	25	50
	BS20.205	Immunology	4	-	-	4	3	25	25	50
	BS20.207	Immunology Laboratory	-	-	4	2	4	25	25	50
	CH20.301	Inorganic Chemistry-IV	3	-	-	3	3	25	25	50
	CH20.303	Physical Chemistry –III	2	-	-	2	3	25	25	50
	CH20.311	Inorganic and Physical chemistry Laboratory –II	-	-	2	1	4	25	25	50
	Skill Enhancement Courses									
	BS20.323	Apiculture	2	-	-	2	2	25	25	50
	FL-V	Foreign Language-V	3	-	-	3	3	25	25	50
		Sub Total				**23**				
	*GE20.301	Proficiency (Non-credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Discipline Specific Elective Courses									
	BS20.320	Economic Botany and Biotechnology	4	-	-	4	3	25	25	50
	BS20.322	Economic Botany and Biotechnology Laboratory	-	-	4	2	4	25	25	50
	BS20.324	Applied Zoology	4	-	-	4	3	25	25	50
	BS20.326	Applied Zoology Laboratory	2	-	-	2	3	25	25	50
	CH20.302	Organic Chemistry-IV	3	-	-	3	3	25	25	50
	CH20.304	Physical Chemistry –IV	2	-	-	2	3	25	25	50
	CH20.312	Organic and Physical chemistry Laboratory –II	-	-	2	1	3	25	25	50
	Skill Enhancement Course									
	BS20.328	Mushroom Culture Technology	2	-	-	2	3	25	25	50
	FL-VI	Foreign Language-VI	3	-	-	3	3	25	25	50
		Sub Total				**23**				
	*GE20.301	Proficiency (Non-credit)				1				

Final Credits Summary								
S.N.	Particulars	Credits Semester wise						
		I	II	III	IV	V	VI	Total
1.	Core Courses	18	18	18	18			**72**
2.	Discipline Specific Elective Courses	-	-	-	-	18	18	**36**
3	Ability Enhancement Compulsory Courses	2	4	-	-	-	-	**06**
4	Skill Enhancement Courses	3	3	8	8	5	5	**32**
Total		23	25	26	26	23	23	**146**

$CW (Course work) includes teacher assessment, assignments, class /quiz test.
Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

CBZ Syllabus
First Year (Autumn Semester)

BS20.117	**Plant Diversity**	**4-0-0-4**
Objective	To familiarize the students to special group of bacteria, algae and fungi and analyse the relationship between them.	
Unit 1:	**Microbes** Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.	**9**
Unit 2	Algae General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia*. Economic importance of algae	**10**
Unit 3	Fungi Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition , nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance	**10**
Unit 4:	Bryophytes & Pteridophyte General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*. General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.	**16**
Unit 5	Gymnosperm & Archegoniate	**7**

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Course Outcome

After completion of the course, students would be able to understand, appreciate and apply the economic, ecological and pathological importance of various microbes

Suggested Readings

Text Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi 2nd edition.
2. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
3. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.
4. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
5. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.

Refence Books:

6. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
7. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
8. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.

BS20.119 Plant Diversity Laboratory **0-0-4-2**

Objective To acquaint the students with external and internal basic structure and cellular composition of the Bacteria, Viruses, Fungi, Bryophytes and Pteridophytes and Gymnosperms.

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *Oedogonium, Vaucheria, Fucus* and Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
5. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria:* Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. ***Marchantia***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. ***Funaria***- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. ***Selaginella***- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. ***Equisetum***- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. ***Pteris***- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).

16. ***Cycas***- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet,
v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. ***Pinus***- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Course Outcome

After completion of the course, students would be able to understand the classification, characteristics features, cell structure and growth and reproduction in viruses, bacteria, and various groups of marine and fresh water algae and their ecological and economic importance and can apply in conducting research.

BS20.121 **Animal Diversity** **4-0-0-4**

Objective To identify different characteristics and classification of various phyla's.

Unit 1: **Kingdom Protista** **4**

General characters and classification up to classes;

Locomotory Organelles and locomotion in Protozoa

Unit 2 **Phylum Porifera, Cnidaria, Platyhelminthes & Nemathelminthes** **12**

General characters and classification up to classes; Canal System in *Sycon*,General characters and classification up to classes; Polymorphism in Hydrozoa, General characters and classification up to classes; Life history of *Taenia solium* General characters and classification up toclasses; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 3 **Phylum Annelida Arthropoda Mollusca & Echinodermata** **14**

General characters and classification up to classes; Metamerism in Annelida; General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects. General characters and classification up to classes; Torsion in gastropods

General characters and classification up to classes; Water-vascular system in Asteroidea

Unit 4: **General features and Phylogeny of Protochordata** **14**

General features of Agnatha and classification of cyclostomes up to classes, General features and Classification up to orders; Osmoregulation in Fishes, General features and Classification up to orders; Parental care, General features and Classification up to

	orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes	
Unit 5	**Aves & Mammals** General features and Classification up to orders; Flight adaptations in birds, Classification up to orders; Origin of mammals	**8**

Note: Classification of Unit 1-9 to be followed from "Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

Course Outcome

After completion of the course, students would be able to apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.

SUGGESTED READINGS

Text Books:

1. Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
2. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
3. Pough H. *Vertebrate life*, VIII Edition, Pearson International.

Reference Books:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
2. Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

BS20.123 Animal diversity laboratory **0-0-4-2**

Objective To identify anatomical and physiological attributes of each animal group.

1. Study of the following specimens:
   Amoeba, *Euglena*, *Plasmodium*, *Paramecium*, *Sycon*, *Hyalonema*, and *Euplectella*, *Obelia*, *Physalia*, *Aurelia*, *Tubipora*, *Metridium*, *Taenia solium*, Male and female *Ascaris lumbricoides*, *Aphrodite*, *Nereis*, *Pheretima*, *Hirudinaria*, *Palaemon*, *Cancer*, *Limulus*, *Palamnaeus*, *Scolopendra*, *Julus*, *Periplaneta*, *Apis*, *Chiton*, *Dentalium*, *Pila*, *Unio*, *Loligo*, *Sepia*, *Octopus*, *Pentaceros*, *Ophiura*, *Echinus*, *Cucumaria* and *Antedon*, *Balanoglossus*, *Herdmania*, *Branchiostoma*, *Petromyzon*, *Sphyrna*, *Pristis*, *Torpedo*, *Labeo*, *Exocoetus*, *Anguilla*, *Ichthyophis/Ureotyphlus*, *Salamandra*, *Bufo*, *Hyla*, *Chelone*, *Hemidactylus*, *Chamaeleon*, *Draco*, *Vipera*, *Naja*, *Crocodylus*, *Gavialis*, Any six common birds from different orders, *Sorex*, Bat, *Funambulus*, *Loris*

2. Study of the following permanent slides:
   T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female
   Ascaris

3. Key for Identification of poisonous and non-poisonous snakes

An "**animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Course Outcome After completion of the course, students would be able to understand animal interactions with the environment and identify the major groups of organisms with an emphasis on animals and classify them within a phylogenetic framework.

CH 20.101 **Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, normal and orthogonal wave functions, quantum numbers and their significance, sign of wave functions, radial and angular wave function, radial probability distribution curves, shapes of s, p, d and f orbitals, Aufbau's principle and its limitations, Pauli's exclusion principle, Hund's rule of maximum multiplicity, variation of orbital energy with atomic number, electronic configurations of the elements and ions. **[7]**

Chemical Bonding: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[7]**

Chemistry of *s*- Block Elements: Electronic configurations, diagonal relationships, solvation and complexation tendencies including their functions in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements, Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[4]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds (XeF2, XeF4, XeF6, XeOF4, XeO2F2, XeO3). Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd

CH 20.103 **Organic Chemistry-I** **3-0-0-3**

Fundamentals of Organic Chemistry: Hybridization, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance, Hyperconjugation, charge-transfer compounds and field effects. **[7]**
Cleavage of Bonds: Homolysis and Heterolysis, Nucleophiles and electrophiles, shape and stability order of reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values.

Stereochemistry: Conformations with respect to ethane, n-butane and cyclohexane. Interconversion of WedgeFormula, Newmann, Sawhorse and Fischer representations. Concept of chirality and Elements of symmetry. Configuration: Geometrical and Optical isomerism; Enantiomerism,Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S and E / Z nomenclature . **[8]**

Chemistry of Alkanes and Alkenes: Preparation, Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

[8]

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.
3. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

CH 20.111 Inorganic and Organic Chemistry Laboratory-I 0-0-2-1

Perform any EIGHT experiments from the below list.

1-4.To analyze the given mixture containing four radicals (two acidic and two basic) including interfering acid radicals- fluoride, borate, oxalate, phosphate and excluding insoluble. (Four mixture)

1. Preparation of standard solutions of different Molarity/Normality of titrants.
2. Purification of a given organic sample solid/liquid through crystallization or distillation and ascertaining their purity through melting point or boiling point.
3. To study the process of sublimation of camphor and phthalic acid.
4. Systematic identification-I (detection of extra elements, functional groups: To determine the functional group of the given organic compound through element detection and functional group analysis: Carboxylic Acid, alcoholic, phenolic, ester, aldehydic, ketonic, carbohydrate, amide, anilide, nitro and hydrocarbon.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
2. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
3. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

EL20.109 **Foundation Course in English** **2-0-0-2**

Objective: Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct)	5
Articles: Definite and Indefinite & omission of articles	
Transformation of Sentence Structure: Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	5
Correct Usage of Language: Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need)	6
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	
Writing Skills: Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing	6
Reading Comprehension: Efficient reading and note taking	4

Course Outcome: The student will be able to:

1 Learn the essentials of English Grammar.
2 Apply the rules of grammar to use flawless English in speech and writing.
3 Analyze, identify and rectify the common errors in speech and writing.
4 Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.
5 Evaluate a piece of writing keeping in mind all the rules of grammar studied.
6 Read and comprehend English

Text Books:

1 Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
2 Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.

Reference Books:

1 Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
2 Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3 Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
4 Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

BS20.118 **Plant Ecology and Taxonomy** **4-0-0-4**

Objective To learn and gain knowledge about ecology and taxonomic evidences of plants

Unit 1: **Ecological factors** **8**

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 2	**Plant communities** Characters; Ecotone and edge effect; Succession; Processes and types.	**8**
Unit 3	**Ecosystem & Phytogeography** Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous Principle biogeographical zones; Endemism	**12**
Unit 4:	**Introduction to plant taxonomy, Identification, Taxonomic evidences & hierarchy** Identification, Classification, Nomenclature. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access **Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.** Ranks, categories and taxonomic groups	**12**
Unit 5	**Botanical nomenclature, Classification and Biometrics, numerical taxonomy and cladistics** Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations. Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).	**12**
Course Outcome	Use knowledge, understanding and skills for critical assessment of wide range of ideas and problems in the field of Plant Ecology and Taxonomy.	

Suggested Readings:

Text Books:

1. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
2. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Reference Books:

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.

BS20.120	**Plant Ecology and Taxonomy Laboratory**	**0-0-4-2**
Objective	To identify anatomical and physiological attributes of each plant group.	

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.

2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta),* Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):Brassicaceae -*Brassica, Alyssum / Iberis;* Asteraceae -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae -*Solanum nigrum, Withania;* Lamiaceae -*Salvia, Ocimum*; Liliaceae - *Asphodelus / Lilium / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Course Outcome

Students will be able to demonstrate the experimental techniques and methods of the subject learnt and will be able to address the practical problems

BS20.122	**Genetics and Evolutionary Biology**	**4-0-0-4**

Objective The course gives students a very basic overview of some principles behind these very fundamental areas of biology

Unit 1: **Introduction to Genetics, Mendelian Genetics and its Extension** **8**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co- dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance.

Unit 2 **Linkage, Crossing Over and Chromosomal Mapping** **6**

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics - an alternative approach to gene mapping

Unit 3 **Mutations & Sex Determination** **8**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations.

Chromosomal mechanisms, dosage compensation

Unit 4: **History of Life, Introduction to Evolutionary Theories, Direct Evidences of Evolution & Processes of Evolutionary Change** **16**

Major Events in History of Life

Lamarckism, Darwinism, Neo-Darwinis

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse.

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 5 **Species Concept, Macro-evolution & Extinction** **14**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Macro-evolutionary Principles (example: Darwin's Finches)

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution.

Course Outcome Students will be able to explain and apply the learnt principles and fundaments of genetics.

Suggested Readings:

Text Books:

1. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
3. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
4. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory

Press.

Reference Books:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
3. Russell, P. J. (2009). *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.
4. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
5. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
6. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
7. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

BS20.124 Genetics and Evolutionary Biology Laboratory 0-0-4-2

Objective To understand the basic scientific methods, including data analysis, used in these fields, and be able to carry out simple analyses using empirical population genetics and quantitative genetics data.

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Charts:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

Course Outcome Student will be able to combine this knowledge to interpret results from studies in population and quantitative genetics.

CH20.102 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[5]**

Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment with their 3d- analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[4]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide and Actinide Elements: Electronic configuration, oxidation states and ionic, atomic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. Preparation of transuranic elements, Chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[10]**

Suggested Readings:

Text Books:

1. P.L. Soni, Text Book of Inorganic Chemistry, 1999, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

1. F.A. Cotton. G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry 5rd Ed. 2005, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.

CH20.104 **Physical Chemistry-I** **3-0-0-3**

Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect). **[9]**

Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases. **[6]**

Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method). **[7]**

Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore. **[4]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counters, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

Spectroscopy: Electromagnetic radiation of the spectrum, basic features of different spectrometers, Rotational Spectrum -Diatomic molecules, idea of vibrational frequencies of different functional groups. Raman Spectrum concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules. **[4]**

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples). **[6]**

Suggested Readings:

Text Books:

1. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
2. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

1. P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
3.Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4.Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

CH20.112 Inorganic and Physical Chemistry Laboratory-I 0-0-2-1

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
3. Determination of Hardness of water by EDTA method.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
6. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
7. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
8. To determine the surface tension of a given liquid by drop number method.
9. To determine the viscosity of a given liquid.
10. To determine the specific refractivity of a given liquid.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
6. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009.

7. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

EV20.102	**Environmental Studies**	**4-0-0-4**
Course Outcome	To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.	
	Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	**9**
	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
	Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
	Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**
	Environmental Policies & Practices. Climate change, global warming,	**7**

ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.

Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). **6**

Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc. **5**

Course Outcome

After completion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.

Suggested Readings
Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An

Environmental History of the Twentieth Century.

Refence Books:

9. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
10. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
11. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
12. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
13. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
14. www.nacwc.nic.in 22.www.opcw.org

BS20.217 Animal Anatomy and Embryology 4-0-0-4

Objective To understand the fascinating world of vertebrates and their embryology.

Unit 1:	**Integumentary and Skeletal System** Derivatives of integument w.r.t. glands and digital tips Evolution of visceral arches	**7**
Unit 2	**Digestive, Respiratory and Circulatory System** Brief account of alimentary canal and digestive glands Brief account of Gills, lungs, air sacs and swim bladder Evolution of heart and aortic arches	**13**
Unit 3	**Urinogenital, Nrevous System and Sense Organs** Succession of kidney, Evolution of urinogenital ducts Comparative account of brain and Types of receptors	**10**
Unit 4:	**Early Embryonic Development** Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	**12**
Unit 5	**Late Embryonic Development & Control of Development** Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation. Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death	**18**

Course Outcome After completion of the course, students would be able to apply the knowledge of developmental behaviour of animal anatomy and vertebrate's embryology in research.

Suggested Readings:

Text Books:

1. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
2. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
3. Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution.* IV Edition. McGraw-Hill Higher Education.
4. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.

Reference Books:

1. Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
2. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
3. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.

BS20.219 Animal Anatomy and Embryology Laboratory **0-0-4-2**

Objective To become proficient in the experiments related to animal anatomy and embryology.

1. Osteology:
   a) Disarticulated skeleton of fowl and rabbit
   b) Carapace and plastron of turtle /tortoise
   c) Mammalian skulls: One herbivorous and one carnivorous animal.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
4. Study of placental development in humans by ultrasound scans.
5. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Course Outcome After completion of the course, students would be able to apply the experimental knowledge of animal anatomy and embryology.

BS20.221	**Plant Anatomy and Embryology**	**4-0-0-4**
Objective	Understand the basics of systematics by learning the diagnostic and general characters of various groups.	
Unit 1:	**Meristematic and permanent tissues** Root and shoot apical meristems; Simple and complex tissues.	**7**
Unit 2	**Organs and Secondary Growth** Structure of dicot and monocot root stem and leaf. Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).	**10**
Unit 3	**Adaptive and protective systems** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.	**7**
Unit 4:	**Structural organization of flower, Pollination and fertilization** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac. Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.	**16**
Unit 5	**Embryo, Endosperm, Apomixis and polyembryony** Endosperm types, structure and functions; Dicot and monocot embryo; Embryo- endosperm relationship. Definition, types and practical applications.	**12**
Course Outcome	After completion of the course, students would be able to apply the knowledge of plant anatomy and embryology in different research domains.	

Suggested Readings:

Text Books:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

Reference Books:

2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

BS20.223 Plant Anatomy and Embryology Laboratory 0-0-4-2

Objective To become proficient in the experiments related to plant anatomy and embryology.

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Course Outcome After completion of the course, students would be able to apply the knowledge of plant Anatomy and embryology in research fields.

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π^* and n-π^* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated dienes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[5]**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers. **[4]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.

CH20.203 **Physical Chemistry-II** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. Definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, Kirchoff's equation. Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Nernst heat theorem, concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD.
2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

1. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co.
3. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd

CH 20.211 Organic and Physical Chemistry Laboratory-I 0-0-2-1

1. Systematic identification-II: To identify the given organic compound through element detection, functional group analysis and confirmative test and preparation of at least one pure solid derivative. Any six organic compounds may be identified, like Naphthalene, m-dinitrobenzene, resorcinol, α-naphthol, β-naphthol, benzophenone, benzaldehyde, benzoic acid, salicyclic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline, glucose.
2. To determine the CST of phenol – water system.
3. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process.
4. To determine the enthalpy of neutralization of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
5. To determine the enthalpy of solution of solid calcium chloride.
6. To study the distribution of iodine between water and CCl_4.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
2. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
3. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

BS20.229 Ethanobotany 2-0-0-2

Objective To learn about ethnic groups or tribals in India & related studies

Unit 1: Ethanobotany and its methodological studies **6**

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit 2 Methodology of Ethnobotanical studies **4**

Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3 Role of ethnobotany in modern Medicine **8**

Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of

	ethnobotany in modern medicine with special example *Rauvolfia sepentina, Trichopus zeylanicus, Artemisia,Withania*.	
Unit 4:	Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).	**3**
Unit 5	**Ethnobotany and legal aspects** Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.	**5**

Course Outcome

After completing the course, students will learn about role of ethnobotany in modern Medicine, role of ethnic groups in conservation of plant genetic resources & about related legal aspects.

Text Books:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

Reference Books:

1. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
2. Lone et al,. Palaeoethnobotany
3. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
4. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah. 8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996 9)

Second Year (Spring Semester)

BS20.212 Plant Physiology and Metabolism **4-0-0-4**

Objective To acquire the knowledge of the cellular behaviour of plant and its metabolism.

Unit 1 **Plant-water relations** **6**

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Unit 2 **Mineral nutrition & Translocation in phloem** **12**

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 3 **Photosynthesis and Plant response to light and temperature** **18**

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Unit 4 **Respiration and Enzymes** **8**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Unit 5 **Nitrogen Metabolism and Plant growth regulators** **8**

Biological nitrogen fixation; Nitrate and ammonia assimilation.

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Course Outcome Students would be able to apply their insight of various metabolic processes in designing their experiments.

Suggested Readings:

Text Books:

1. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Reference Books:

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

BS20.208 Plant Physiology Laboratory **0-0-4-2**

Objective To get acquainted with the experiments on cellular behaviour of plant and its metabolism.

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Course Outcome Students would be able to apply hands on expertise on physiological detections in plants.

BS20.214 Animal Physiology and Biochemistry **4-0-0-4**

Objective To acquire the knowledge of the animal cell behaviour.

Unit 1:	**Nerve and muscle** Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction	**7**
Unit 2	**Digestion Respiration & Excretion** Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	**16**
Unit 3	**Cardiovascular system Reproduction and Endocrine Glands** Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal	**14**
Unit 4:	**Carbohydrate, Lipid & Protein Metabolism** Glycolysis, Kreb's cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain	**8**
Unit 5	**Enzymes** Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	**7**

Course Outcome After completion of the course, students would be able to apply the knowledge of biochemical and physiological aspects of animals in practical field.

Suggested Readings:

Text Books:

1. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.
2. Guyton, A.C. and Hall, J.E. (2011). T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

Reference Books:

1. Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
3. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co.

4. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.

BS20.216 Animal Physiology and Biochemistry Laboratory 0-0-4-2

Objective To gain the acquaintance of latest laboratory technology towards cell animal physiology and biochemistry.

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
2. Estimation of total protein in given solutions by Lowry's method.
3. Study of activity of salivary amylase under optimum conditions.

Course Outcome After completion of the course, students would be able to apply the knowledge of conduction of successful laboratory experiments.

BS20.220	**Aquatic Biology**	**2-0-0-2**
Objective	To learn about aquatic biomes, freshwater ecosystem, estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs etc.	
Unit 1:	**Aquatic Biomes** Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.	**5**
Unit 2	**Freshwater Biology** **Lakes**: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico–chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous.	**6**
Unit 3	**Freshwater Biology** **Streams:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.	**8**
Unit 4:	**Marine Biology** Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	**3**
Unit 5	**Management of Aquatic Resources** Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.	**4**
Course outcome	Students will be able to learn about Management of Aquatic Resources, Marine Biology and Freshwater Biology	

Suggested Readings

Text Books:

1. **Anathakrishnan** : Bioresources Ecology 3rd Edition
2. **Trivedi and Goyal** : Chemical and biological methods for water pollution studies
3. **Pawlowski** : Physicochemical Methods for Water and Wastewater Treatment, 1st Edition

Reference Books:

1. **Goldman** : Limnology, 2nd Edition
2. **Odum and Barrett** : Fundamentals of Ecology, 5th Edition
3. **Wetzel** : Limnology, 3rd edition
4. **Welch** : Limnology Vols. I-II

CH20.202 **Inorganic Chemistry-III** **2-0-0-2**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Hard and Soft Acids and Bases (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness. **[8]**

Oxidation and Reduction: Oxidation and reduction potential, applications of electrochemical series. Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. P. L. Soni, Text Book of Inorganic Chemistry, 2005, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2004, RBD.

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 4th Ed. 2005, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
3. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2003, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co. Ltd.

CH 20.204 **Organic Chemistry-III** **3-0-0-3**

Nuclear magnetic resonance (NMR) spectroscopy: Proton magnetic resonance (^{1}H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques. **[9]**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Organic Synthesis via Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate; the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes. Alkylation and acylation of enamines. **[4]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.

CH20.212 Inorganic and Organic Chemistry Laboratory-II **0-0-2-1**

1. Estimation of Ni(II) using dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN.
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
4. Quantitative estimation of copper-Zinc of the following mixture by volumetric and gravimetric methods
5. Quantitative estimation of Zinc-nickel of the following mixture by volumetric and gravimetric methods
6. Steam distillation (non evaluative) Naphthalene from its suspension in water Separation of o-and p-nitrophenols
7. Column chromatography (non evaluative) Separation of fluorescein and methylene blue. Separation of leaf pigments from spinach leaves.
8. Determination of Rf values and identification of organic compounds.
9. Separation of green leaf pigments (spinach leaves may be used) by paper chromatographic method (b) Separation of a mixture of coloured organic compounds using common organic solvents by TLC.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
6. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

BS20.319	**Cell and Molecular Biology**	**4-0-0-4**
Objective	To get hold of basic familiarity of cell and molecular biology for application in biotechnology.	
Unit 1	**Techniques in Biology** Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.	**6**
Unit 2	**Cell as a unit of Life: Cell Membrane and Cell Wall** The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components. The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.	**6**
Unit 3	**Cell Organelles** Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis. Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).	**18**
Unit 4	**Cell Cycle and Genetic material** Overview of Cell cycle, Mitosis and Meiosis; Molecular controls. DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi–conservative, semi discontinuous RNA priming, Ǿ (theta) mode of replication, replication of linear, ds-DNA, replicating the 5´end of linear chromosome including replication enzymes.	**12**
Unit 5	**Transcription and Regulation of gene expression** Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase-various types; Translation (Prokaryotes and eukaryotes), genetic code. Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.	**10**
Course Outcome	After completion of the course, students would be able to apply the knowledge of molecular biology in sciences and applied sciences.	

Suggested Readings:

Text Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and

Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

1. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

BS20.321 Cell and Molecular Biology Laboratory **0-0-4-2**

Objective To get acquainted for application of experiments of cellular molecular biology in biotechnology and other applied research fields.

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
7. Study of mitosis and meiosis (temporary mounts and permanent slides).
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp)Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
13. Study DNA packaging by micrographs.
14. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Course Outcome After completion of the course, students would be able to apply the knowledge in conduction of successful laboratory experiments.

BS20.205 Immunology 4-0-0-4

Course Objective: To become proficient in the knowledge of basic immunological cells and molecules required in different fields of science.

Immune Response: An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses. [10]

Immune Cells: T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination [10]

Regulation of Immuno globulin gene expression–clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germline & somatic mutation), antibody diversity [12]

Major Histocompatibility complexes– class I & class II MHC antigens, antigen processing. Immunity to infection– immunity to different organisms, pathogen defense strategies, avoidance of recognition. Auto immune diseases, Immunodeficiency- AIDS. [10]

Vaccines & Vaccination– adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to their infectious agents, passive & active immunization. Introduction to immunodiagnostics– RIA, ELISA. [10]

Course Outcome: After completion of the course, students would be able to apply the knowledge of immunology in sciences and medical sciences

Text Books:

1. Abbas A K, Lichtman A H, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt I M. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.

Reference Books:

1. Goldsby R A, Kindt T J, Osborne B A. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, NewYork.
2. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology.7th edition Garland Science Publishers, New York.
3. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Living stone Publishers, Edinberg.
4. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

BS20.207 Immunology Laboratory 0-0-4-2

Course Objective: To become familiar with the different experiments of immunology.

Practicals

1. To determine differential leucocytes count
2. To determine total leucocytes count
3. To determine total RBC count
4. To perform Haemagglutination assay
5. To perform Haemagglutination inhibition assay
6. To perform separate serum from blood
7. To perform Double immuno diffusion test using specific antibody and antigen.
8. To perform ELISA.

Course Outcome: After completion of the course, students would be able to apply the laboratory skills of immunology laboratory in sciences and applied sciences

CH20.301 **Inorganic Chemistry-IV** **3-0-0-3**

Thermodynamic and Kinetic Aspects of Metal Complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, determination of composition of complex by Job's method and mole ratio method substitution reactions of square planar complexes. **[7]**

Metal-ligand Bonding in Transition Metal complexes: Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal-field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters. Magnetic Properties of Transition Metal Complexes, Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes. **[10]**

Electron Spectra of Transition Metal Complexes: Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion. **[8]**

Volumetric Estimation: Theory of oxidation-reduction titrations and complexometric titrations. **[3]**

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds, applications of alkyls and aryls of Li, Al, Hg, Sn and Ti and the nature of bonding in metal carbonyls. **[4]**

Bioinorganic Chemistry: Essential and trace elements to Biological processes, metalloporphyrins. Biological role of alkali and alkaline eath metal ions.Nitrogen fixation. **[4]**

Silicones and Phosphazenes: Silicones and phosphazenes as examples of inorganic polymers. **[3]**

Suggested Readings:

Text Books:

1. P. L. Soni, Text Book of Inorganic Chemistry, 2008, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2009, RBD.

Reference Books:

1. F.A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry 3rd Ed. 1995, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
3. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2009, S. Chand & Co. Ltd.
4. Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co. Ltd.

CH20.303 **Physical Chemistry-III** **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H_2O), ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-HCl-H_2O and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Chemical and ionic Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[6]**

Strong, moderate and weak electrolytes, degree of ionization, pH scale, common ion effect, Buffer solutions and applications of solubility product principle.

Elementary Quantum Mechanics: Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, basic ideas-criteria for forming M.O. from A.O., construction of M.O.'s by LCAO-H_2^+ ion, calculation of energy levels from wave functions, Hybrid orbitals-sp, sp^2, sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals. **[5]**

Physical Properties and Molecular Structure: Optical activity, polarization-(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment- temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism. **[5]**

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B.Sc. Part III, 2009, RBD.
2. K. R. Genwa, Physical Chemistry B.Sc. Part III, 2008, RBD.
3. P.W. Atkins, The elements of Physical Chemistry, 5th Ed. 2004, Oxford.
4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
5. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co
6. Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co. Ltd.

CH 20.311 **Inorganic and Physical Chemistry Laboratory-II** **0-0-2-1**

1. Preparation of sodiumtrioxalatoferrate(III) $Na_3[Fe(C_2O_4)_3]$.
2. Preparation of Ni-DMG complex$[Ni(DMG)_2]$.
3. Preparation of coppertetraamminecomplex $[Cu(NH_3)_3]SO_4$.
4. Preparation of cis- and trans-bisoxalatodiaquachromate(III)ion.
5. Preparation of Pyridine complex of copper.
6. To determine the CST of phenol – water system.
7. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process
8. To determine the enthalpy of neutralisation of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base
9. To determine the enthalpy of solution of solid calcium chloride
10. To study the distribution of iodine between water and CCl_4.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

BS20.323	**Apiculture**	**2-0-0-2**
Objective	To learn about honey production at commercial scale	
Unit 1:	Introduction to Apiculture and study of habit, habitat and nesting behaviour of *Apis dorsata, Apis indica, Apis floera, Apis mellifera.* Life cycle, Colony organization and division of labour.	**6**
Unit 2	Bee behaviour and communication. Bee keeping equipments: **a)** Bee box (Langstroth type) **b)** Honey extractor **c)** Smoker **d)** Bee-veil **e)** Gloves **f)** Hive tool **g)** Brush **h)** queen excluder. Bee keeping and seasonal management.	**10**
Unit 3	Bee products (collection methods, composition and uses): **a)** Honey b) Wax c) Venom d) Propolis e) Royal jelly f) Pollen. Diseases and enemies of Bees: **a)** Bee diseases- Protozoan, Bacterial,viral, Fungal. **b)** Bee pests- Wax moth (Greater and Lesser), wax beetle. Bee predators- Bee eater, King crow, Wasp, Lizard, Bear, Man. Bee pollination and management of bee colonies for pollination	**10**
Course Outcome	Students will be able to learn about Honeybee behavior, communication, products.	

Suggested Readings

Text Books:

1. A Text Book of Entomology, 1974. V. K. Mathur and K. d. Upadhayay. Goel Printing press, Barani.
2. Destructive and useful Insects, their habit and Control, 1973. C. L. Metcalf and W. p. flint, Tata McGraw Hill Publications, New Delhi.
3. Biology of Insects, 1992. S. C. Saxena. Oxford and IBH Publishing Co., New Delhi. Bombay. Calcutta.

Reference Books:

1. Bee and Bee Keeping, 1978, Roger A. Morse, Conell University Press, London.
2. The Behaviour and social Life of Honey Bees, C. R. Ribbandas. Dover Publication inc. New York.

BS20.320 Economic Botany and Biotechnology **4-0-0-4**

Objective To provide thorough knowledge of biotechnological techniques and economic botany.

Unit 1: **Origin of Cultivated Plants, Cereals & Legumes** **14**

Concept of centres of origin, their importance with reference to Vavilov's work

Wheat -Origin, morphology, uses.

General account with special reference to Gram and soybean.

Unit 2 **Spices & Beverages** **8**

General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

Tea (morphology, processing, uses)

Unit 3 **Oils and Fats, Fibre Yielding Plants** **7**

General description with special reference to groundnut

General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 4: **Introduction to biotechnology : Plant tissue culture** **8**

Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

Unit 5 **Recombinant DNA Techniques** **15**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase- PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

Course Outcome The students will able to apply the acquired knowledge in practical ventures.

Suggested Readings:

Text Books:

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.

Reference Books:

1. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

BS20.322 Economic Botany and Biotechnology Laboratory 0-0-4-2

Objective To become familiar with the practical experiments in biotechnology and economic use of botanical knowledge.

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Course Outcome After completion of the course, students would be able to apply the knowledge of biotechnological techniques and economic botany in applied sciences.

BS20.324 Applied Zoology **4-0-0-4**

Objective To get the basic understanding of human genomics and reproductive biology.

Unit 1:	**Introduction to Host-parasite Relationship** Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis	**3**
Unit 2	**Epidemiology of Diseases,** Transmission, Prevention and control of diseases: Tuberculosis, typhoid	**5**
Unit 3	**Rickettsiae and Spirochaetes and Parasitic Protozoa & Helminthes** Brief account of *Rickettsia prowazekii, Borrelia recurrentis* and *Treponema pallidum* Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax* and *Trypanosoma gambiense* Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*	**15**
Unit 4:	**Insects of Economic & Medical Importance** Biology, Control and damage caused by *Helicoverpa armigera, Pyrilla perpusilla* and *Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum* Medical importance and control of *Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla cheopis*	**15**
Unit 5	**Animal Husbandry, Poultry Farming and Fish Technology** Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed.	**14**
Course Outcome	After completion of the course, students would be able to apply the knowledge in conduction of successful laboratory experiments.	

Suggested Readings:

Text Books:

1. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
2. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approache*s. CABI publications, U.K.
3. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
4. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.

Reference Books:

1. Kumar and Corton. *Pathological Basis of Diseases*.
2. Dennis, H. (2009). *Agricultural Entomology.* Timber Press (OR).
3. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
4. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

BS20.326 Applied Zoology Laboratory **0-0-4-2**

Objective To familiarize and experience zoological tests and specimens.

1. Study of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes* and *Xenopsylla.*
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa* (*Heliothis*) *armigera, Papilio demoleus, Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

Course Outcome Student will be able to carry out routine clinical analysis of animals and humans.

CH20.302 Organic Chemistry-IV **3-0-0-3**

Heterocyclic Compounds: Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Only one method of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Comparison in basicity of pyridine, piperidine and pyrrole. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. **[7]**

Organometallic and Organosulphur Compounds: Organomagnesium Compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions **[6]**

Organosulphur: Nomenclature, structural features. Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine.

Amines: *Preparation*: from Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, Schotten – Baumann Reaction and formation of diazonium salts. **[4]**

Carbohydrates: Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharide. Erythro and threo diastereomers. Conversion of glucose into mannose. Cyclic structure of D (+)- glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination. **[7]**

Amino Acids, Peptides, Proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids: Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA. **[7]**

Fats, Oils, Detergents and Synthetic Dyes: Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value, soaps, synthetic detergents, alkyl and aryl sulphonates. **[8]**

Dyes: Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Suggested Readings:

Text Books:

1. P. L. Soni and H.M. Chawla, Text Book of Organic Chemistry, 28th Ed.1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Giri, Bajpai and Pandey, Practical Chemistry, reprint, 2005, S. Chand & Co. Ltd.

CH20.304 Physical Chemistry-IV **2-0-0-2**

Colloidal State: Definition, classification of colloids. Solids in liquids (sols): properties-kinetic, optical and electrical; stability of colloids, protective action. Hardy-Schulze law, gold number. Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids. Liquids in liquids (emulsions): types of emulsions, preparation, emulsifier. **[6]**

Solutions: Dilute Solutions and Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes. **[8]**

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD.
2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD.
3. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford.
4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co.
5. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd

CH 20.312 Organic and Physical Chemistry Laboratory-II 0-0-2-1

1. Synthesis of the following organic compounds:
(a) To prepare o-chlorobenzoic acid from anthranilic acid.
(b) To prepare p-bromoaniline from p-bromoacetanilide.
(c) To prepare m-nitroaniline from m-dinitrobenzene.
(d) To prepare S-Benzyl-iso-thiouronium chloride from thiourea.
2. To determine the strength of the given acid solution (mono and dibasic acid) conductometrically.
3. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
4. To determine the strength of given acid solution (mono and dibasic acid)/$KMnO_4$ – Mohr salt potentiometrically.
5. To determine the molecular weight of a non-volatile solute by Rast method.
6. To standardize the given acid solution (mono and dibasic acid) pH metrically.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

BS20.328 **Mushroom Culture Technology** **2-0-0-2**

Objective To empower students with entrepreneurial skills through the production and disease management of mushrooms.

Unit 1	Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms availablin India - *Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus*.	**4**
Unit 2	Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication.	**5**
Unit 3	Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation- Low cost technology, Composting technology in mushroom production.	**5**
Unit 4	Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.	**8**
Unit 5	Food Preparation : Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.	**4**

Course Outcome The students will able to apply the acquired sufficient academic and practical experiences and become self- employed in the mushroom and nursery ventures.

Suggested Readings:

Text Books:

1. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

Reference Books:

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Mody University of Science & Technology

Bachelor of Science (Hons) Food and Nutrition

(Effective from Academic Year 2020-21)

[B.Sc. (Hons) Food & Nutition]
(Session 2020-2021 onwards)

Programme **Level:**Undergraduate	**No. of Seats:** 15	**Duration: Three Years (Six Semesters)**

Affiliation: The proposed programme shall be governed by the Department of - Biosciences, SLAS, MUST, Laxshmangarh.

Programme Educational Objectives:

The graduate will

PEO1 Graduates are prepared to be employed in industry, academia and research laboratories and by providing expected domain knowledge.

PEO2 Graduates are provided with practical training, hands-on and project experience to meet the industrial needs.

PEO3 Graduates are motivated in career and entrepreneurial skill development to become global leaders.

PEO4 Graduates are trained to demonstrate creativity, develop innovative ideas and to work in teams to accomplish a common goal.

PEO5 Graduates are addressed with social issues and guided to operate problems with solutions.

Programme Outcome:

At the end of the B.Sc. (Hons) Food & Nutrition Programme, graduates will be able to

PO1 **Critical Thinking:** Apply knowledge of food and nutrition field to identify, analyze problems of society and to provide effective solution.

PO2 **Employability Skills:** Inculcate skills to excel in the fields of nutrition in Government and Private sectors in academia and research industries.

PO3 **Ethics**: Instill ethical responsibilities, human and professional values and make their

contribution to the society.

PO4 **Self-Directed and Life-long Learning:** Engaged in lifelong learning to equip them to the changing environment and be prepared to take-up entrepreneurship skills.

Programme Specific Outcome:

PSO 1 To integrate the knowledge of nutritional sciences for developing technologies for food, pharma and healthcare industries.

PSO 2 To impart knowledge for understanding of legal issues affecting nutrition related industries.

PSO 3 To enhance expertise in tools and techniques in applied fields of nutritional sciences.

Scope:

The role of nutritionists within the food industry is increasingly important, as consumers have started emphasizing on the importance of healthy eating. BSc (H) Food and Nutrition programme will help students to understand the principles of food and human nutrition. The students are also introduced to food safety and quality, food processing and preservation as well as applied and practical nutritional skills of clinical nutrition and dietetics. After graduating the students will be eligible to work as nutrition professional and to take the next step into their chosen career.

Input Qualification:

The minimum eligibility criteria needed to be met for admission to the course are:

Candidate should have passed 10+2 PCB with minimum 50% marks in Science stream from a recognized Board with proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [5] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation:
Year up-gradation of the student will be as per the University ordinance.

Session 2020-2021 onwards										
Name of the Programme: B.Sc. (Hons) Food & Nutrition								**Year: First**		
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
Autumn Semester	FN20.101	Principles of Nutrition	4	-	-	4	3	25	25	50
	BS20.105	General Biochemistry	4	-	-	4	3	25	25	50
	BS20.107	General Biochemistry Laboratory	-	-	4	2	4	25	25	50
	CH20.113	Chemistry I	4	-	-	4	3	25	25	50
	BS20.115	Chemistry Laboratory I	-	-	4	2	4	25	25	50
	Generic Elective Courses									
	BS20.101	Cell Biology	4		-	4	3	25	25	50
	BS20.103	Cell Biology Laboratory	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Courses									
	EL20.109	Foundation Course in English	2	–	–	2	3	25	25	50
	Skill Enhancement Courses									
	FL-I	Foreign language-I	3	–	–	3	3	25	25	50
		Sub Total				27				
	SF 101	Personal Grooming, Fine Dining (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Core Courses									
	FN20.102	Food Science	4	-	-	4	3	25	25	50
	FN20.104	Food safety and preservation	2	-	-	2	2	25	25	50
	FN20.106	Food Science Laboratory	-	-	4	2	4	25	25	50
	CH20.114	Chemistry II	4	-	-	4	3	25	25	50
	BS20.116	Chemistry Laboratory II	-	-	4	2	4	25	25	50
	Generic Elective Courses									
	BS20.106	General Microbiology	4	-	-	4	3	25	25	50
	BS20.108	General Microbiology Laboratory	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Courses									
	EV20.102	Environmental Studies	4	-	-	4	3	25	25	50
	Skill Enhancement Courses									
	FL-II	Foreign language-II	3	–	–	3	3	25	25	50
		Sub Total				27				
		Social Grooming, Home & Decor and Business Communication				1				

							Year: Second			
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Autumn Semester										
	Core Courses									
	FN20.201	Food Chemistry	3	-	-	3	3	25	25	50
	FN20.203	Food Technology	2	-	-	2	3	25	25	50
	BS20.201	Molecular Biology	4	-	-	4	3	25	25	50
	FN20.205	Nutritional Laboratory- I	-	-	4	2	4	25	25	50
	BS20.213	Human Development Biology	2	-	-	2	3	25	25	50
	BS20.215	Human Development Biology Laboratory	-	-	2	1	4	25	25	50
	Generic Elective Course									
	BS20.205	Immunology	4	-	-	4	3	25	25	50
	BS20.207	Immunology Laboratory	-	-	4	2	4	25	25	50
	Skill Enhancement Courses									
		Mody University Elective Course (any course from the list)	3	-	-	3		20	80	
	FL-III	Foreign language-III	3	–	–	3	3	25	25	50

		Sub Total				26				
	SF 201	Personal Grooming, Fine Dining and Home Safety(Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
Spring Semester										
	Core Courses									
	FN20.202	Public Health nutrition	4	-	-	4	3	25	25	50
	FN20.204	Human Nutrition	3	-	-	3	3	25	25	50
	FN20.206	Nutrition Laboratory-II	-	-	4	2	4	25	25	50
	BS20.202	Mammalian Physiology	3		-	3	3	25	25	50
	BS20.204	Mammalian Physiology Laboratory	-	-	4	2	4	25	25	50
	Generic Elective Courses									
	BS20.210	Entrepreneurship Development	3	-	-	3	3	25	25	50
	MS20.214	Math and Biostatistics for Biology	3	-	-	3	3	25	25	50
	Skill Enhancement Courses									
		Mody University Elective Course (any course from the list)	3	-	-	3		20	80	
	FL-IV	Foreign language-IV	3	–	–	3	3	25	25	50
		Sub Total				26				
	SF 202	Social Grooming and Professional Skills (Non credit)				1				

							Year: Third			
Autumn Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
	FN20.301	Community Nutrition	4	-	-	4	3	25	25	50
	FN20.303	Nutrition for Health and Fitness	4	-	-	4	4	25	25	50
	FN20.305	Therapeutic Nutrition	4	-	-	4	3	25	25	50
	FN20.307	Nutritional Laboratory-III	-	-	4	2	4	25	25	50
	Discipline Specific Elective Courses									
	FN20.309	Maternal and Child Nutrition	4	-	-	4	3	25	25	50
	BS20.305	Bioprocess Technology	4	-	-	4	3	25	25	50
	BS20.307	Bioprocess Technology Laboratory	-	-	4	2	4	25	25	50
	RM20.301	Research Methodology	2	-	-	2	3	25	25	50
	Skill Enhancement Courses									
	FL-V	Foreign Language -V	3	–	–	3	3	25	25	50
		Sub Total				**29**				
	GE20.301	Proficiency (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester										
	Core Courses									
	FN20.302	Food Quality and Sensory Evaluation	4	-	-	4	4	25	25	50
	FN20.304	Nutraceuticals and Health Food	4	-	-	4	3	25	25	50
	FN20.306	Nutritional Laboratory- IV	-	-	4	2	4	25	25	50
	FN20.308	Project work	-	-	4	2	-	-	-	100
	Discipline Specific Elective Courses									
	FN20.310	Food Analysis	4	-	-	4	3	25	25	50
	FN20.312	Food Analysis Laboratory	-	-	4	2	4	25	25	50
	FN20.314	Nutrigenomics and Proteomics	4	-	-	4	3	25	25	50
	FN20.316	Nutrigenomics and Proteomics Laboratory	-	-	4	2	4	25	25	50
		Sub Total				24				
	Skill Enhancement Courses									
	FL-VI	Foreign Language -VI	3	–	–	3	3	25	25	50
		Sub Total				**27**				
	GE20.302	Proficiency (Non credit)				1				

Final Credits Summary								
S.N.	Particulars	Credits Semester wise						
		I	II	III	IV	V	VI	Total
1.	Core Courses	16	14	14	14	14	12	84
2.	Discipline Specific Elective Courses	-	-	-	-	12	12	24
3.	Generic Elective Courses	6	6	6	6	-	-	24
4.	Ability Enhancement Compulsory Courses	2	4	-	-	-	-	06
5	Skill Enhancement Courses	3	3	6	6	3	3	24
Total		27	27	26	26	29	27	162

$CW (Course work) includes teacher assessment, assignments, class /quiz test.
Evaluation of proficiency will be based on the participation in extra-curricular/co-curricular activities.

FN20.101 Principles of Nutrition **4-0-0-4**

Course Objective: To describe the properties and function of components in food: Carbohydrates, proteins, lipids, water, colours, aroma compounds, vitamins and minerals.

Indian foods - Food and culture, Traditional Indian Dietary patterns and Indian ethnic cuisines, Nutritional/medicinal quality of traditional foods - Traditional food beliefs, foods in Ayurveda. Food processing technologies [12]

Nutrition and Food Science – Definition, history, RDA (Recent), factors affecting RDA – Methods used for deriving RDA, Basic four/five food groups and the functions of food, Food pyramid

Carbohydrates – classification, functions, digestion and absorption, Sources, deficiency diseases. Role of fiber in human Nutrition [10]

Lipids – Classification, functions, digestion and absorption, sources, excess and deficiency disorder

Protein – classification – functions, sources digestion and absorption, sources and deficiency disorders [10]

Vitamins – Fat soluble vitamins A, D, E & K, functions, sources, requirements deficiency diseases. Water soluble vitamins – B like thiamine, Riboflavin, Niacin, Phridoscin, Folic acid, B2 and Vitamin C and their functions sources requirements and deficiency diseases. [10]

Minerals – Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Flourine and their functions, sources requirements and deficiency diseases [10]

Course outcome: Students are expected to understand and be able to control the major chemical and biochemical (enzymatic) reactions that influence food quality with emphasis on food industry applications.

Text Book

1. Srilakshmi. B. (2010) Nutrition Science, V Edition, New Age International Publishers, New Delhi

References:

2. Chintapalli Vidya (2004) A Text book of Nutrition, New Delhi: Discovery Publishing House
3. Gopalan. C. Ramasastry, B.V. and Balasubramanian, S.C. (1976), Nutrition value of Indian Foods, Hyderabad: National Institute of Nutrition
4. 4. Swaminathan M. (1972), Essentials of Food and Nutrition, Philadelphia: Ganesh and Company

BS20.105 General Biochemistry 4-0-0-4

Course objective To get acquainted for application of chemistry in biological sciences

Introduction to Biochemistry:

Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins. [10]

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

Lipids and Nucleic acids:

Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. [10]

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

Enzymes

Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites. [10]

Enzyme specificity: [6]
Types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD^+, $NADP^+$, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate,lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

Carbohydrates Metabolism: [16]
Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. ß-oxidation of fatty acids.

Course Outcome: After completion of the course, students would be able to apply the knowledge of Biochemistry in understanding of Biotechnological industries

Text Books:

1. Bhardwaj Uma (2014). Biochemistry for Life Sciences. Dorling Kindersley (India) Pvt. Ltd, Pearson IN.
2. Jain J L, Jain Supriya and Jain N (2005) Fundamentals of Biochemistry. S Chand and Compant Ltd. New Delhi

Reference Books:

1. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4 Freeman and Company, New York, USA. edition, W.H.
2. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

BS20.107 General Biochemistry Laboratory 0-0-4-2

Practicals

1. Preparation of buffers.
2. To study activity of any enzyme under optimum conditions.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4.Principles of Colorimetry: (i) Verification of Beer's law, estimation of protein. (ii) To study relation between absorbance and % transmission.

5. Separation of Amino acids by paper chromatography.
6. Qualitative tests for Carbohydrates, lipids and proteins
7. Quantitative tests for Carbohydrates
8. Qualitative tests for Carbohydrates, lipids and proteins
9. Qualitative tests for Carbohydrates, lipids and proteins

CH20.113 Chemistry I 4-0-0-4

Course Objective: To learn basic of chemical sciences applicable in food and nutrition field

Atomic Structure and Chemical Bonding: Bohr's theory and its limitations, atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, Valence bond Theory and its limitations, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, percentage ionic character, radius ratio effect and coordination number, lattice energy and Born Haber cycle, polarizing power and polarisability of ions, Fajan's rule. [11]

Chemical Kinetics, Catalysis and Electrochemistry: Rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order and half-life. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation, collision theory, transition state theory. [10]

Catalysis & types of catalysis, Mechanism of catalysis, Enzyme catalysis.

Specific and equivalent conductance, migration of ions and Kohlrausch law, SHE , reference electrodes, standard electrode potential, Nernst equation, electrochemical series and its significance. Electrolytic and Galvanic cells, conductometric and potentiometr

Fundamentals of Organic Chemistry and Stereochemistry: Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Reactive intermediates - carbocations, carbanions and free [10]

radicals.

Optical Isomerism-Elements of symmetry, molecular chirality, enantiomers, optical activity, chiral and achiral molecules with two stereogeniccentres, diastereomers, resolution of enantiomers, inversion, retention. Sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature. Conformational isomerism: Conformational analysis of ethane and n-butane by the Newman projection

Hydrocarbons

Preparation and reactions of alkanes, alkenes and alkynes. Special emphasis tocatalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction), cis-addition to alkenes (alk. KMnO4)and trans-addition (bromine), Markownikoff's and anti-Markownikoff's rule. Acidity of alkynes, hydroboration-oxidation, metal-ammonia reduction, and polymerization of alkynes. Preparation and reactions of alkyl halides. Williamson's ether synthesis: Mechanisms of nucleophilic substitution SN^1 and SN^2 [13]

Arenes and Aromaticity: Structure of benzene:Kekule structure, resonance structure, MO picture. Aromaticity: Huckel's rule, Aromatic electrophilic substitution: Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction.

Ultraviolet and Infrared spectroscopy: Electromagnetic radiation,Absorption laws (Beer Lambert Law), types of electronic transitions, Concept of chromophore and auxochrome. Types of shifts, Application of Woodward Rules for calculation of λ_{max} for conjugated dienes: homoannular and heteroannular, Extended conjugated systems.Molecular vibrations, fundamental bands, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. [8]

Course outcome: After completion of this course the student will be able use chemistry principles for food science applications

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.
2. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.
4. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
5. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
4. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).
5. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

7.P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.

8. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.

CH20.115 Chemistry Laboratory I 0-0-4-2

Course Objective: To learn basic of chemical sciences experiments applicable in Food science and nutrition field

Practicals

1. Purification of a given organic sample solid/liquid through crystallization.
2. Preparation of standard solutions of different Molarity/Normality of titrants.
3. Determination of the melting points of organic compounds
4. Determination of optical activity by using polarimeter
5. To determine the specific reaction rate of the hydrolysis of methyacetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
6. To determine the viscosity of a given liquid.
7. To determine the λ max of $KMnO_4$ solution using

colorimeter.

8. To perform pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

Course outcome: After completion of this course the student will be able use chemistry laboratory sklills for food science applications in industries.

BS20.101 Cell Biology 4-0-0-4

Course Objective: To get hold of basic familiarity of cell and molecular biology for application in biotechnology

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. [10]

Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion. [10]

Lysosomes: Vacuoles and microbodies: Structure and functions. [20]

Ribosomes: Structures and function including role in protein synthesis.

Mitochondria: Structure and function, Genomes, biogenesis.

Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. [06]

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer. [06]

Course Outcome: After completion of the course, students would be able to apply the knowledge of cell biology in sciences and applied sciences

Text Books:

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

1. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco

EL20.109 **Foundation Course in English** **2-0-0-2**

Objective: Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct) **Articles:** Definite and Indefinite & omission of articles	5
Transformation of Sentence Structure: Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	5
Correct Usage of Language: Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need)	6
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	
Writing Skills: Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing	6
Reading Comprehension: Efficient reading and note taking	4

Course Outcome: The student will be able to:

1 Learn the essentials of English Grammar.
2 Apply the rules of grammar to use flawless English in speech and writing.
3 Analyze, identify and rectify the common errors in speech and writing.

4 Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.
5 Evaluate a piece of writing keeping in mind all the rules of grammar studied.
6 Read and comprehend English

Text Books:

1 Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
2 Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.

Reference Books:

1 Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
2 Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3 Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
4 Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

FN20.102	**Food Science**	**4-0-0-4**
Course Objective:	**To familiarize students with fundamentals of food, nutrients and their relationship to Health**	
	Concept and definition of terms: Food, Food Groups, Food Pyramid, Functions of food. Nutrient and Nutritive value, Concept of Balanced Diet.	[8]
	Cereals, Pulses and legumes: Nutritional aspects of wheat, rice and oat. Types of pulses and legumes, uses, and nutritional aspects.	[10]
	Milk and milk Products: Nutritive value and composition of milk, Concept of milk processing and Pasteurization Types of processed milk, milk products (butter, curd, paneer and cheese).	[15]
	Egg, Fish and meat: Nutritional aspects and uses. Nutritional aspects of edible fish and meat, concept of red and white meat.	
	Vegetables and fruits: Uses and nutritional aspect of commonly available vegetables. Fresh fruits and dry fruits– raw and processed product.	[10]
	Salts, Fats and oils: Uses and nutritional aspects of various salts. Types, sources, use and nutritional aspects of fats and oils.	[10]
Course outcome:	To create awareness with respect to deriving maximum benefit from available food resources	

Text book:

1. Hughes O, Bennion M (1970). Introductory Foods, Macrnillan & Co. New York.

References Book:

1. Lavies S (1998). Food Commodities.
2. Pomeranz Y (Ed) (1991). Functional Properties of Food Components, (2nd edition), Academic Press, New York.
3. Tindall HD (1983). Vegetables in the Tropics, MacMillan Press, London.
4. Winton AL, Winton KB (1999). Techniques of Food Analysis. Allied Scientific Publishers.

FN20.104 Food safety and preservation **2-0-0-2**

Course Objective Understand the importance of maintaining a written food safety management system to control food safety hazards.

Food Safety: Definition and factors affecting food safety, safety of left over foods. Control of Food spoilage. [5]

Food Adulteration: Definition, reasons and types. Adulterants in common food items. [5]

Food Standards : ISI, Agmark, FPO, MPO, PFA, FSSAI. [5]

Food preservation: definition, objectives and principles of food preservation. Different methods of food preservation [8]

Preserved Products: manufacture, selection, cost, storage, uses and nutritional aspects. [3]

Course Outcome On successful completion of the syllabus students will understand: How individuals can take personal responsibility for food safety and the importance of keeping food safe.

Text book:

1. Roday S.(1998). Food Hygiene and Sanitation 10th Reprint. New Delhi: Tata McGraw-Hill Education.

References Book:

1. ChattopadayGhosh S and Basu N.(2015). Uccha Madhaymik Khadda O Pusti, Calcutta Book House
2. Subalakshmi, G and Udipi, SA(2006):Food processing and preservation, 1st Ed. New Age International (P)Ltd.
3. Srilakshmi B(2018): Food Science, 7th Colour Ed. New Age International (P) Lt Potter NN and Hotchkiss JH(1999): Food science,5th Ed , Spinger

FN20.106 Food Laboratory **0-0-4-2**

Course Objective: To understand the experimental part of food sciences and their safety and preservation

Practical

1. Food preparation, understanding the principals involved, nutritional quality and portion size Beverages: Hot tea/coffee, Milk shake/ lassi, fruit based beverages Cereals: Boiled rice, pulao, chapatti, parantha, puri, pastas Pulses: Whole, dehusked Vegetables: curries.
2. Preparation of solutions and buffers, Determination of titratable acidity in foods using a potentiometric titration, Diastatic activity of honey, UV-Visible Spectro-photometric analysis of a carotenoid,
3. Determination of hydroxymethyl furfural in honey
4. Market survey of preserved fruit and vegetable products
5. Visit to food testing lab /or any agency of food standards
6. Nutritional labeling Development and understanding- use of computer graphics as an aid
7. Simple test for food adulteration

Course outcome After completion of course the student will be able to understand the instrument and techniques utilized in food science discipline

CH 20.114 Chemistry II **4-0-0-4**

Course Objective: To learn basic of chemistry useful for food and nutrition students

Unit-I

Periodic Properties, Coordination Compounds and Acid-Base Concept: Atomic and ionic radii, ionization energy, electron affinity and electronegativity. Properties of s, p, d and f block elements. Werner's coordination theory effective atomic number concept and isomerism in coordination compounds. Arrhenius, Bronsted-Lowry, and Lewis concepts of acids and bases. [10]

Unit-II

Thermodynamics, Equilibrium and Photochemistry: Concept of heat, q, work, w, internal energy, U, and statement of first law, Second Law: Concept of entropy. Free energy change in a chemical reaction. Thermodynamic derivation of the law of mass action. Le Chatelier's principle. Strong, moderate and weak electrolytes, pH scale, common ion effect and Buffer solutions. [12]

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Jablonski diagram, description of fluorescence, phosphorescence, photochemistry of carbonyl compounds, Norrish type-I and Norrish type II cleavage examples, quantum efficiency and quantum yield.

Unit-III Functional groups [20]

(i) Alcohols: Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Reactions: With sodium, HX (Lucas test), esterification and oxidation.

(ii) Phenols: Preparation: from Cumene hydroperoxide method and diazonium salts. Comparative acidic strength of alcohols and phenols, Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Mechanisms of Fries rearrangement, Claisen rearrangement and Reimer Tiemann reaction.

(iii) Aldehydes and Ketones: Synthesis of aldehydes and ketones from acid chlorides and nitriles.Reactions: with HCN, $NaHSO_3$ and NH_2-G derivatives. Aldol Condensation, Cannizzaro's reaction, Clemensen reduction and Wolff Kishner reduction.

(iv) Carboxylic acids and their derivatives: Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction. **Carboxylic acid derivatives:** Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids. Reactions: Comparative study of nucleophilicity of acyl derivatives.

(v)Amines and Diazonium Salts: Amines: Preparation from Hofmann Bromamide reaction. Reactions: Carbylamine test, Hinsberg test, with HNO_2.

Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol and dyes.

Unit-IV

^{1}HNMR Spectroscopy and Mass Spectrometry: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant, Interpretation of NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. [10]

Mass Spectrometry:Basic principle, Instrumentation, Ion production (EI and CI techniques), molecular ion peak, base peak, nitrogen rule, McLafferty rearrangement, modes of fragmentation, metastable peak.

Course Outcome: After completion of this course the student can have basic of chemistry for better understanding of subject

Suggested Readings:

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.
2. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.
4. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
5. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

6. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
7. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
8. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.

9. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).
10. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
11. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India
Edition, 2013.
12. P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.
13. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.

BS20.116 Chemistry Laboratory II 0-0-4-2

Course Objective: To learn basic experimentation skills I chemistry useful for Food and nutrition students

Section A: Physical Chemistry

1. Study of the solubility of benzoic acid in water and determination of H.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Inorganic Chemistry

4. Preparation of hexamminenickel(II)chloride
5. Preparation of Potassium tris-oxalatoferrate(III)
6. Preparation of potassium-chromium alum, $KCr(SO_4)2•12H_2O$
7. Preparation of coordination compound, $[Ni(NH_3)_6]I_2$

Section C: Organic Chemistry

8. Systematic Qualitative organic analyses of organic compounds possessing monofunctional groups (Alcohols, Phenols, Carbonyl, -COOH) and preparation of one suitable derivative.
9. Separation of a Two Component Mixture Using Extraction Techniques
10. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
    (a)Bromination of Phenol/Aniline
    (b)Benzoylation of amines/phenols
    (c)Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

Course Outcome: After completion of this course the student can utilize acquired laboratory skills in the field of food and nutrition for better understanding of experimentation part.

BS20.106 General Microbiology **4-0-0-4**

Course objective To give the knowledge of microorganisms structure and functions to undergraduate students

Introduction and Historical Aspects [10]

Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

Microbial Isolation and Identification [10]

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

Microbial Growth and Metabolism [20]

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

Microbes in Environment [06]

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: [06]

Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.

Course Outcome: After completion of this course the student can learn the physiology of microorganism.

Text Books:

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.

Reference Books:

1. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
2. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
3. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
4. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

BS20.108 General Microbiology Laboratory 0-0-4-2

Course Objective: To get acquainted for application of experiments of Microbiology in biotechnology and other applied research fields

Practical

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

Course Outcome: After completion of this course the student can be able to work with microorganism and its concerned experiments

EV20.102 Environmental Studies **4-0-0-4**

To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.

Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	**9**
Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**
Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation	**7**

Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.

Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). **6**

Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc. **5**

Course Outcome After completion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.

Suggested Readings
Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of

dams (pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Refence Books:

1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
2. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
3. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
4. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
5. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
6. www.nacwc.nic.in 22.www.opcw.org

FN20.201 Food Chemistry **3-0-0-3**

Course Objective To acquaint with properties and role of various constituents in foods, interaction and changes during processing. To acquaint with importance of various foods and nutrients in human nutrition.

Water and Ice: Physical properties, structure of water and ice, water soluble interaction, water activity and relative vapor pressure. Dispersed systems: Surface phenomena, colloidal interactions, Liquid dispersions, gels, emulsions and Foam. [7]

Carbohydrates: Monosaccharides, Oligosaccharides, Polysaccharides, Starch, Cellulose, Guar and Locust Bean Gum, Xanthan, Carrageenans, Algins, Pectins, Gum Arabica and Dietary fiber [8]

Lipids: Classification, physical aspects, chemical aspects, chemistry of fats and oil processing, role of food lipids in flavor, physiological effects of Lipids. [8]

Amino Acids, Peptides and Proteins: Physiochemical properties of amino acids, protein structure, protein denaturation, functional properties of proteins, nutritional [8]

properties of proteins, processing induced physical and chemical changes of protein.

Food colorants: pigments in animal and plant tissues. Flavors: Taste and nonspecific saporous sensations, vegetable, fruit and spice flavor. Food additives: Acid, bases, buffer systems, chelating agent, antioxidant, antimicrobial agent, sweeteners, fat replacers and Mastigatory substances. [8]

Course Outcome Students will be able to identify solutions to problems related to the chemical composition and functionality of food and to apply and expand upon the theoretical concepts presented in lectures.

Text Book

1. Meyer, L.H. 1987. Food Chemistry. CBS publishers and Distributors, New Delhi.

Reference: Book

2. Beltz, H.D. 2005. Food Chemistry. Springer Verlag.
3. Fennema, O.R, 2006, Food Chemistry, Academic Press.
4. Potter, N.N. and Hotchikiss, J.H. (2006), Food Sciences, Fifth edition, CBS publishers and Distributors, New Delhi.
5. Fennema, O.R.2006. Food Chemistry. Marcel Dekker.

FN20.203 Food Technology **2-0-0-2**

Course Objective To understand processing technology of various food stuffs, physical and chemical principles in food processing and ways of quality control, waste disposal and sanitation in food industries.

Food & Fermentation Technology: Origin, scope and development of fermented food products. [2]

Development of novel food and food ingredients: Single cell protein, Mushroom cultivation, Nutraceuticals, Probiotic foods, genetically modified foods. [5]

General principles: Food spoilage and preservation, contamination of foods and their involvement in disease outbreaks. Methods of food preservation. [9]

Packaging of foods: Packaging Materials, Controlled atmosphere packaging. [4]

Food plant Sanitation: Disposal and treatment of food industry waste, food laws and current concepts in food safety [6]

Course Objective: Understand the Packaging requirements of food categories, material handling in food industry ,conveyer types, separation processes by distillation, extraction, filtration, centrifugation, sieving and sedimentation

Text Book

1. Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company Ltd, New Delhi
2. Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New Delhi

References Book

3. Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BS20.201 Molecular Biology 4-0-0-4

Course Objective: To get hold of basic familiarity of molecular biology for application in biotechnology

DNA structure and replication: DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication. [10]

DNA damage, repair and homologous recombination: DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism. [10]

Transcription : RNA structure and types of RNA,Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains [04]

RNA processing: Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription [10]

initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA:5'cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

Regulation of gene expression and translation: Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation. Post translational modifications of proteins. Trafficking mechanism [18]

Course Outcome: After completion of the course, students would be able to apply the knowledge of molecular biology in sciences and applied sciences.

Text Books:

1. Karp,G.(2010).Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P.and De Robertis, E.M.F.(2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

Reference Books:

1. Karp,G.(2010).Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P.and De Robertis, E.M.F.(2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker,W.M.,Kleinsmith, L.J., Hardin .J.and Bertoni,G.P. (2009).The World of the Cell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R.,(2008) Molecular Biology of the Gene (VI Edition.).Cold Spring Harbour Lab. Press, Pearson Pub.

FN20.205 Nutritional Laboratory-I 0-0-4-2

Course Objective: To provide experimental skills to students about physical and chemical parameters of food samples.

Practical

1. Proximate analysis of foods
2. Determination of TSS, pH, and acidity of food samples
3. Tin coating measurement and tests for sulphide stain and crystal size of tin plates;
4. Determination of thermal inactivation time of enzymes;
5. Thermal processing of foods; Dehydration of foods;
6. Refrigeration Freezing of foods; Concentration of foods;

7. Use of chemicals in preservation of foods;
8. Fermented food products analysis
9. Preparation of solutions for Molecular Biology experiments.
10. Isolation of chromosomal DNA from bacterial cells.
11. Isolation of Plasmid DNA by alkaline lysis method.
12. Agarose gel electrophoresis of genomic DNA & plasmid DNA

Course Outcome Students will be able to analyze the food samples and determine their physical and chemical parameters

BS20.213 Human Development Biology **2-0-0-2**

Course Objective: To learn and get the knowledge of the development of various living organisms required for the further applications.

History and scope of animal developmental biology. Gametogenesis – Spermatogenesis and Oogenesis – vitellogenesis, types of eggs. Fertilization – mechanism of fertilization, post fertilization changes in the egg cytoplasm, monospermic and polyspermic fertilization, parthenogenesis. Cleavage – Planes and patterns of cleavage, significance of cleavage	[10]
Embryonic development – Morulation, Blastulation (types and significance), Gastrulation (Characteristics, morphogenetic movements, physiology and significance), Tubulation, concept of fate maps (w.r.t. frog and chick).	[10]
General concepts of Differentiation, Regeneration, and Metamorphosis, extra embryonic membrane, organizer concept and embryonic induction. Embryo sexing and ageing.	[6]

Course Outcome After completion of the course, students would be able to apply the knowledge of developmental behaviour of organisms

Text Book

1. Verma P.S., Agarwal V.K. and Tyagi B.S; Chordate Embryology. S. Chand and Co., New Delhi

Reference Book

2. Balinsky B. I; An Introduction to Embryology; W. B. Saunders, New Delhi
3. Berrill N. J; Developmental Biology; Mc Graw Hill, New York

BS20.215 Human Development Biology Laboratory-I 0-0-2-1

Course Objective: To become proficient in the experiments related to the developmental studies.

1. Study of permanent slides: Frog: egg, blastula, gastrula, neurula, different stages of tadpole larva; Chick: egg, different stages of chick embryo development; Mammals: testis, ovary, T.S. Placenta.
2. Permanent slide preparation: Developmental stages of chick embryo.
3. Study of various foetal envelopes in a 10-12 day old chick embryo (amnion, chorion, allantois yolk sac).
4. Urine analysis for pregnancy in mammal (Demonstration only).

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of developmental biology laboratory.

BS20.205 Immunology 4-0-0-4

Course Objective: To become proficient in the knowledge of basic immunological cells and molecules required in different fields of science.

Immune Response: An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses. [10]

Immune Cells: T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination [10]

Regulation of Immuno globulin gene expression–clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germline & somatic mutation), antibody diversity [12]

Major Histocompatibility complexes– class I & class II MHC antigens, antigen processing. Immunity to infection– immunity to different organisms, pathogen defense strategies, avoidance of recognition. Auto immune diseases, Immunodeficiency- AIDS. [10]

Vaccines & Vaccination– adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to their infectious agents, passive & active immunization. Introduction to immunodiagnostics– RIA, ELISA. [10]

Course Outcome: After completion of the course, students would be able to apply the knowledge of immunology in sciences and medical sciences

Text Books:

1. Abbas A K, Lichtman A H, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt I M. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.

Reference Books:

1. Goldsby R A, Kindt T J, Osborne B A. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, NewYork.
2. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology.7th edition Garland Science Publishers, New York.
3. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Living stone Publishers, Edinberg.
4. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

BS20.207 Immunology Laboratory 4-0-0-2

Course Objective: To become familiar with the different experiments of immunology.

Practicals

1. To determine differential leucocytes count
2. To determine total leucocytes count
3. To determine total RBC count
4. To perform Haemagglutination assay
5. To perform Haemagglutination inhibition assay
6. To perform separate serum from blood
7. To perform Double immuno diffusion test using specific antibody and antigen.
8. To perform ELISA.

Course Outcome: After completion of the course, students would be able to apply the laboratory skills of immunology laboratory in sciences and applied sciences

FN20.202 **Public Health nutrition** **4-0-0-4**

Course Objective

To enable students to identify and contribute to the prevention of public health/ social health problems in the country and to equip students with workable knowledge to treat common illnesses at home.

Concept of public health nutrition- relationship between health and nutrition, role of public health nutritionists in the health care delivery. Public health and nutrition policies- plan of action and programs. [10]

Food and nutrition security- food production, distribution, access, availability and consumption. Socio cultural aspects and dietary patterns: their implication for nutrition and health. [10]

Health care facility- primary health care of the community, health care delivery system. [8]

Determinants of nutrition and health status- socio cultural, biologic, environmental and economic factor, indicators of health and malnutrition. Economics of malnutrition- impact on productivity and national development. Socio demographic, health and nutrition transitions [10]

Approaches and strategies for improving nutritional status and health: national and international contributions, role of government and non-government organizations. Case studies of selected strategies and programs: their rationale and context- health based, intervention, food based interventions including fortification, genetic improvement of foods, supplementary feeding, and nutrition education for behavior change [14]

Course Outcome

Critically analyze factors which impact on food choices and eating patterns, demonstrating a broad understanding of how these impact on the nutritional health of individuals and populations

Text Book

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers

Reference Book:

2. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill..
3. Sethi P and lakra P Aahaarvigyaan ,Poshanevam Suruksha, Elite Publishing house, 2015
4. Khanna K et al. Textbook of Nutrition

and Dietetics;2013; Phoenix Publisher.

FN20.204 **Human Nutrition** **3-0-0-3**

Course Objective

Describe how to properly design individualized eating plans by utilizing diet planning principles, the Food guide Pyramid, Exchange System and other food guide plans that incorporate personal food preferences.

Concept and definition of terms-Nutrition, Malnutrition and Health: Scope of Nutrition [7]

Minimum Nutritional Requirement and RDA: formulation of RDA and Dietary Guidelines Reference Man and Reference Woman, Adult consumption unit. [8]

Energy in Human Nutrition: Idea of Energy and its unit, Energy Balance, Assessment of Energy Requirements—deficiency and excess, Determination of Energy in food, B.M.R. and its regulation, S.D.A. [8]

Growth & Development from infancy to adulthood: Somatic, physical, brain and mental development, puberty, menarch, pre-pubertal and pubertal changes, Factors affecting growth and development. Importance of Nutrition for ensuring adequate development. [8]

Growth monitoring and promotion: Use of growth charts and standards, Prevention of growth faltering. [8]

Course Objective

Explain the differences between and identify energy- and non-energy-yielding nutrients and describe how nutrition and lifestyle choices impact the life cycle before and during pregnancy, during lactation and infancy, during childhood and adolescence, and through adulthood and aging.

Text Book:

1. Srilakshmi B (2014): Dietetics, 7th Multicolour Ed. New Age International (P) Ltd.
2. Swaminathan M (2007): Essentials of Food and Nutrition(Vol. I & II), 2nd Ed. Bappco

References:

1. Guthrie AH(1986):Introductory Nutrition, 6th Revised Ed., McGraw-Hill Inc., US.
2. Robinson CH and Lawler M(1990): Normal and

Therapeutic Nutrition. 17th Revised Ed. Macmillan USA.
3. GopalanC , Rama Sastri BV and Balasubramanian SC(2016): Nutritive value of Indian Foods, Indian Council of Medical Research.

4. Nutrient Requirements and Recommended Dietary Allowance for Indians, Indian Council of Medical Research: New Delhi

5. Geissler C and Powers H (2005):Human Nutrition, 11th Ed. Churchill Livingston.

FN20.206 Nutritional Laboratory-II **0-0-4-2**

Course Objective To get hand on training about assessment of nutritional quality of food

Practical

1. Estimation of browning intensity in foods
2. Determination of vitamin C and beta-carotene, sugar contents in food samples
3. Determination of calorific value of foods
4. Planning balanced diets for normal andtherapeutic nutrition;
5. Formulation of nutrient rich foods,
6. Assessment of nutritional quality of food.
7. Estimation of BMI and other nutritional status parameters.

Course Outcome Students will be able to use these techniques for qualitative estimation of food samples

BS20.202 Mammalian Physiology 3-0-0-3

Course Objective: To get the knowledge of the physiology related information of the mammals

Digestion and Respiration: Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. [05]

Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift. [04]

Circulation: Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood.
Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heartbeat. [10]

Muscle physiology and osmoregulation: Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. [10]
Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

Nervous and endocrine coordination: Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands–Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. [10]

Course Outcome: After completion of the course, students would be able to apply the knowledge of mammalian Physiology

Text Books:

1. Chatterjee C.C.; Human Physiology; Medical Book Depot

Reference Book

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd./W.B. Saunders Company.

2. Tortora, G.J. & Grabowski,S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc

BS20.204 Mammalian Physiology Laboratory 0-0-4-2

Course Objective: To get hands on training of the physiology of the different organisms

Practicals

1. Finding the coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.
4. Determination of TLC and DLC.
5. Demonstration of action of an enzyme.
6. Determination of Haemoglobin.

Course outcome: After completion of the course, students would be able to apply the experimental knowledge of Mammalian Physiology Laboratory.

BS20.210 Entrepreneurship Development 3-0-0-3

Course Objective: The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Introduction
Meaning, Needs and Importance of Entrepreneurship, Promotion of entrepreneurship, Factors influencing entrepreneurship, Features of a successful Entrepreneurship. [10]

Establishing an enterprise
Forms of Business Organization, Project Identification, Selection of the product, Project formulation, Assessment of project feasibility. [04]

Financing the enterprise
Importance of finance/ loans and repayments, Characteristics of Business finance, Fixed capital management: Sources of fixed capital, working capitalist sources and how to move for loans, Inventory direct and indirect raw materials and its management. [05]

Marketing management
Meaning and Importance, Marketing-mix, product management–Product line, Product mix, stages of product like cycle, marketing Research and Importance of survey, Physical Distribution and Stock Management. [10]

Entrepreneurship and international business
Meaning of International business, Selection of a product, Selection of a market for international business, Export financing, Institutional support for exports. [10]

Course Outcome: Apply marketing and advertising principles to describe consumer behavior in food selection and able to write a business plan

SUGGESTED READING

Text Books:

1. Gupta C B, Khanka S S. Entrepreneurship and Small Business Management, Sultan Chand & Sons.

Reference Books:

1. Kaplan JM. Patterns of Entrepreneurship.
2. Holt DH. Entrepreneurship: New Venture Creation

MS20.214 Mathematics and Statistics for Biology 3-0-0-3

Objective: To acquire fundamental knowledge of algebra, calculus, statistics with correlation and regression.

Algebra: Number system, Permutations and Combinations, Basics of probability theory, Baye's theorem, Basics of matrix and determinants, types of matrices, properties of determinants.	**09**
Calculus: Functions, Logarithms, Derivative of standard function, Successive Differentiation, basics rules of differentiations.	**08**
Integration: Indefinite Integrals, Methods Of Integration By Substitution. Definite Integrals, Properties of Definite Integration.	**08**
Statistics: Measure of Central Tendency-Mean, Median & Mode, Measures of Dispersion-Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Elementary ideas of Binomial, Poisson and Normal Distributions.	**08**
Correlation and Regression: Correlation-Meaning and Significance, Karl Pearson's coefficient of linear correlation between two variables, Coefficient of correlation by Spearman's Rank Differences method, Lines of Regression, Relationship between Correlation and Regression.	**06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of algebra, calculus, statistics with correlation and regression sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Fundamental of Mathematical Statistics by Gupta and Kapoor, SCS Publisher, 2002.
2. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson.

Reference Books:

1. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.
2. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
3. Ramana B.V (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

FN20.301	**Community Nutrition**	**4-0-0-4**
Course Objective	Students will be able to interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities.	
	Concept of Community, types of Community, Factors affecting health of the Community. Nutrition and health in National development. Malnutrition- meaning. factors contributing to malnutrition, over nutrition. nutritional disorders- Epidemiology,	[10]

clinical features, prevention and dietary treatment for Protein Energy malnutrition, nutritional anaemias & vitmain deficiency disorders

Nutritional Assessment and Surveillance: Meaning, need, objectives and importance a) Sampling techniques , Identifications of risk groups, Clinical findings, nutritional anthropometry, biochemical tests, biophysical methods. [10]

b) Direct assessment - Diet surveys, anthropometric, clinical and biochemical estimation.

c) Indirect assessment- Food balance sheet, ecological parameters and vital statistics

Diet survey: Need and importance, methods of dietary survey, Interpretation - concept of consumption unit, individual and total distribution of food in family, adequacy of diet in respect to RDA, concept of family food security. Immunization and its importance, Food borne infection and intoxication diseases, foods involved, methods of prevention, Infestation of food borne diseases, Outbreak, Prevention signs and control of infection a) Modern methods of improvement or nutritional quality of food, food fortification, enrichment and nutrient supplementations. [12]

b) Nutrition education themes and messages in nutrition and health, Antenatal and postnatal care.

Improvement of nutrition of a community: [10]

a) Modern methods of improvement or nutritional quality of food, food fortification, enrichment and nutrient supplementations.

b) Nutrition education themes and messages in nutrition and health, Antenatal and postnatal care.

International Efforts: in uplifting the nutritional status -WHO, UNICEF, CARE, ICMR, ICAR, CSIR, CFTRI. Various nutrition related welfare programmes, ICDS, SLP, MOM, and others (in brief). Identification of problem, analysis of causes, resources constraints, selection of interventions, setting a strategy, implementations and evaluation of the programme [10]

Course Outcome Identify major concepts in nutrition assessment, community needs assessment, designing interventions, motivating consumers and the marketing and evaluation of nutrition-related programs.

Text Book:

1. Park K(2017): Textbook of Preventive and Social Medicine,24th Ed. BanarsidasBhanot Publishers

2. *Textbook of Community Nutrition* (9788171640744) by Sehgal, Salil & *Rita* S *Raghuvanshi Published by* Indian Council of Agricultural Research (2007)

References Book

1. Jelliffe DB. Assessment of the Nutritional Status of the Community; World Health Organisation
2. Sahn DE, Lockwood R,Scrimshaw NS(1988): Methods the Evaluation of the Impact of Food and Nutrition Programmes, 2nd Printing, United Nations University.
3. Ritchie, JAS(1979): Learning Better Nutrition , Nutritional Studies number 20, FAO, Rome.
4. Gopaldas T and Seshadri S(1988): Nutrition Monitoring and Assessment, Oxford University Press.
5. Mason JB, Habicht, JP, Tabatabai H and Valverde V(1984): Nutritional Surveillance, World Health Organisation.

FN20.303 Nutrition for Health and Fitness **4-0-0-4**

Course Objective To explain health principles incorporating a wide variety of aspects from nutrition to aging and self-responsibility for personal health and wellness.

Understanding Fitness: Definition of fitness, health and related terms. Assessment of fitness, Approaches for keeping fit. [10]

Importance and benefits of physical activity: Physical Activity – frequency, intensity, time and type with examples Physical Activity, physical activity guidelines and physical activity pyramid. [12]

Importance of nutrition Role of nutrition in fitness, Nutritional guidelines for health and fitness, Nutritional supplements. Nutritional requirements of sports person Importance of diet and exercise for weight management [10]

[10]

Water and electrolytes balances: Losses and their replenishment during exercise and sports events, effects of dehydration, sports drinks.

Alternative systmes for health and fitness lile ayurveda, yoga, meditation, vegetarianism and traditional diets. [10]

Course outcome

Students will be able to describe the principles of health and wellness from a multidimensional and interdisciplinary perspective.
Students will able to explain the benefits of physical activity and nutrition for health, wellness, and quantity and quality of life.

Text Book:

1. Srilakshmi B. (2018). Dietetics, New Delhi: New Age International.

References Book:

1. Haff GG. (2008). Essentials of Sports Nutrition Study Guide, Humana Press.
2. Campbell B (2017): Sports Nutrition: Enhancing Athletic Performance, CRC Press, Taylor & Francis.
3. HaffGG(2008): Essentials of Sports Nutrition Study Guide, Humana Press.
4. Dunford M and Doyle JA. (2008). Nutrition for Sport and Exercise, Thomson Wadsworth.

FN20.305 Therapeutic Nutrition **4-0-0-4**

Course objective

Establish the connection between diet and disease, focusing on the chronic diseases of adults that result from poor dietary habits

Basic concepts of diet therapy: Therapeutic adaptations of normal diet, principles and classification of the therapeutic diets, [10]

Nutritional assessment & care of patients

a) Nutrition care process

- Nutrition care process

- Nutritional screening and assessment of patients

– out patient & hospitalized

- Nutritional interpretation of routine medical and laboratory data

- Nutrition care plan and implementation

- Monitoring and follow up

- Ethical issues

b) Dietary Counseling

c) Nutrition Support: Enteral Nutrition

Etiology, symptoms, and management of intestinal diseases: Diarrhoea, steatorrhoea, Diverticular disease, inflammatory bowel disease, Ulcerative Colitis, Flatulence, Constipation, Irritable Bowel Syndrome. [12]

Anaemias: General concept, aetiology, classification, and dietary management of Nutritional anaemia [10]

Obesity and underweight: Etiopathophysiology, metabolic & clinical aberrations, diagnosis, complications, treatment, MNT, dietary counseling and recent advances in [10]

a) Weight imbalance disorders – Overweight and Underweight

b) Diabetes Mellitus – Type 1, Type 2 and Gestational diabetes.

Cardiovascular disorders & GI tract disorders [10]

Etiopathophysiology, metabolic & clinical aberrations, diagnosis, complications, treatment, MNT, dietary counseling and recent advances in

a) Cardio Vascular Diseases – hypertension, hyperlipidemia, metabolic syndrome, peripheral and cerebro vascular disease

b) Gastrointestinal tract Disorders – GERD, peptic ulcer, diarrhoea, lactose intolerance, celiac disease

Overview of some degenerative disorders

a) Cancer - Role of diet in etiology and management

b) Alzheimer's disease and Parkinson's disease

c) HIV-AIDS

Course Outcome: Students will be able to interpret and apply

nutrition concepts to evaluate and improve the nutritional health of individuals with medical conditions

Text Book:

Sohi D. A Comprehensive Textbook of Nutrition & Therapeutic Diets, New Delhi: Jaypee Brothers Medical Publishers.

References Book:

1. Robinson. CH, Lawler MR, Chenoweth WL and Garwick, AE(1986): Normal and Therapeutic Nutrition. 17th Ed.,Macmilian Publishing Co.
2. Proudfit FT and Robinson CH(1967):Normal and Therapeutic Nutrition, 13th Ed. Mamillan.
3. Escott-Stump S (1998): Nutrition and Diagnosis Related Care, 4th Edition, Williams and Wilkinson.
4. Garrow JS, James WPT and Ralph A (2000). Human Nutrition and Diabetics, 10th Edition, Churchill Livingstone.

FN20.307 Nutritional Laboratory-III **0-0-4-2**

Course Objective To get hand on training about estimation of nutritional components in food

Practical

1. Determination of Ash content in food
2. Determination of Moisture content in food
3. Determination of calcium, iron, and Vitamin C content in foods
4. On job training at a N.G.O. project centre of Health centre where nutritionist works.
5. Preparation of dishes suitable for older person- soft, semisolid, easily digestible, nutritious and calorie dense balanced diet.
6. Introduction to meal planning, concept of food exchange system.
7. Preparation of nutritious snacks using various methods of cooking.

Course Outcome: Students will be able to analyze the food samples

FN20.309 **Maternal and Child Nutrition** **4-0-0-4**

Course Objective

Describe appropriate weight gain for women during pregnancy including total and rate of gain as well as promising practices for achieving an appropriate gestational weight gain.

Discuss the relationships between food intake, psychosocial development and physiological needs

Nutrition During Pregnancy: Non-nutritional factors affecting pregnancy, Nutritional requirements during pregnancy and modification of existing diet and supplementation. Adolescent pregnancy. [12]

Nutrition during Lactation: Nutritional requirements during lactation, dietary management, food supplements, galactogogues, preparation for lactation. Care and preparation of nipples during breast feeding. Management of preterm and low birth weight babies. [19]

Nutrition during Infancy: Infant physiology relevant to feeding and care, Breast feeding- colostrum, its composition and importance in feeding, Initiations of breast feeding.
Care & sterilization of bottles. Mixed feeding, breast feeding and artificial feeding [11]

Nutritional needs of toddlers, preschool, school going children-and adolescents- Dietary management. [10]

Course Outcome

To understand the role of nutrition for the pregnant woman, lactating mothers, breast feeding and complementary foods
To enable the students to know about child health, morbidity, maternal and child heath programmes.

Text Book:

1. Srilakshmi B (2014): Dietetics, 7th Multicolour Ed. New Age International (P) Ltd.

Refrence Book:

1. WHO (1979). A growth chart for International use in Maternal and Children Health Care, Geneva.
2. Bamji MS, Krishnaswamy K and Brahmam GNV

(2017): Textbook of Human Nutrition , 4th Ed. Oxford & IBH Publishing Co. Pvt. Ltd.
3. Mann and Truswell: Essentials of Human Nutrition, Oxford University Press.
4. Walker WA and Watkins JB (Ed.) (1985). Nutrition in Pediatrics, Boston, Little Brown & Co.

BS20.305 Bioprocess Technology 4-0-0-4

Course Objective: To get the basic information of the different mathematical models required for smooth functioning of the industrial processes.

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology.	[07]
Types of microbial culture and its growth kinetics– Batch, Fed-batch and Continuous culture.	[05]
Design of bioprocess vessels-Significance of Impeller, Baffles, Sparger; Types of culture / production vessels-Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing Media preparation, Inocula development and sterilization.	[10]
Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.	[15]
Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.	[15]

Text Book:

1. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

Reference Book

2. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
3. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

BS20.307 Bioprocess Technology Laboratory 0-0-4-2

Course Outcome: After completion of the course, students would be able to apply knowledge of Bioprocess Technology for future research and studies

Practicals

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

RM20.301 Research Methodology 2-0-0-2

Objective: To acquire fundamental knowledge research methodology and apply in liberal arts, sciences and applied sciences.

Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation - Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of research methodology in liberal arts, sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Suggested Readings:

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

FN20.302	**Food Quality and Sensory Evaluation**	**4-0-0-4**
Course Objective	Demonstrated familiarity and competence with the practical skills and techniques used to analyse the sensory properties of food. This will include experimental planning, the preparation of suitable samples and the use of instruments e.g. viscometers and colour meters, as well as the collection of experimental data and its presentation, statistical analysis and interpretation.	
	Introduction to quality attributes of food, Appearance, flavor, textural factors and additional quality factors	[8]
	Gustation: introduction and importance of gustation, Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands. Mechanism of taste perception Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami, Factors affecting taste quality, reaction time, taste modification, absolute and recognition threshold, Taste measurement- Electronic Tongue, Taste abnormalities	[12]
	Olfaction: Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Theories of odour classification, chemical specificity of odour. Odour measurement techniques – historical perspective and emphasis on recent techniques- e- nose etc. Olfactory abnormalities	[10]

Colour: Introduction and importance of colour, Dimensions of colour and attributes of colour; gloss etc. Perception of colour. Colour Measurement: Munsell colour system, CIE colour system, Hunter colour system, etc. Colour abnormalities [10]

Texture: Introduction, definition and importance of texture, Phases of oral processing, Texture perception, receptors involved in texture perception, Rheology of foods Texture classification, Texture measurement – basic rheological models, forces involved in texture measurement and recent advances in texture evaluation. Application of texture measurement in cereals, fruits and vegetables, dairy, meat and meat products [12]

Course outcomes: Apply scientific research, including microbiology, food science and food safety to functions of ingredients in food and process controls

Text Book

Pomeranz Y and Meloan CE (2002). Food Analysis – Theory and Practice, CBS Publishers and Distributors, New Delhi.

ReferenceBook:

Rao E. S. (2013). Food Quality Evaluation. Variety Books.

deMan J. (2007). Principles of Food Chemistry, 3rd ed., Springer.

FN20.304 Nutraceuticals and Health Food **4-0-0-4**

Course Objective The objectives of this course are to provide students with an overview of the field of functional foods, nutraceuticals and natural health products. The course enables students to understand the functional food concept as related to ingredient efficacy and safety

Nutraceutical and Health: Concept, classification, sources and importance of nutraceuticals and functional foods. [10]

Role of nutraceutical on diabetes, obesity and cardiovascular diseases.

Oxidative stress and Nutraceutical: Concept of oxidant, antioxidant, oxidative stress and nutraceutical on oxidative stress. [10]

Dietary fibre, Prebiotics and Probiotics: Classification and nutritional significance of dietary fibre. [10]

Prebiotics-Concept, important features, role on health.

Probiotics in fermented milk product and non-milk products.

Enhancing the nutritional quality of foods: [10]

Fundamentals of Germination and Fermentation. Genetically modified food and Food fortification: Concept, available genetically modified (GM) foods in India, techniques for GM food preparation, steps adopted for acceptability of GM food. Concept, importance and application of food fortification.

Clinical role of nutraceuticals [12]

Nutraceutical use in disease and disorder – cardiovascular disease, cancer, diabetes, hypercholesterolemia, obesity, immunity, joint pain, age-related macular degeneration, osteoporosis, gastrointestinal disturbances, menopause, mood disorders Nutraceuticals for Sports Performance

Mechanism of their Action, Dosage, Contraindications, and Toxicity Interactions between Nutraceuticals and Prescription Drugs

Course Outcome: Explain the major bioactive food constituents that are being incorporated into nutraceuticals and functional foods and know their benefits.

Evaluate the standards of evidence required for efficacy and safety assessment of nutraceutical and functional foods

Text Book:

1. Gopalan, C. et al: Nutritive value of Indian Foods. Indian Council of Medical Research.

References:

1. Cho S. S. and Dreher, M.L. (2001): Handbook Dietary Fibre, Marcel Dekker Inc., New York.
2. Yurawecz, M.P., M.M. Mossoba, J.K.G. Kramer, M.W. Pariza and G.J. Nelson eds (1999) Advances in Conjugated Linoleic Acid Research, Vol. 1. AOCS Press, Champaign.
3. Wildman, R.E.C. ed. (2000) Handbook of Nutraceuticals and Functional Foods, CRC Press, Boca Raton.
4. Fuller, R. ed. (1997) Probiotics Applications and Practical Aspects, London: Chapman and Hall, New York. Prazier, W.C. and Westhoff, D.C. (1988): 4th

edition, Food Microbiology, MaGraw Hill Inc.
5. Gibson, G., Williams, C. eds (2000): Functional Foods. Woodhead Publishing Ltd. U.K.

FN20.306 Nutritional Laboratory-IV 0-0-4-2

Course Objective To get trained about molecular biology and physical chemistry for food quality estimation

Practical

1. Quantification of alcohol content in beverages using the internal standard method
2. Thin layer chromatography (TLC) of food colors,
3. Microstructural and particle size analysis of starch
4. Determination of thermal properties of food samples
5. Extraction of different types of proteins and identification using electrophoresis
6. DNA isolation and fingerprinting of plant tissues.
7. Sensory evaluation, methods, training of judges, score card preparation.
8. Selection and modification of food product to be developed.

Course Outcome: After completion of the course, students would be able to apply the experimental knowledge of biophysical techniques in food analysis

FN20.308 Project work 0-0-4-2

Course Objective: To accomplish a minor project so that student can learn and think about research work

Students are required to do project/dissertation work under the supervision of assigned faculty member and will submit a report at the end of semester. She will also give a presentation of the research work done and her evaluation will be based work and done and viva voce.

Course outcome: To gain the knowledge to accomplish the research in different laboratories.

FN20.310 **Food Analysis** **4-0-0-4**

Course Objective To develop an understanding about the advanced analytical and instrumental techniques and to illustrate the principle and mechanism of analytical instruments.

Sampling techniques; Water activity, its measurements and significance in food quality; Calibration and standardization of different instruments.	[10]
Spectroscopic techniques using UV/Vis, fluorescence, IR, FTIR, NIR, NMR, atomic absorption, ICP, polarimetry, refractometry, microscopic techniques in food analysis (light microscopy, SEM, TEM, XRD, particle size analysis, image analysis etc	[12]
Chromatographic techniques: Adsorption, column, partition, affinity, ion exchange, size exclusion, GC, GLC, HPLC, HPTLC, GCMS, LCMS.	[10]
Separation techniques: Gel filtration, dialysis, electrophoresis, sedimentation, ultrafiltration and ultracentrifugation, solid phase extraction, supercritical fluid extraction, isoelectric focusing, isotopic techniques, manometric techniques.	[10]
Special techniques: Immunoassay techniques; Isotopic, non-isotopic and enzyme immunoassays; surface tension; enzymatic methods of food analysis; thermal methods in food analysis (Differential scanning colorimetry and others).	[10]

Course Outcome: Students will have a thorough knowledge about the applications various analytical and instrumental techniques.

Text Book:

1. Ranganna S. 2001. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata-McGraw-Hill.

References Book:

1. AOAC International. 2003. Official methods of analysis of AOAC International. 17th Ed. Gaithersburg, MD, USA, Association of Analytical Communities.
2. Kirk RS & Sawyer R. 1991. Pearson's Chemical Analysis of Foods. 9th Ed. Longman Scientific & Technical.
3. Leo ML. 2004. Handbook of Food Analysis. 2nd Ed. Vols. I-III.
4. Linden G. 1996. Analytical Techniques for Foods and Agricultural Products. VCH.
5. Macleod AJ. 1973. Instrumental Methods of Food

Analysis. Elek Sci.Marcel Dekker.
6. Nielsen S. (Eds.). 1994. Introduction to Chemical Analysis of Foods. Jones & Bartlett.
7. Pomrenz Y & Meloan CE. 1996. Food Analysis - Theory and Practice. 3rd Ed. CBS.
8. Robinson JW. 1970. Undergraduate Instrumental Analysis. Marcel Dekker.

FN20.312 Food Analysis Laboratory **0-0-4-2**

Course Objective To get hands on training for the analysis of food employing several techniques

Practical

1. Handling of equipment and instruments;
2. preparation of samples, solutions and buffers;
3. quantitative estimation of proximate principles, minerals and vitamins by use of colorimetry, flame photometry, UV spectrophotometer;
4. chromatography, atomic absorption spectrophotometer and photofluorometry, analysis of antinutritional factors;
5. estimation of protein and starch digestibility;
6. fractionation of protein;
7. food adulteration.

Course Outcome: After completion of the course, students would be able to apply knowledge of food analysis techniques for future research and studies

FN20.314 Nutrigenomics and Proteomics **4-0-0-4**

Course Objective Student will understand about the Influence of genetic variation on nutritional requirement and the role of genetics in human nutrient metabolism

Introduction. Concept of functional genomics, systems [15]

biology, nutrigenomics, nutrigenetics, personalized nutrition

Molecular biology and genomics: Nutritional requirements and metabolic responses at cellular level, Impact of a changing nutrient environment, Introduction to molecular diagnostics: nutrients influences on genomes [12]

Diet and gene expression: nutrients as regulators of activity and transcription factors. Nutrients as epigenetic exchange agents. [15]

Diet in early life and metabolic programming. Diet as a possible risk or preventive factor in illnesses. Gene polymorphisms and responses to diet. Examples related to cardiovascular disease, cancer, osteoporosis. Risk/benefit biomarkers [10]

Course Outcome: Students will be able to explain what gene expression is and how environmental factors such as diet can influence gene expression and genome function thereby influencing health and susceptibility to disease

FN20.316 Nutrigenomics and Proteomics Laboratory 0-0-2-4

Course Objective: To get familiar about the importance of different aspects of the genomics and its applications in nutrition research

Practical

1. Isolation of DNA from vegetables or food samples
2. Quantification of DNA using electrophoresis
3. Restriction digestion of DNA components
4. Demonstration of DNA sequencing technologies
5. Identification and alignment of genomic sequences
6. Gene polymorphism- SNPs and gene expression analyses
7. Gene prediction & DNA motifs identification
8. Biological databases for nucleic acids and proteins
9. Databases for metabolic pathways and gene interactions

Course Outcome: Students will be able to analyze the gene sequences and able to find the polymorphisms between genes

Mody University of Science & Technology

B.Sc. (Hons) Maths
Session 2020-2021

Curriculum Structure

Curriculum Structure

Session 2020-2021 onwards

Name of the Programme: B.Sc. (Hons) Mathematics **Year: First**

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Core Courses									
	MS20.101	**Differential and Integral Calculus**	**5**	**1**	**–**	**6**	**3**	**25**	**25**	**50**
	MS20.103	Algebra	5	1	–	6	3	25	25	50
	MS20.105	Numerical Methods-I	2	1	–	3	3	25	25	50
Autumn Semester	**Generic Elective Courses (Either Physics Or Chemistry)**									
	Either									
	PH20.103	Mechanics	4	-	-	4	3	25	25	50
	PH20.105	Physics Laboratory I	-	-	4	2	4	25	25	50
	Or									
	CH20.101	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH20.103	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH20.111	Inorganic and Organic Chemistry Laboratory-I	-	-	2	1	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EL20.109	Foundation Course in English	2	–	–	2	3	25	25	50
	Skill Enhancement Courses									
		Foreign language-I*	3	–	–	3	3	25	25	50
		Sub Total				**26**				
	SF 101	Personal Grooming and Fine Dining(Non-Credit)	-	-	-	1	2	50		50

Summary: I Semester (Autumn)		
S.N.	Particulars	Credits
1.	Core Courses	15
2.	Generic Elective Courses(Phy/Chem)	6
3.	Ability Enhancement Compulsory Courses	2
4.	Skill Enhancement Course	3
Total		26
5.	SEFS(Non-Credit Compulsory)	1
Grand Total		27

$CW (Course work): It would include attendance, assignments, class /quiz test.
**Refer to the Foreign Languages Section*

Name of the Programme: B.Sc. (Hons) Mathematics										Year: First
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Core Courses									
	MS20.102	**Group Theory**	**5**	**1**	**–**	**6**	**3**	**25**	**25**	**50**
	MS20.104	Multivariate Calculus	5	1	–	6	3	25	25	50
	MS20.106	Numerical Methods-II	2	1	–	3	3	25	25	50
	Generic Elective Courses (Either Physics/ Or Chemistry)									
		Either								
Spring Semester	PH20.102	Electricity and Magnetism	4	-	-	4	3	25	25	50
	PH20.106	Physics Laboratory II	-	-	4	2	4	25	25	50
		Or								
	CH20.102	Inorganic Chemistry-II	2	-	-	2	3	25	25	50
	CH20.104	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH20.112	Inorganic and Physical Chemistry Laboratory-I	-	-	2	1	3	25	25	50
	Ability Enhancement Compulsory Courses									
	EV20.102	Environmental Studies	4	0	–	4	3	25	25	50
	Skill Enhancement Courses									
		Foreign language-II*	3	–	–	3	3	25	25	50
		Sub Total				**28**				
	SF 102	Social Grooming, Home & Decor and Business Communication (Non-Credit)	-	-	-	1	5	50		50

Summary: II Semester (Spring)		
S.N.	Particulars	Credits
1.	Core Courses	15
2.	Generic Elective Courses(Phy/Chem)	6
3.	Ability Enhancement Compulsory Courses	4
4.	Skill Enhancement Course	3
Total		28
5.	SEFS(Non-Credit Compulsory)	1
Grand Total		29

$CW (Course work): It would include attendance, assignments, class /quiz test.
**Refer to the Foreign Languages Section*

Name of the Programme: B.Sc. (Hons) Mathematics								Year: Second		
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Core Courses									
	MS20.201	**Differential Equations**	**5**	**1**	**–**	**6**	**3**	**25**	**25**	**50**
	MS20.203	Theory of Real Functions	5	1	–	6	3	25	25	50
	MS20.205	Advanced Group Theory-I	3	-	–	3	3	25	25	50
	Generic Elective Courses (Either Physics/ Or Chemistry)									
		Either								
	PH20.209	Thermal Physics and Statistical Mechanics	4	-	-	4	3	25	25	50
	PH20.207	Physics Laboratory III	-	-	4	2	4	25	25	50
		Or								
	CH20.201	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH20.203	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH20.211	Organic and Physical Chemistry Laboratory-I	-	-	2	1	3	25	25	50
	Skill Enhancement Courses									
		Foreign language-III*	3	–	–	3	3	25	25	50
		Mody University Elective	3	-	-	3				
		Sub Total				**27**				
	SF 201	Personal Grooming, Fine Dining and Home &Safety(Non-Credit)	-	-	-	1	2	50		50

Autumn Semester

Summary: III Semester (Autumn)		
S.N.	Particulars	Credits
1.	Core Courses	15
2.	Generic Elective Courses(Phy/Chem)	6
3.	Skill Enhancement Courses	6
Total		27
4	SEFS(Non-Credit Compulsory)	1
Grand Total		28

**Refer to the Foreign Languages Section*

$CW (Course work): It would include attendance, assignments, class /quiz test.

Name of the Programme: B.Sc. (Hons) Mathematics								Year: Second		
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Core Courses									
	MS20.202	**Real Analysis**	**5**	**1**	**-**	**6**	**3**	**25**	**25**	**50**
	MS20.204	PDE and System of ODE	5	1	-	6	3	25	25	50
	MS20.206	Advanced Group Theory-II	3	-	–	3	3	25	25	50
	Generic Elective Courses (Either Physics/ Or Chemistry)									
	Either									
	PH20.204	Wave and Optics	4	-	-	4	3	25	25	50
	PH20.208	Physics Laboratory IV	-	-	4	2	4	25	25	50
	Or									
	CH20.202	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH20.204	Organic Chemistry-III	3	-	-	3	3	25	25	50
	CH20.212	Inorganic and Organic Chemistry Laboratory-II	-	-	2	1	3	25	25	50
	Skill Enhancement Courses									
		Foreign language-IV*	3	-	-	3	3	25	25	50
		Mody University Elective	3	-	-	3				
		Sub Total				**27**				
	SF 202	Social Grooming and Professional Skills(Non-Credit)	-	-	-	1	1	50		50

Spring Semester

Summary: IV Semester (Spring)		
S.N.	Particulars	Credits
1.	Core Courses	15
2.	Generic Elective Courses(Phy/Chem)	6
3.	Skill Enhancement Courses	6
Total		27
4.	SEFS(Non-Credit Compulsory)	1
Grand Total		28

**Refer to the Foreign Languages Section*

$CW (Course work): It would include attendance, assignments, class /quiz test.

Name of the Programme: B.Sc. (Hons) Mathematics									Year: Third		
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Autumn Semester										
	Core Courses									
	MS20.301	Ring Theory and Linear Algebra-I	5	1	–	6	3	25	25	50
	MS20.303	Riemann Integration and Series of Functions	5	1	–	6	3	25	25	50
	Skill Enhancement Courses									
		Foreign language-V*	3	–	–	3	3	25	25	50
	Discipline Specific Elective(DSE) Courses									
		DSE-1	3	–	–	3	3	25	25	50
		DSE-2	3	–	–	3	3	25	25	50
		DSE-3	3	1	–	4	3	25	25	50
		DSE-4	2	-	-	2	3	25	25	50
		Sub Total				**27**				
	GE20.301	Proficiency(Non-Credit)	-	-	-	1	-	100		

Discipline Specific Electives(DSE)	
Choices for DSE-1 (choose one) **1.** MS20.305 Elementary Probability and Statistics **2.** MS20.307 Basics of Combinatorics	Choices for DSE-2 (choose one) **1.** MS20.309 Linear Programming **2.** MS20.311 Analytical Geometry
Choices for DSE-3 (choose one) **1.** MS20.313 Integral Transforms and Special Functions **2.** MS20.315 Elements of Discrete Mathematics	Choices for DSE-4 (choose one) **1.** RM20.301Research Methodology** **2.** MS20.317 Differential Geometry
Remarks: Discipline Specific Elective Courses Choice shall be allotted at the time of registration by the Department of Mathematics on the basis of availability of expertise.	

Summary: V Semester (Autumn)		
S.N.	Particulars	Credits
1.	Core Courses	12
2.	Discipline Specific Elective Courses	12
3.	Skill Enhancement Course	3
Total		27
4.	Proficiency(Non-Credit)	1
Grand Total		28

$CW (Course work): It would include attendance, assignments, class /quiz test.

** **RM 20.301(Research Methodology) shall be reflected for all undergraduate courses of SLAS where it is applicable.**

***** For MS 20.309(DSE), the next shall be MS 20.312 (DSE)**

**Refer to the Foreign Languages Section*

Name of the Programme: B.Sc. (Hons) Mathematics											Year: Third
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)			
			L	T	P			CW$	MTE	ETE	
Spring Semester											
	Core Courses										
	MS20.302	Metric Spaces and Complex Analysis	5	1	---	6	3	25	25	50	
	MS20.304	Ring Theory and Linear Algebra-II	5	1	---	6	3	25	25	50	
	Skill Enhancement Courses										
		Foreign language-VI*	3	–	–	3	3	25	25	50	
	Discipline Specific Elective Courses										
		DSE-5	3	–	–	3	3	25	25	50	
		DSE-6	3	–	–	3	3	25	25	50	
	MS20.314	Dissertation	---	---	---	6	---	100			
	Remarks: Discipline Specific Elective Courses Choice shall be allotted at the time of registration by the Department of Mathematics on the basis of availability of expertise.										
		Sub Total				**24**					
	GE20.302	Proficiency(Non-Credit)	-	-	-	1	-	100			

Discipline Specific Electives(DSE)	
Choices for DSE-5 (choose one)	Choices for DSE-6 (choose one)
1.MS20.306 Elementary Graph Theory	**1.** MS20.310 Basics of Vector Calculus
2.MS20.308 Basics of Dynamics and Mechanics	**2.**MS20.312 Advance Linear Programming
Remarks: Discipline Specific Elective Courses Choice shall be allotted at the time of registration by the Department of Mathematics on the basis of availability of expertise.	

Summary: V Semester (Autumn)		
S.N.	Particulars	Credits
1.	Core Courses	12
2.	Discipline Specific Elective Courses	12
3.	Skill Enhancement Course	3
Total		27
4.	Proficiency(Non-Credit)	1
Grand Total		28

$CW (Course work): It would include attendance, assignments, class /quiz test.

*** For Selecting MS 20.312 in Spring Semester, MS 20.309 is mandotery in Autumn Semester III Yr.

**Refer to the Foreign Languages Section*

MS20.101 Differential and Integral Calculus 5-1-0-6

Objective: To acquire fundamental knowledge of differential calculus and integral calculus and apply in sciences and applied sciences.

1.	Differential Calculus I: Functions, Types of functions, Limits and continuity ($\epsilon - \delta$ definition),Types of discontinuities, Higher order derivatives, Indeterminate forms, L-Hospital's rule, Leibniz rule , Points of extreme, Concavity and inflection points, Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series, Jacobeans, interdisciplinary applications.	**13**
2.	Differential Calculus II : Parallel and oblique asymptotes in Cartesian and Polar coordinates, Intersection of a curve with its asymptotes, application of differentiation in curve sketching/tracing in cartesian and polar coordinates, Tangent and normal-Introduction,Equation of tangent and normal,Angle of intersection of two curves, Suntangent and subnormal,Polar subtangent and subnormal,Pedal equation;Curvature and Evolutes-Introduction, Center and radius of curvature in Cartesian and polar forms,Pedal curve,Tangential polar formula,Chord of curvature,Evolutes and involutes,Newtonian method.	**13**
3.	Integral Calculus I: Review as a limiting sum of areas and the anti-derivative/ indefinite integral, the fundamental theorem of Calculus, Reduction formulae and its derivation and illustration for the type $\int \sin^n(x)dx$, $\int \cos^n(x)dx$, $\int \tan^n(x)dx$, $\int \sin^n(x)\cos^n(x)dx$,$\int sinnxdx$,$\int cosnxdx$, $\int tannxdx$, $\int secnxdx$, $\int (logx)^n dx$ etc.	**13**
4.	Integral Calculus II: Computing volumes by slicing, disk and washer method, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, area of surface of revolution Surface areas and volumes using Pappus-Guldinus theorems(with proof) and solid of revolution.	**13**
5.	Conic Section and Vector Functions: Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminate, polar equation of conics, Triple product, introduction, operations of vector functions, limit, continuity, differentiation and integration of vector functions, tangent and normal form of acceleration, modeling ballistics and planetary motion, Kepler's second law with interdisciplinary applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential calculus and integral calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson.
2. Dennis G. Zill and Warren S. Wright (2011), Single Variable Calculus, 4/e, Jones and Bartlett Learning.

Reference Books:

1. Mittal P.K. (2016), Mathematics for Degree Students, S. Chand and Company Pvt. Ltd.
2. Ramana B.V (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Jain and Iyengar (2004) Advanced Engineering Mathematics, Narosa Publishing House.
4. Mendelson (2016), Schaum's outline of Beginning Calculus, McGraw Hill Education.

MS20.103 **Algebra** **5-1-0-6**

Objective: To acquire fundamental knowledge of set algebra, complex algebra, matrix algebra and theory of equations and apply in sciences and applied sciences.

1.	Set Algebra: Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of mathematical induction, Statement of fundamental theorem of arithmetic.	**13**
2.	Complex Algebra: Definition and properties of complex numbers, Polar representation of complex numbers, n^{th} roots of unity, De Moivre's theorem and its applications , $C + iS$ method of summation, Exponential and logarithmic of complex numbers, Hyperbolic and circular functions with basic properties.	**13**
3.	Matrix Algebra I: Definition, Properties and types of matrices, Elementary transformations, Rank of a matrix, Normal form, Echelon form, Linear dependence and independence of vectors, Solution of system of simultaneous linear equations with all necessary proofs of results with geometric approach, interdisciplinary applications.	**13**
4.	Matrix Algebra II: Eigen values, Eigen vectors of a matrix, Cayley-Hamilton theorem and its applications, Sylvester theorem, Quadratic forms, Canonical form, with all necessary proofs of results with geometric approach, interdisciplinary applications.	**13**
5.	Theory of Equations: Relations between the roots and coefficients of general polynomial equation in one variable, Solutions of polynomial equations having conditions on roots, Common roots and multiple roots. Transformation of equations, nature of the roots of an equation, Descartes's rule of signs, solutions of cubic equations by Cardon's method, Irreducible case of Cardon's solution, Biquadratic equations and their solutions.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of set algebra, complex algebra, matrix algebra and theory of equations in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Ignacio Bello (2014), Introductory Algebra (A Real –World Approach), Fourth Edition, McGraw Hill Education.
2. Mittal P.K. (2016), Mathematics for Degree Students, S.Chand and Compnay Pvt. Ltd..

Reference Books:

1. Hall and Knight (2002), Higher Algebra, AITBS Pub. And Dist.
2. Kenneth H. Rosen (2016), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, McGraw Hill Education .
3. Jain and Iyengar (2014), Advanced Engineering Mathematics by, Narosa Publishing House.
4. Ramana B.V. (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

MS20.105 **Numerical Methods-I** **2-1-0-3**

Objective: To acquire fundamental knowledge of numerical methods and apply in sciences and applied sciences.

1.	Errors and Floationg Point: Introduction, Accuracy of Numbers, Errors, A general formula for error, Errors in series approximation, Floating point, Floating point arithmetic and their omputation.	**05**
2.	Calculus of Finite Difference-I: Introduction of finite difference, Difference formulae,Argument and entry, Forward,backward,central,and other difference operatorss, Relations and properti different operators , Construction of difference tables, Fundamental theorem of difference calculus(statement with proof)and application to find higher differences.	**05**
3.	Calculus of Finite Difference-II: Estimation of errors by differences table, Technique to determine the missing term,Factorial notations and properties, Reciprocal factorial notation, Method of representing polunomial in factorial notation by direct method and method of synthetic division.	**05**
4.	Interpolation-I: Interpolation with equal intervals, Newton's Gregory forward interpolation and Newton's Gregory backward interpolation,Central difference formulae(Gauss forward and backward,Stirling, Bessel's, Laplace-Everett's) with proofs.	**06**
5.	Interpolation-II: Interpolation with unequal intervals, Lagrange's interpolation formula, errors in polynomial interpolation, divided differences and its properties,Newton's divided difference formula with proofs.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of numerical methods in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Chapra (2017), Applied numerical Methods with MATLAB, McGraw Hill Education.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.

Reference Books:

1. Balagurusamy E., Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd, 2008.
2. Srimanta Pal, Numerical Methods, 1st ed., Oxford University Press, Oxford, 2009.
3. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.
4. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.

B.Sc. (Hons) Mathematics	Year: First	Semester: Spring/2
MS20.102	Group Theory	**5-1-0-6**

Objective: To acquire fundamental knowledge of group theory and apply in sciences and applied sciences.

1.	Preliminaries: Sets, Subsets, Relations,Equivalence classes,Functions,Equality and composition of mappings,Binary compositions,Permutations,Cyclic permutations,Cycles of a permutation,Disjoint permutations, Some results from number theory(Euclid's theorem and Basis representation theorem),The greatest common divisor, Prime numbers,Congruences, Chinese reminder theorem, proof of all properties and applications.	**13**
2.	Group-I: Algebraic Structure, Symmetries of a square, Dihedral groups, Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups, Order of an element of a group, proof of all properties and applications.	**13**
3.	Group-II: Subgroups and examples of subgroups, Theorems on subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups with theorems related to centralizer,normalizer, and center of a group, proof of all properties and applications.	**13**
4.	Cyclic Group and Cosets-I: Properties of cyclic groups, Classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, Even and odd permutations, proof of all properties and applications.	**13**
5.	Cyclic Group and Cosets-II: Alternating group, Definition and properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, proof of all properties and applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of group theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vashistha A.R. and Vashistha A.K (2015), Modern Algebra, Krishna Educational Publisher.
2. John B. Fraleigh (2014), A First Course In Abstract Algebra, Seventh Edition, Pearson.

Reference Books:

1. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.
2. Khanna and Bhambri(2016), A Course in Abstract Algebra, Fifth Edition, Vikas Publishing House Pvt. Ltd.
3. Michael Artin (2015), Algebra, Second Edition, Pearson.
4. Herstein I.N. (2006), Topics in Algebra, Second Edition, John Wiley and Sons.

B.Sc. (Hons) Mathematics	Year: First	Semester: Spring/2

MS20.104	Multivariate Calculus	**5-1-0-6**

Objective: To acquire fundamental knowledge of multivariate calculus and apply in sciences and applied sciences.

1.	Partial Differentiation-I: Introduction-Functions of several variables, Domain and range for function of several variables,Open and closed regions,graph,Level curves, and surfaces,Limits and continuity of functions of two variables, Partial derivatives, The mixed derivative theorem, Geometric interpretation of partial derivatives,Differentiability,Total derivatives, Sufficient condition of differentiability.	**13**
2.	Partial Differentiation-II: Euler's theorem for homogenous functions for two variables and n variables, Composite function and Chain rule for one and two independent parameters, implicit functions, Jacobians,Jacobian of function of functions, Jacobian of implicit functions,Theorem of dependency of functions, proof of all properties.	**13**
3.	Application of Partial Derivatives: The gradient, Maximal and normal property of the gradient, Tangent planes, Extrema of functions of two variables, method of Lagrange's multipliers, Constrained optimization problems, definition of the vector field, Divergence, Curl.	**13**
4.	Integration: Double integration over rectangular/non-rectangular region, double integrals in polar coordinates, Triple integrals, triple integration over parallelepiped and solid regions, Volumes, Cylindrical and spherical coordinates, change of variables in double and triple integrals using the Jacobian matrix.	**13**
5.	Vector Calculus: Line integrals and its applications (Mass and Work), Independence of path, Conservative vector fields, Green's theorem with proof, Surface integral, Integrals over parametrically defined surfaces, Stoke's theorem with proof, and Gauss Divergence theorem with proof.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of multivariate calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson.
2. Mittal P.K. (2016), Mathematics for Degree Students, S.Chand and Compnay Pvt. Ltd.

Reference Books:

1. Dennis G. Zill and W. Scott Wright (2011), Multivariable Calculus, Jones Bartlett Learning, 4/e.
2. Ramana B.V. (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Jain and Iyengar (2004), Advanced Engineering Mathematics by, Narosa Publishing House.
4. James Stewart (2007), Multivariable Calculus, 2nd Edition ,Tata McGraw-Hill Publishing Company Limited, New Delhi.

B.Sc. (Hons) Mathematics Year: First Semester: Spring/2

MS20.106 **Numerical Methods-II** **2-1-0-3**

Objective: To acquire fundamental knowledge of numerical methods and apply in sciences and applied sciences.

1.	Solution of Algebraic and Transcendental Equation: Introduction, rate of convergence and approximation of real root of equation by Bisection (Bolzano) method, Regula Falsi method (Method of false position), Secant method and Newton Raphson method with proofs.	**06**
2.	Numerical Differentiation-I: Formula for derivatives,Derivatives using Newton's forward difference formula, Derivatives using Newton's backward difference formula, Derivatives using Stirling central difference formula. Proof of all methods.	**05**
3.	Numerical Differentiation-II: Derivatives using unequally spaced values of argumnets,maxima and minima of a tabulated function.	**05**
4.	Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal, Simpson's one third and three eighth rule, Weddle's rule of integration, errors in quadrature formulae, Romberg's method. Proof of all methods.	**05**
5.	Numerical Solution of ODE: Introduction, Picard's method,Taylor's series method,Euler's method,Modified Euler's method,Runge-Kutta metod of order four.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of numerical methods in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create .

Text Books:

1. Chapra (2017), Applied numerical Methods with MATLAB, McGraw Hill Education.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.

Reference Books:

1. Balagurusamy E., Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd, 2008.

2. Srimanta Pal, Numerical Methods, 1st ed., Oxford University Press, Oxford, 2009.
3. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.
4. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.

B.Sc. (Hons) Mathematics	Year: Second	Semester: Autumn/3
MS20.201	Differential Equations	**5-1-0-6**

Objective: To acquire fundamental knowledge of differential equations and apply in sciences and applied sciences.

1.	First Order Differential Equations-I: Basic concepts of differential equations,Definition, Order and degree of differential equation, general, particular, explicit, implicit and singular solution of differential equation, standard form, equations in which variables are separable, homogeneous and reducible to homogeneous differential equations, linear and reducible to linear (Bernoulli) differential equations, exact and reducible to exact differential equations, different methods of finding integrating factor of equation, equations of first order but not of the first degree, equations solvable for p, y and x , Clairaut's and Lagrange's equations.	**13**
2.	First Order Differential Equations-II: Existence and uniqueness theorm for first –order differential equations,Lipschitz condition and examples,Gronwall's inequality, continuous dependence and initial conditions, Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting. Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.	**13**
3.	Second and Higher Order Differential Equations: Linear differential equations with constant and variable coefficients (Euler Cauchy equation), different forms of complimentary functions and particular integrals, equations reducible to homogeneous liner form, change of independent variables, normal form and method of variation of parameters with proofs of all results.	**13**
4.	Differential Equation of other Types:Introduction, Equation of the type $\frac{d^n y}{dx^n} = f(x)$, Equation of the type $\frac{d^n y}{dx^n} = f(y)$, Equations which do not contain y directly, Equations which do not contain x directly,Equations whose solution is known, Normal form(removable of first derivative),Method of solving linear differential equations by changing the independent variable,Method of variation of parameters, Method of undetermined coefficients.	**13**
5.	Power Series Solution: Introduction,Review of power series,Ordinary and singular points of a differential equation, Power series solution about an ordinary point, Frobenius method series solution about a regular singular point.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential equations in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Sundarapandian (2012), Ordinary and Partial differential Equations, McGraw Hill Education.
2. **Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations, 18th Edition, S. Chand Limited.**

Reference Books:

1. Nagle, Saff and Snider (2016), Fundamental of Differential Equations, 8th Edition, Pearson.
2. Simmons (2016), Differential Equations with Applications and Historical Notes, McGraw Hill Education.
3. Ramana B.V. (2007), Higher Engineering Mathematics, 2nd Edition, McGraw-Hill Publishing Company Limited, New Delhi.
4. Dennis G. Zill and Michael R Cullen (2009) , Differential Equations with Boundary-Value

Problems, 7th ed., Brooks/Cole.

B.Sc. (Hons) Mathematics	Year: Second	Semester: Autumn/3

MS20.203	Theory of Real Functions	5-1-0-6

Objective: To acquire fundamental knowledge of theory of real functions and apply in sciences and applied sciences.

1.	Limit and Continuity-I:Introduction,Algebraic operations on function,Bounded and unbounded functions,Limit of a function,Algebra of limits,One sided limits-right and left hand limits,Limits at infinity and infinite limits,Characterization of the limit of a function at a point in terms of sequences,Cauchy's criterion fo finite limits,The four functional limits at a point,Continuous functions, Discontinuity of function,Algebra of continuous functions,Function of a function, composite of functions,Continuity of composite functions, proof of all properties and applications.	**13**
2.	Limit and Continuity-II: Criteria for continuity, Equivalent definition of continuity,Some properties of the continuity of a function at a point,Properties of functions continuous in closed finite intervals(Boundedness theorem,Location of roots theorem,Bolzano's intermediate value theorem,Fixed point theorem,Borel's theorem) Existence of the nth root of a given positive real number,Uniform continuity, Continuity of the inverse of continuous functions, root function, proof of all properties and applications.	**13**
3.	Real Fynctions-The Derivative-I:Derivability of a function,A necessary condition for the existence of a finite derivative,Algebra of derivatives,Geometrical meaning of the derivative,Meaning of the sign of derivative at a point,Darboux's theorem, Roll's theorem with geometrical interpretation and failure, First mean value theorem,Cauchy's mean value theorem.	**13**
4.	Real Fynctions-The Derivative-II:Mean Value Theorems: Generalized mean value theorem,Taylor's theorem with Schlomilch and Roche form of remainder,Taylor's theorem with cauchy's form of remainder. Taylor's theorem with Lagrange's form of remainder,Power series representation of functions, Maclaurin's infinite series,	**13**
5.	Maxima, Minima, and Indeterminant Forms:Introduction Power series expansions of some standard functions, Vortex function.,A necessary condition for the existence of extreme values, Sufficient criteria for the existence of extreme values, Application to problems,The indeterminate forms,L'Hospital theorem and its applications,Some useful results and illustrations, proofs of all properties and applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of theory of real functions in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Gerald G. Bilodeau, Thie P. R., and Keough G.E. (2010), An Introduction to Analysis, 2nd Ed., Jones & Bartlett.
2. Malik S.C. and Arora S.(2010), Mathematical Analysis, 4th Edition New Age International Ltd.

Reference Books:

1. Royden H.L.(2017), Real Analysis, 2nd Edition, PHI.
2. Charles G. Denlinger (2014), Elements of Real Analysis, Jones and Bartlett Learning.
3. Apostle (1997), Mathematical Analysis, 2nd Edition, Narosa Publishing House.
4. Bartle R.G. and Sherbert D. R. (2002), Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.

B.Sc. (Hons) Mathematics Year: Second Semester: Autumn/3

MS20.205 **Advanced Group Theory-I** **3-0-0-3**

Objective: To acquire fundamental knowledge of advanced group theory and apply in sciences and applied sciences.

1.	Group Homomorphism and Isomorphism-I: External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite Abelian groups, proof of all properties and applications.	**07**
2.	Group Homomorphism and Isomorphism-II:. Group homeomorphisms, properties of homomorphism's, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems, proof of all properties and applications, proof of all properties and applications.	**08**
3.	Automorphism-I: Automorphism,inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, proof of all properties and applications.	**08**
4.	Automorphism-II: Applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties, proof of all properties and applications.	**08**
5.	External Direct Products: Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups, proof of all properties and applications.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of advanced group theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vashistha A.R. and Vashistha A.K (2015), Modern Algebra, Krishna Educational Publisher.
2. John B. Fraleigh (2014), A First Course In Abstract Algebra, Seventh Edition, Pearson.

Reference Books:

1. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.
2. Khanna and Bhambri(2016), A Course in Abstract Algebra, Fifth Edition, Vikas Publishing House Pvt. Ltd.
3. Michael Artin (2015), Algebra, Second Edition, Pearson.

4. Herstein I.N. (2006), Topics in Algebra, Second Edition, John Wiley and Sons.

B.Sc. (Hons) Mathematics Year: Second Semester: Spring/4

MS20.202 **Real Analysis** **5-1-0-6**

Objective: To acquire fundamental knowledge of real analysis and apply in sciences and applied sciences.

1.	The Real Numbers: Introduction,The set N of natural numbers,The set Z of lintegers, The set Q of rational numbers, The set of real numbers R as a complete ordered field, Closed,open,semi-closed and semi-open intervals, Set bounded above, set bounded below, supremum and infimum of a set, the greatest and smallest members of a set, bounded and unbounded sets,Order-completeness of the set of real numbers,Equivalent description of the order-completeness, property of the set of real numbers,Explicit statement of the properties of the set of real numbers as a complete ordered field,Some important properties of the set of real numbers,The denseness property, the modulus, Principal of mathematical induction,Bernoulli's inequality.	**13**
2.	Neighborhoods and Limit Points: Introduction and properties of nbd,Limit points of a set and its properties,Properties of closed and open sets, properties of interior, exterior,and boundary points , properties of a closure of a set,Dense and perfect sets,compact sets,Countability of sets.	**13**
3.	Sequences: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.	**13**
4.	Infinite Series with Positive Terms: Infinite series, its convergence and sum,A necessary condition for the convergence of an infinite series,Cauchy's general principle of convergence of series,General test for the convergence of positive term series,convergence of geometric series and generalized harmonic series,Comparision tests for the convergence of positive term series,Comparison tests of first type,Practical comparision tests of the first type,Comparision tests of the second type: D'Alembert's ration test,Cauchy's nth root test,Rabbe's Test,Logarithmic test,DeMorgan's and Bertrand's test,Second logarithmic test,Kummer's test,Gauss's test,Cauchy's integral	**13**

test,Cauchy's condensation test, auxiliary series.

5. Infinite Series with Positive and Negative Terms: Introduction,Absolute convergenceand conditional convergence,Cauchy principle of convergence for a series,Dirichlet's theorem,Abel's theorem,Re-arrangements of series,Re-arrangements of a conditional convergent series,Sauchy product of two infinite series. **13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of real analysis in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Gerald G. Bilodeau, Thie P. R., and Keough G.E. (2010), An Introduction to Analysis, 2nd Ed., Jones & Bartlett.
2. Malik S.C. and Arora S.(2010), Mathematical Analysis, 4th Edition New Age International Ltd.

Reference Books:

1. Royden H.L.(2017), Real Analysis, 2nd Edition, PHI.
2. Charles G. Denlinger (2014), Elements of Real Analysis, Jones and Bartlett Learning.
3. Apostle (1997), Mathematical Analysis, 2nd Edition, Narosa Publishing House.
4. Bartle R.G. and Sherbert D. R. (2002), Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.

B.Sc. (Hons) Mathematics Year: Second Semester: Spring/4

MS20.204 PDE and System of ODE **5-1-0-6**

Objective: To acquire fundamental knowledge of PDE and System of ODE and apply in sciences and applied sciences.

1. Partial Differential Equations: Basic concepts and definition, order and degree of partial differential equation, concept of linear and non linear partial differential equations, formation of first order partial differential equations, linear partial differential equations of first order, Lagrange's method, Charpit's method. **13**
2. Second and Higher Order PDE: Linear partial differential equations of second and higher orders, Linear and non-linear homogeneous and non homogeneous equations with constant coefficients, partial differential equation with variable coefficients reducible to equations with constant coefficients, their complimentary functions and particular Integrals, equations reducible to linear equations with constant coefficients. **13**
3. Classification of PDE: Classification of linear partial differential equations of second order, hyperbolic, parabolic and elliptic type's reduction of second order linear partial differential equations to Canonical forms, Monge's method(with all aspects). **13**
4. Applications of PDE:Introduction,Method of separation of variables,Equation of vibrating string,Solution of wave equation by D'Alembert's method,One dimensional heat flow,Two dimensional heat flow,Equation of heat flow in two dimensions in polar coordinates,Transmission line equations, Laplace equation, Vibrating membrance, Solution of the equation of the vibrating membrane(rectangular membrane). **13**
5. System of ODE: Systems of linear differential equations, types of linear systems, **13**

differential operators, an operator method for linear systems with constant coefficients, basic theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions,Theoretical aspects of The Runge-Kutta family method, Interdisciplinery applications.

Course Outcome: After completion of the course, students would be able to apply the knowledge of PDE and System of ODE in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Sundarapandian (2012), Ordinary and Partial differential Equations, McGraw Hill Education.
2. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations, 18th Edition, S. Chand Limited.

Reference Books:

1. K. Sankara Rao (2003), Introduction to Partial Differential Equations, PHI Pvt. Ltd.
2. Tyn Myint-U and Lokenath Debnath (2006), Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint.
3. S.L. Ross (2004), Differential equations, 3rd Ed., John Wiley and Sons, India.
4. Martha L Abell and James P Braselton (2004), Differential equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press.

B.Sc. (Hons) Mathematics Year: Second Semester: Spring/4

MS20.206 **Advanced Group Theory-II** **3-0-0-3**

Objective: To acquire fundamental knowledge of advanced group theory and apply in sciences and applied sciences.

1.	Group actions, stabilizers and kernels, permutation representation associated with a given group action, proof of all properties and applications.	**07**
2.	Applications of group actions: Generalized Cayley's theorem, Index theorem, proof of all properties and applications.	**08**
3.	Groups acting on themselves by conjugation, class equation and consequences, conjugacy in S_n, *p*-groups, proof of all properties and applications.	**08**
4.	Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non-simplicity tests, proof of all properties and applications.	**08**
5.	Group actions,Normal series,solvable groups,Nilpotent groups, proof of all properties and applications.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of advanced group theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vashistha A.R. and Vashistha A.K (2015), Modern Algebra, Krishna Educational Publisher.
2. John B. Fraleigh (2014), A First Course In Abstract Algebra, Seventh Edition, Pearson.

Reference Books:

1. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.
2. Khanna and Bhambri(2016), A Course in Abstract Algebra, Fifth Edition, Vikas Publishing House Pvt. Ltd.
3. Michael Artin (2015), Algebra, Second Edition, Pearson.
4. Herstein I.N. (2006), Topics in Algebra, Second Edition, John Wiley and Sons.

B.Sc. (Hons) Mathematics Year: Third Semester: Autumn/5

MS20.301 Ring Theory and Linear Algebra-I **5-1-0-6**

Objective: To acquire fundamental knowledge ring theory and linear algebra and apply in sciences and applied sciences.

1.	Ring, Integral Domain and Field-I: Definition, examples and basic properties of ring, integral domain and field, Zero divisors, proof of all properties and applications.	**13**
2.	Ring, Integral Domain and Field-II: Sub ring, ordered integral domain and subfield, Definition, examples, types and characteristics of ideal, Homomorphism and isomorphism of rings, proof of all properties and applications.	**13**
3.	Vector Space-I: Introduction and definitions, Vector space, General properties of vector spaces, Vector subspaces, Criterion for a subspace, Algebra of subspaces, Linear combination of vectors, Linear span of a set, Finite dimensional vector space, Linear sum of two spaces, Quotient space, Direct sum of vector sub-spaces, proof of all properties and applications.	**13**
4.	Vector Space-II: Linearly dependent and linearly independent vectors, Deductions, Some theorems on linear dependence and linear independence, Basis of a vector space,	**13**

Existence of basis of a finite dimensional vector space, Dimension of a finitely generated vector space, Some properties of finite dimensional vector spaces, Co-ordinate representation of a vector, proof of all properties and applications.

5. Linear Mapping: Linear mapping , Properties of linear mappings, Isomorphism of vector spaces, Some theorems, Applications to ordinary differential equations, Rank and nullity of linear transformation, Eigen values and Eigen vectors of a linear map, Eigen subspace of a matrix representation of linear maps, Diagonalization of matrices, proof of all properties and applications.. **13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of ring theory and linear algebra in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. David C. Lay (2013), Linear Algebra and Its Applications, Third Edition, Pearson.
2. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.

Reference Books:

1. Seymour Lipschutz and Mark Lipson (2017), Schaum's Outline of Linear Algebra, McGraw Hill Education.
2. Defranza and Gagliardi (2012), Introduction to Linear Algebra with Application, Mc Graw Hill Edition.
3. Hoffman and Kunze (2014), Linear Algebra, Second Edition, Pearson.
4. Kumaresan (2014), Linear Algebra: A Geometric Approach, PHI Learning.
5. Gareth Williams (2014), Linear Algebra with Applications: Alternate Edition. $8/e$, Jones and Bartlett Learning.

B.Sc. (Hons) Mathematics Year: Third Semester: Autumn/5

MS20.303 Riemann Integration and Series of Functions **5-1-0-6**

Objective: To acquire fundamental knowledge Riemann integration and series of functions and apply in sciences and applied sciences.

1. Riemann Integration: Introduction,Partitions and Riemann(or Darboux)sums,Some properties of Darboux sums,Upper and lower Riemann integrals,Darboux theorem,Another equivalent definitionof integrability and integral,Second definition of iemann integrability,Necessary and sufficient conditions for integrability,Particular classes of bounded integrable functions, Properties of integrable functions, Integrability of the sum,difference, product, and quotient of integrable functions,Integrability of the modulus of a bounded integrable function,Fundamental theorem of integral calculus,Second mean value theorem,Abel's lemma,Second mean value theorem(Weierstrass form). **13**

2. Riemann Stieltjes Integral: Introduction,Partition of a set,Upper and lower Riemann Stieltjes sums ,The lower and upper Riemann Stieltjes integrals,The Riemann Stieltjes integrals,The Riemann Stieltjes integrals as a limit of sum,Some useful inequalities related to Riemann Stieltjes integrals,Algebra of Riemann Stieltjes integrable functions,Reduction of Riemann **13**

	Stieltjes integrals into Riemann integrals, ,proof of all properties and applications.	
3.	Uniform Convergence and Improper Integrals: Introduction,Cauchy's general principle of uniform convergence,Continuity of the uniform limit of a uniformly convergent sequence of continuous functions, Integrability of uniform limit of a uniformly convergent sequence of integrable functions, Infinite series of functions with uniform convergence,Cauchy's general principle, Weierstras's M-Test, Abel's test, Dirichlet's test, properties of uniformly convergent series of functions, The Weierstrass approximation theorem, Improper integrals-Convergence, absolute and conditional convergence,necessary and sufficient condition for the convergence,comparison test of two integrals,, Abel's test and Dirichlet's test.	**13**
4.	Sequence and Series of functions: Point wise and uniform convergence of sequence of functions, Theorems on continuity, Derivability and integrability of the limit function of a sequence of functions, Theorems on the continuity and derivability of the sum function of a series of functions, Cauchy criterion for uniform convergence and Weierstrass M-Test.	**13**
5.	Power series: Introduction,Power series,Some important facts about the power series,Radius of convergence and interval of convergence,Formulas for determining the radius of convergence,Some basic theorems,Properties of functions expressible as power series,Abel's theorem,Double sequence,Convergemce of double sequence,Cauchy general principle of convergence of duble sequence,Repeated double limits,Double series,Convergence of double series,Double series of positive terms,Some test fro convergenceof a double series of positive terms, Taylor's theorem fro power series.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of Riemann integration and series of functions in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Denlinger C. G. (2011), Elements of Real Analysis, Jones & Bartlett (Student Edition).
2. Malik S.C. and Arora S.(2010), Mathematical Analysis, 4th Edition New Age International Ltd.

Reference Books:

1. Royden H.L. (2017), Real Analysis, 2nd Edition, PHI.
2. Bartle R.G. and Sherbert D.R. (2002), Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.
3. Apostle (1997), Mathematical Analysis, 2nd Edition, Narosa Publishing House.
4. Ross K.A. (2004), Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian Reprint.

Year: Third Semester: Autumn/5

B.Sc. (Hons) Mathematics

MS20.305 Elementary Probability and Statistics **3-0-0-3**

Objective: To acquire fundamental knowledge elementary probability and statistics and apply in sciences and applied sciences.

1.	Basic Statistics: Mean, mode, median for grouped and ungrouped data, variance, standard deviation, dispersion and measures of dispersion, skewness and measures of skewness, moments proof of all properties and illustrations..	**07**
2.	Probability Theory: Recapitulation of basic probability theory, law of addition and law of multiplication, conditional probability, total probability, Bayes' theorem, proof of all properties and illustrations.	**08**
3.	Random Variables and Distribution-I: Discrete and continuous random variables, types of distribution, probability mass and density functions, mean variance and standard deviation of distribution, discrete distributions (binomial and Poisson), proof of all properties and applications.	**08**
4.	Random Variables and Distribution-II: Continuous distributions-Normal distribution, Uniform distribution and Exponential distribution, proof of all properties and illustrations.	**08**
5.	Hypothesis and Correlation-Regression: Simple and composite hypothesis, type I and type II errors, tests of significance, simple correlations, linear regression.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of elementary probability and statistics in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Elements of Probability and Statistics by A.P. Baisnab and Manoranjan Jas, TMH 2003.
2. Fundamental of Mathematical Statistics by Gupta and Kapoor, SCS Publisher, 2002.
3. Introduction to Probability and Statistics by J. Susan Milton and Jesse C. Arnold, Fourth Edition, McGraw Hill Education, 2016.

Reference Books:

1. Probability, Random Variables and Stochastic Processes by Papoulis, TMH.
2. Probability and Statistics (Schaum's outline Series) by Spiegel, TMH.
3. Mathematical Statistics with Applications by Miller and Freund's, 7th Edition, Pearson.

B.Sc. (Hons) Mathematics Year: Third Semester: Autumn/5

MS20.307 Basics of Combinatorics **3-0-0-3**

Objective: To acquire fundamental knowledge basics of Combinatorics and apply in sciences and applied sciences.

1.	Relation and Function-I: Definition, different forms, properties and operations on sets, principle of inclusion and exclusion, partition of a set, definition of relation, types of relation, composition, properties and graphical representation of relation, equivalence classes, Proof of all properties and illustrations.	**08**
2.	Relation and Function-II: Closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice and different forms, properties ,definition of function and different forms, composition and properties of functions, recursively defined functions, Proof of all properties and illustrations.	**08**
3.	Induction: Mathematical induction, strong induction and well-ordering, definition of recursive, structural induction, Proof of all properties and illustrations.	**08**
4.	Counting: Basics of counting, Pigeonhole principle,Generalized pigeonhole principle, Proof of all properties and illustrations.	**07**
5.	Counting: Permutations and combinations, Binomial coefficients, Generalized permutations and combinations, Proof of all properties and illustrations.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of basics of Combinatorics in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory by Kenneth H. Rosen, Seventh Edition, TMH Education.
2. Discrete Mathematical Structure by Kolman, Busby and Ross, 6th Edition, PHI Learning.
3. Foundations of Discrete Mathematics by K.D. Joshi, New Age International Reprint 2002.

Reference Books:

1. Discrete Mathematical Structures with Application to Computer Science by Tremblay,McGraw Hill Education.
2. Elements of Discrete Mathematics by Liu and Mohapatra, McGraw Hill Education.

B.Sc. (Hons) Mathematics Year: Third Semester: Autumn/5

MS20.309 Linear Programming **3-0-0-3**

Objective: To acquire fundamental knowledge linear programming and apply in sciences and applied sciences.

1.	Introduction: Origin and Development of OR, Meaning and Definition of OR, Different Phases of OR study, Methodology of OR, Scope and Limitations of OR, OR in decision making, Applications of OR with illustrations.	**06**
2.	Linear Programming: Linear combination of vectors, Linearly independent / dependent vectors, Basis of a vector space, Convex set and its properties, Extreme points, General Linear programming problem (LPP), Standard and canonical form of LPP, Formulation of LPP in all possible domains, Proof of all properties with illustrations.	**06**
3.	Simplex Method: Simplex table, Conditions for application of simplex method, Solution to maximization and minimization problems including the Big- M Method, Two phase method,Proof of all properties with illustrations.	**12**
4.	Transportation Problem: Methods of obtaining initial feasible solution by northwest-corner method, least cost method and Vogel approximation method, Optimal Solution of Transportation problems using Modi Method and stepping Stone method, Unbalanced Transportation Problems, Proof of all properties with illustrations.	**09**
5.	Assignment Problem: Mathematical formulation of Assignment Problem, Hungarian method for solving Assignment problem, Proof of all properties with illustrations.	**06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of linear programming in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Hira and Gupta (2014), Operations Research, Revised Edition, S. Chand and Company Ltd.
2. Hamdy A., Taha (2016), Operations Research: An Introduction, 10th Edition, Pearson.

Reference Books:

1. G. Hadley (2002), Linear Programming, Narosa Publishing House, New Delhi.
2. Hillier and. Lieberman (2009), Introduction to Operations Research, 9thEdition, Tata McGraw Hill, Singapore.
3. Sharma S. D .and Himanshu Sharma (2004), Operations Research: Theory, Methods and Applications, 14th edition, Kedar Nath Ram Nath.

4. Kanti Swarup, PK Gupta and Manmohan (2001), Operations Research, 9th Edition, Sultan Chand and Sons, New Delhi

MS20.311 Analytical Geometry **3-0-0-3**

Objective: To acquire fundamental knowledge analytical geometry and apply in sciences and applied sciences.

1.	Plane: Definition and different form of planes, angle between two planes, perpendicular distance of a point from a plane, plane through intersection of two planes, bisectors of two intersecting planes, locus of a plane, intersection of three planes.	**06**
2.	Straight Line: Definition and different form of straight line, angle between two lines, distance of a point from a straight line, image of a point and straight line in a plane, co planarity of straight lines, shortest distance between two skew lines.	**07**
3.	Sphere: Different form of sphere, plane section of a sphere, intersection of two spheres, sphere through a given circle, intersection of a straight line and sphere, tangent planes and normal, touching spheres and condition of orthogonal spheres.	**08**
4.	Conicoids I: Different form of cone, equation of the cone with given vertex and a given conic for its base, angle between the lines in which a plane cuts a cone, tangent lines and tangent plane, reciprocal con, right circular con, different form of cylinder, equation of tangent plane, enveloping cylinder, right circular cylinder.	**09**
5.	Conicoids II: Ellipsoid, hyperboloid of one and two sheets, elliptic paraboloid , hyperbolic paraboloid, tangent plane , equation of normal, director sphere, polar plane and pole of the plane.	**09**

Course Outcome: After completion of the course, students would be able to apply the knowledge of analytical geometry in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Analytic Geometry by Gordon Fuller and Dalton Tarwater, Pearson; 7th edition.
2. Elementary Treatise on Co-Ordinate Geometry of Three Dimensions by R.J.T. Bell, Macmillan India Ltd., 1994.
3. Analytical Solid Geometry by Shanti Narayan, S. Chand & Company, New Delhi.

Reference Books:

1. Analytic Solid Geometry by Deepak Chatterjee, PHI Learning Private Ltd., New Delhi.
2. Analytical Geometry of Two and Three Dimensions by H.M. Vasavada, 1992.

MS20.313 Integral Transforms and Special Functions **3-1-0-4**

Objective: To acquire fundamental knowledge integral transforms and special functions and apply in sciences and applied sciences.

1.	Bessel Polynomials: Solution of Bessel equation, Bessel Function, Recurrence relations, Generating function, orthogonal property of Bessel polynomials.	**07**
2.	Legendre Polynomials: Legendre function, generating function, Recurrence relations, orthogonal property of Legendre polynomials, Rodrigue's formula.	**08**
3.	Gamma and Beta Functions: Definition of Gamma Function, Recurrence Formula of Gamma Function, Definition of Beta Function, Properties of Beta Function, Relation between Beta and Gamma Function, Duplication Formula.	**08**
4.	Laplace Transforms: Laplace transform, Properties of Laplace Transform, Laplace transform of Dirac Delta function, Inverse Laplace Transform, Convolution theorem for Inverse Laplace Transform, Method to solve some ordinary differential equations by using Laplace Transform.	**08**
5.	Fourier Series and Fourier Transform: Fourier Series, Half Range Fourier Series, Change of interval, Complex form of Fourier series, Fourier Transform and its properties.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of integral transforms and special functions in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Rainville E. D, Special Functions, Latest Edition Macmillan Company, New York.
2. Jain and Iyengar (2004), Advanced Engineering Mathematics by, Narosa Publishing House.

Reference Books:

1. Bell W.W. (2013), Special Functions, Courier Corporation.
2. Nico M. Temme (2011), Special Functions, John Wiley.
3. Ramana B.V. (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

MS20.315 Elements of Discrete Mathematics **3-1-0-4**

Objective: To acquire fundamental knowledge elements of discrete mathematics and apply in sciences and applied sciences.

1. Mathematical Logic: Introduction,Statements,Laws of formal logic, Connectives and compound statements, Proposition, Conditional Statements,Well formed formulas,Tautology, Contradiction, Contingency, Logical Eqivalence,Laws of logic, The duality principle, Logical Implication, Normal Forms, proof of all properties and illustrations. **[07]**
2. Logics and Proofs: Propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, notion of a proof and methods for constructing proofs, normal forms (disjunctive and conjunctive), proof methods and strategy, statements of Fermat's last theorem, the $(3x+1)$ conjecture and Godel's incompleteness theorem, program correctness proof of all properties and illustrations.,. **[08]**
3. .Boolean Algebra-I: Introduction, Partial ordering,Totally ordered set,Dual Oorder,Hasse diagram,Lexicographic order,Cover of an element,Least and greatest elements,Minimal and maximal elements,Upper and lower bounds,Well order set,Binary and n-arry opreations,Choice function, Axiom of choice,Well-ordering theorem,Lattice, Properties of lattice,Lattice as an algebraic system, Bounded lattice, Sun lattice, Direct products, proof of all properties and illustrations. **[08]**
4. Boolean Algebra-II and Logic Gates: introduction, Sub-Boolean algebra, direct products, Homomorphism, Axioms of Boolean algebra, Boolean expressions and minimization of Boolean functions, Minimization of Boolean expressions, proof of all properties and illustrations. **[08]**
5. Finite Automata: Deterministic and non-deterministic finite automata, transition table and transition diagram, Mealy and Moore machines, minimization of finite automation. **[08]**

Course Outcome: After completion of the course, students would be able to apply the knowledge of elements of discrete mathematics in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory by Kenneth H. Rosen, Seventh Edition, TMH Education.
2. Discrete Mathematical Structure by Kolman, Busby and Ross, 6th Edition, PHI Learning.
3. Foundations of Discrete Mathematics by K.D. Joshi, New Age International Reprint 2002.

Reference Books:

1. Discrete Mathematical Structures with Application to Computer Science by Tremblay, McGraw Hill Education.
2.Elements of Discrete Mathematics by Liu and Mohapatra, McGraw Hill Education.
3. Graph Theory with Applications to Engineering and Computer Science by Narsingh Deo, PHI, 2001.

RM20.301 Research Methodology **2-0-0-2**

Objective: To acquire fundamental knowledge research methodology and apply in liberal arts, sciences and applied sciences.

1.	Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
2.	Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
3.	Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
4.	Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation - Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
5.	Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of research methodology in liberal arts,sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Suggested Readings:

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

MS20.317 Differential Geometry **2-0-0-2**

Objective: To acquire fundamental knowledge differential geometry and apply in sciences and applied sciences.

1.	Tensors I: Introduction, definition and basic properties of tensors, Contra variant and Co variant tensors of different order, Invariant tensor, Mixed tensors of different order, Kronecker delta and its properties.	**05**
2.	Tensors II: Basic algebraic operations with tensors, quotient law of tensors, introduction of different Christoffel symbols, properties of Christoffel symbols and applications.	**05**
3.	Differential Geometry I: Basics of differential geometry, basic definitions of graphs and level sets and curves, different standard surfaces, nomenclature, equations and images.	**05**
4.	Differential Geometry II: Introduction and definition of Conoid, different forms, degree of surface, tangent and tangent planes, inflexional tangents, representation of surfaces by parameters.	**05**
5.	Geodesics: Space curves as intersection of two surfaces, parametric and vector representation, introduction of Geodesics and differential equations of geodesics, arc length and curvature of surfaces, different form of curvatures of a surface.	**06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential geometry in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Differential Geometry of Curves and Surfaces by A. K. Peters, Ltd., Natick, 2010.
2. A First Course in Differential Geometry by Chuan-Chih Hsiung, International Press, Cambridge, MA, 1997.
3. An Introduction to Differential Geometry by T.J. Willmore, Oxford University Press, 1964.

Reference Books:

1. Differential Geometry of Curves and Surfaces by M. P. D. Carmo, Prentice-Hall, Englewood, NJ, 1976
2. Curves and Surfaces by M. Abate and F. Tovena, Springer.
3. Lectures on Classical Differential Geometry by D.J. Struik, 2nd Edition, Addison-Wesley, 1988.

MS20.302 Metric Spaces and Complex Analysis 5-1-0-6

Objective: To acquire fundamental knowledge metric spaces and complex analysis and apply in sciences and applied sciences.

1.	Metric Spaces-I: Introduction,Metric space,Pseudo space,Some important reults for direct applications,Examples of metric space,Distance between two sets,Diameter of a set,Bounded and unbounded metric spaces,Open and closed balls,nbd of a point and all properties related to nbd,open sets and its properties,Limit point and its properties, Closed sets and its properties,Subspaces,Adherent point, Closure of a ste and its properties,Interior, exterior,frontier, and boundary point with properties,Dense and perfect sets with properties,Sepearble space, Product of metric spaces, Proof of all theorems and applications.	**13**
2.	Metric Spaces-II: Continuous function on metric space, Cauchy sequence,Complete metric space with properties,Canor's intersection theorem,Contraction mapping principle,Banach's fixed point theorem,Compact metric space,Finite intersection property,Bolzano-Weierstrass property,Sequentially compact metric space,Countably compact metric space,Locally compact metric space,Connected metric space, , Proof of all theorems and applications.	**13**
3.	Function of Complex Variable: Limit and Continuity, Uniform Continuity, Differentiability and analyticity, Cauchy-Riemann Equation in Cartesian and polar forms with proof, Harmonic functions, Bilinear transformations and conformal mapping.	**13**
4.	Complex Integration: Introduction, Curves in the complex plane, Contour integrals, Cauchy integral theorem, Extension of Cauchy integral theorem for multiply connected domains, Use of indefinite integrals in the evaluation of line integrals, Cauchy integral formula, Cauchy integral formula for derivatives, Poisson's integral formula, Maximum Modulus Principle.	**13**
5.	Zeros, Singularities and Residues: Introduction, Zeros and singularities of complex functions with classifications, Power series, Taylor series, Laurent Series, Residues, Evaluation of contour integrals using residues, Evaluation of real integrals using residues.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of metric spaces and complex analysis in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Ahlfors (2017), Complex Analysis, Third edition, McGraw Hill Education, Indian Edition.
2. Malik and Arora (2011), Mathematical Analysis, Fourth Edition, New Age International (P) Ltd., Pub.

Reference Books:

1. Hahn and Epstein (2014), Classical Complex Analysis, Jones and Bartlett Learning.
2. Brown (2016), Complex variables and Applications, McGraw Hill Education.
3. Jain and Iyengar (2014), Advanced Engineering Mathematics by, Narosa Publishing House.
4. Wunsch A. David (2009), Complex variables with Applications, Pearson.

MS20.304 Ring Theory and Linear Algebra-II **5-1-0-6**

Objective: To acquire fundamental knowledge ring theory and linear algebra and apply in sciences and applied sciences.

1.	Ring Theory-I: Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x], proof of all properties and applications..	**13**
2.	Ring Theory-II: Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.Historical discussion of Frmet's last theorem,proof of all properties and applications.	**13**
3.	Ring Theory-III:Frieze group and Crystallographic, Cayley digrphs of groups, An Introduction to Galios theory-Fundamental theorem of Galios theory, Solvability of polynomials by radicals,Insolvability of a Quintic, proof of all properties and applications.	**13**
4.	Dual Spaces: Introduction, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, proof of all properties and applications..	**13**
5.	Inner Product: Inner product space, Properties of inner product, Norm of a vector in inner product space, Orthogonalization of a base, Schwarz's inequality with special cases, Triangle inequality, Bessel's inequality, Gram –Schmidt orthogonalization process, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem,Introduction to algebraic codingbtheory-Linear codes, Parity-Check Matrix Decoding, Coset decoding, proof of all properties and applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of ring theory and linear algebra in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. David C. Lay (2013), Linear Algebra and Its Applications, Third Edition, Pearson.
2. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.

Reference Books:

1. Seymour Lipschutz and Mark Lipson (2017), Schaum's Outline of Linear Algebra, McGraw Hill Education.
2. Defranza and Gagliardi (2012), Introduction to Linear Algebra with Application, Mc Graw Hill Edition.
3. Hoffman and Kunze (2014), Linear Algebra, Second Edition, Pearson.
4. Kumaresan (2014), Linear Algebra: A Geometric Approach, PHI Learning.
5. Gareth Williams (2014), Linear Algebra with Applications: Alternate Edition. $8/e$, Jones and Bartlett Learning.

MS20.306 Elementary Graph Theory **3-0-0-3**

Objective: To acquire fundamental knowledge elementary graph theory and apply in sciences and applied sciences.

1.	Graphs-I: Introduction, definition and applications of graphs, finite and infinite graphs, null graph, sub graphs, incidence and degree, isolated vertex, pendant vertex, walk, path and circuits, connected graphs, disconnected graphs and components, proofs of all properties with illustartions.	**07**
2.	Graphs-II: Isomorphism, Euler graphs, operations on graphs, Hamiltonian paths and circuits, the travelling sales man problem, matrix representation of graphs, properties and some standard theorems on graphs, proof of all properties with illustrations..	**08**
3.	Directed Graphs: Definition, in-degree, out-degree, isomorphic digraphs, types of digraphs, digraph and binary relations, relation matrices, directed paths and connectedness, Euler digraphs, fundamental circuits in digraphs, properties and some standard theorems on digraphs.	**08**
4.	Trees: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees,rank,nullity and cyclomatic number, Kruskal's algorithm and Prim's algorithm.	**08**
5.	Cut-Sets and Cut-Vertices: Cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism, some standard theorems.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of elementary graph theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Graph Theory with Applications to Engineering and Computer Science by Narsingh Deo, 2001, PHI.
2. Introduction to Graph Theory by Chartland, McGraw Hill Education.
3. Introduction to Graph theory by West, 2nd Edition, PHI Learning.

Reference Books:

1. Introduction to Graph Theory by Wilson, 4th Edition, Pearson.
2. Handbook of Graph Theory by Jonathan L.G., and Yellen J., CRC Press, 2004.
3. Theory of Graphs by Ore O., Volume 38, American Mathematical Society, Colloquium Publications, 1991.

MS20.308 Basics of Dynamics and Mechanics **3-0-0-3**

Objective: To acquire fundamental knowledge basics of dynamics and mechanics and apply in sciences and applied sciences.

1.	Velocity and acceleration: Velocity and acceleration along radial, transverse, tangential and normal directions. Relative velocity and acceleration.	**07**
2.	Rectilinear Motion: Simple Harmonic Motion, Motion under inverse square law, Motion under different laws.	**08**
3.	Coplanar Forces: Resultant force and resultant couple, Special cases, Varignon's theorem, Necessary and sufficient conditions of equilibrium. Equilibrium equations of the first, second and third kind. General conditions of equilibrium of a body under several coplanar forces,	**08**
4.	Friction and Virtual work: Contact force between bodies, Coulomb's laws of static Friction and dynamic friction. The angle and cone of friction, the equilibrium region. Workless constraints - examples, virtual displacements and virtual work. The principle of virtual work,	**08**
5.	Rigid Body Dynamics: Moments and product of inertia, Theorems of parallel and perpendicular axes, Principal axis, Kinetic energy of body rotating about a fixed point.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of basics of dynamics and mechanics in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. S. L. Loney: An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies, Cambridge University Press, 1956
2. S. L. Loney: An Elementary Treatise on Statics, Cambridge: University Press,1912
3. F. Chorlton: Dynamics, CBS Publishers, New Delhi, 2002
4. D. C. Gokhroo: Statics, Navkar prakashan, Edition, 2007
5. D. T. Greenwood: Principle of Dynamics, Prentice Hall, 1987

Reference Books:

1. H. Goldstein, C. Poole and J. Safko: Classical Mechanics, 3rd Edition, Addition Wesley (2002)
2. F. Grantmacher: Lecture in analytical Mechanics, Mir Publication, 2013
3. R.D. Gregory: Classical mechanics, Cambridge UP, 2006
4. Timoshenko and Young: Engineering Mechanics, Mcgraw Hill, 2017
5. K. R. Symon: Mechanics, Addison Wesley, 1971

MS20.310 Basics of Vector Calculus **3-0-0-3**

Objective: To acquire fundamental knowledge basics of vector calculus and apply in sciences and applied sciences.

1.	Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors.	**07**
2.	Vector Differentiation-I: Vector algebra, operations with vectors, scalar and vector product of three vectors, product of four vectors, reciprocal vectors, scalar-valued functions over the plane and the space, vector function of a scalar variable, curves and paths, vector differentiation, proof of all properties and illustrations.	**08**
3.	Vector Differentiation-II: Directional derivative, gradient of a scalar function, conservative field, divergence, curl, related properties of gradient, divergence and curl of sums, second order differential operator, cylindrical and spherical coordinates,	**08**
4.	Vector Integration-I: Integration of a vector function of a scalar argument, line integral, work done , potential, conservative field and area, surface integrals, surface area and flux,proofs of all properties and illustrations.	**08**
5.	Vector Integration-II: Volume integrals, Proof Green's theorem in plane, transformation between line integral and double integral, area in Cartesian and polar coordinate,Proof's Stoke's theorem, Gauss divergence theorem with proof, illustrations of all theorems..	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of basics of vector calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vector Analysis (Schaum's outlines Series) by Spiegel, MC Graw Hill Education.
2. A Text Book of Vector Calculus by Shanti Narayna, S. Chand & Co., New Delhi.
3. Theory and Problems of Advanced Calculus by Murrary R. Spiegal, Schaum's Publishing Company, New York.
4. Higher Engineering Mathematics by B.V. Ramana, TMH,2006.

Reference Books:

1. Introduction to Vector Analysis by N. Saran and S.N. Nigam, Pothishala Pvt. Ltd., Allahabad.
2. Thomas Calculus by Thomas, 11 Editions, Pearson.
3. A Text Book on Vector Calculus by G. Paria, Scholar's Publishing House, Indore.

B.Sc. (Hons) Mathematics Year: Third Semester: Spring/6

Prerequisite: MS20.351 (Mandotery)

MS20.312 Advanced Linear Programming **3-0-0-3**

Objective: To acquire fundamental knowledge advanced linear programming and apply in sciences and applied sciences.

1. Duality: Definition of duality Definition of the dual problem, Primal-dual relationships, solution of LPP by duality, Dual Simplex Method,Proof of all properties with illustrations. **[08]**
2. Integer Linear Programming: Introduction, Integer programming formulation, The Branch and Bound Technique, Proof of all properties with illustrations.. **[08]**
3. Sensitivity analysis: Shadow Price, Graphical and simplex method based approach for changes in cost and resource vector, Proof of all properties with illustrations.. **[08]**
4. Game Theory: Introduction, Terminologies of Game Theory, Game with pure strategies, Game with mixed strategies, Dominance Property, Graphical method for $2 \times n$ or $m \times 2$ Games, Linear Programming Approach for Game Theory, Proof of all properties with illustrations.. **[08]**
5. Sequencing and Scheduling Problems: Introduction of Job Sequencing, Optimal Solution [i.e. job sequences, total elapsed time, idle time for every machine] of (n-Jobs 2-Machines, n-jobs 3-Machines, n-jobs m-Machines, 2-Jobs n- Machines), Proof of all properties with illustrations. **[07]**

Course Outcome: After completion of the course, students would be able to apply the knowledge of advanced linear programming in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

3. Hira and Gupta (2014), Operations Research, Revised Edition, S. Chand and Company Ltd.
4. Hamdy A., Taha (2016), Operations Research: An Introduction, 10th Edition, Pearson.

Reference Books:

5. G. Hadley (2002), Linear Programming, Narosa Publishing House, New Delhi.
6. Hillier and. Lieberman (2009), Introduction to Operations Research, 9thEdition, Tata McGraw Hill, Singapore.
7. Sharma S. D .and Himanshu Sharma (2004), Operations Research: Theory, Methods and Applications, 14th edition, Kedar Nath Ram Nath.
8. Kanti Swarup, PK Gupta and Manmohan (2001), Operations Research, 9th Edition, Sultan Chand and Sons, New Delhi

B.Sc. (Hons) Mathematics	Year: Third	Semester: Spring/6
MS20.314	Dissertation	**0-0-0-6**

Mody University of Science & Technology

B.Sc. (Hons) Forensic Science
Session 2020-2021

Curriculum Structure

B.Sc. (Forensic science)

(Session 2020 − 2021 onwards)

Programme Level: Undergraduate **Duration:** Three Years (Six Semesters)
No. of Seats: 30

Affiliation: Mody University of Science and technology

Objective: To impart world class teaching in Forensic Science at undergraduate level

Scope: Employability in various Forensic Science Laboratories and Forensic Science research institutions across India

Input Qualification: 10+2 with science stream

Evaluation Procedure:
All the Rules and Regulations as provided in the Ordinances and Regulations of the Undergraduate Programmes of Mody University shall be followed.

Vision: To edify our students on various levels of crime scene investigation and analytical techniques and to disseminate knowledge in Forensic Science with the perspective of Criminal Justice System.

Mission:

- Provide excellent undergraduate education in a state-of-the-art environment, preparing students for careers as Forensic professionals in industry, government and academia.
- Advance the quality and impact of investigative research with educational experience nationally and internationally.
- Support students for their career development, professional growth and to sustain in lifelong learning.

Program Educational Objectives(PEOs):

Graduates will develop

PEO1	Graduates are prepared to be employed in Forensic Science laboratories and crime investigation agencies by providing expected domain knowledge.
PEO2	Graduates are provided with practical training, hands-on and project experience to meet the industrial/governmental needs.
PEO3	Graduates are motivated in analytical and investigative skill development to become competent experts
PEO4	Graduates are trained to demonstrate/present testimony to courts, develop scientific acumen and to work in teams to handle criminal and civil court cases.
PEO5	Graduates are addressed with social issues and guided to operate problems with solutions.

Program Outcomes (POs)	
At the end of the B.Sc.(Hons.) Forensic Science Program, graduate	
PO1	To provide a structured teaching and learning experience that combines a sound theoretical and practical grounding in Forensic Science.
PO2	To provide a knowledge and skill base consistent with employment opportunities in the specialist area of Forensic Science and its allied disciplines.
PO3	To provide a degree level programme consistent with the development of general scientific practical laboratory skills and quantitative analysis so producing a graduate with a recognizable skill base for a range of employment opportunities outside the forensic field.
PO4	To promote analytical, critical and lateral thinking and contextualize these processes with respect to the forensic discipline.
PO5	To engender an honest and rational approach to investigative science.
PO6	To provide students with an understanding of the legal framework and the role of forensic science in a government enquiry and a criminal prosecution.
PO7	To inspire the confidence required for intellectual independence, teamwork, responsibility, originality and the development of the reflective practitioner through training and support.
PO8	To produce students who have experience in proposing, planning, executing and reviewing scientific work in the office and the laboratory.
PO9	To develop the students' ability to plan and review forensic casework and independently analyze forensic exhibits, while explaining the concepts used in the examination of these exhibits and evaluating the significance of evidential results.
PO10	To develop the students' ability to communicate their scientific work effectively, both orally and in written form.
Program Specific Outcomes (PSOs):	
PSO1	Crime scene principles, investigative processes and trace evidence analysis.
PSO2	Criminological theories to explain crime, criminal and criminal behavior.
PSO3	Physical and chemical basis for understanding the nature and behavior of materials and the modus operandi.
PSO4	Biological and anthropological basis for understanding human identification and the effects of trauma (blunt instruments, sharp instruments and weapons) and toxicity (drugs, poisons) on the human condition.
PSO5	Wildlife crime investigation and analysis.
PSO6	Fingerprint development, lifting and comparison techniques.
PSO7	Forensic Ballistics and tool marks identification.
PSO8	Forensic photography and the use of digital techniques in photography.
PSO9	Questioned documents examination and comparative analysis.
PSO10	Digital Forensics and Multimedia Forensics investigation processes.
PSO12	Legal context of forensic science and its use in the provision and/or interpretation of evidence.
PSO13	Laboratory techniques and instrumentation in investigative science.
PSO14	The roles of forensic personnel and the role of an expert witness in the presentation of unbiased testimony for court.

Name of the Programme: B.Sc. (Forensic Science) **Year: First**

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	FS20.101	Introduction to Forensic Science and Criminology	3	1	-	4	3	25	25	50
	FS20.103	Criminal Law-IPC/CrPC/IEA	3	1	-	4	3	25	25	50
	FS20.105	Trace Evidence Analysis	3	1	-	4	3	25	25	50
	FS20.107	Trace Evidence Analysis Practical	-	-	4	2	4	25	25	50
	Generic Elective Course									
	BS20.101	Cell Biology	4	-	-	4	3	25	25	50
	BS20.103	Cell Biology Lab	-	-	4	2	4	25	25	50
	CH20.113	Chemistry I	4	-	-	4	3	25	25	50
	CH20.115	Chemistry Laboratory I	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Course									
	EL20.109	Foundation Course in English	2	-	-	2	3	25	25	50
	Ability Enhancement Elective (Skill Based)									
	FL	Foreign Language-I	3		-	3	3	25	25	50
		Sub Total				**31**				
	SF 101	Personal Grooming, Fine Dining				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	FS20.102	Crime Scene Investigation	4	1	-	5	3	25	25	50
	FS20.104	Crime Scene Investigation Practical	-	-	4	2	4	25	25	50
	FS20.106	Forensic Psychology	4	1	-	5	3	25	25	50
	FS20.108	Forensic Psychology Practical			4	2	4	25	25	50
	Generic Elective Course									
	CH 20.114	Chemistry II	4	-	-	4	3	25	25	50
	CH 20.116	Chemistry Laboratory II	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Course									
	EV20.102	Environmental Studies	4	-	-	4	3	25	25	50
	Ability Enhancement Elective (Skill Based)									
	FL	Foreign Language-II	3		-	3	3	25	25	50
		Sub Total				**27**				
	SF 102	Social Grooming, Home & Decor and Business Communication				1				

Year: Second

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	FS20.201	Forensic Biology	3	1	-	4	3	25	25	50
	FS20.203	Forensic Biology Practical	-	-	4	2	4	25	25	50
	FS20.205	Forensic Anthropology and Personal Identification	4	1	-	5	3	25	25	50
	FS20.207	Forensic Anthropology Practical	-	-	4	2	4	25	25	50
	Generic Elective Course									
	BS20.201	Molecular Biology	4	-	-	4	3	25	25	50
	BS20.203	Molecular Biology Laboratory	-	-	4	2	4	25	25	50
	Ability Enhancement Elective (Skill Based)									
	FL	Foreign Language-III	3		-	3	3	25	25	50
	*****	Mody University Elective- I	3	-	-	3	3	25	25	50
		Sub Total				**25**				
	SF 201	Personal Grooming, Fine Dining and Home Safety				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	FS20.202	Forensic Toxicology	4	1	-	5	3	25	25	25
	FS20.204	Forensic Toxicology Practical	-	-	4	2	3	25	25	25
	FS20.206	Fingerprint Science	4	1	-	5	3	25	25	50
	FS20.208	Fingerprint Science Practical	-	-	4	2	3	25	25	50
	Generic Elective Course									
	BS20.202	Mammalian Physiology	3		-	3	3	25	25	50
	BS20.204	Mammalian Physiology Laboratory	-	-	4	2	4	25	25	50
	Ability Enhancement Elective (Skill Based)									
	FL	Foreign Language-IV	3	-	-	3	3	25	25	50
	*****	Mody University Elective- II	3	-	-	3	3	25	25	50
		Sub Total				**26**				
	SF 202	Social Grooming and Professional Skills				1				

Year: Third

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	FS20.301	DNA Profiling	4	1	-	5	3	25	25	50
	FS20.303	DNA Profiling Lab	-	-	4	2	3	25	25	50
	FS20.305	Forensic Medicine	3	1	-	4	3	25	25	50
	FS20.307	Forensic Medicine Practical	-	-	4	2	3	25	25	50
	RM20.301	Introduction to Research Methodology	2	-	-	2	3	25	25	50
	Discipline Specific Elective Course									
	FS20.309	Digital Forensics	3	1	-	4	3	25	25	50
	FS20.311	Digital Forensics Practical	-	-	4	2	3	25	25	50
	FS20.313	Forensic Photography, Digital Imaging and Portrait Parley	3	1	-	4	3	25	25	50
	FS20.315	Digital Imaging Lab	-	-	4	2	3	25	25	50
	Ability Enhancement Elective (Skill Based)									
	FL	Foreign Language-V	3	-	-	3	3	25	25	50
		Sub Total				**30**				
		Proficiency (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	FS20.302	Instrumentation in Forensic Science	3	1	-	4	3	25	25	50
	FS20.304	Instrumentation Practical	-	-	4	2	4	25	25	50
	FS20.306	Questioned Document Examination	3	1	-	4	3	25	25	50
	FS20.308	Questioned Document Examination Practical	-	-	4	2	3	25	25	50
	FS20.310	Forensic Ballistics	3	1	-	4	3	25	25	50
	Discipline Specific Elective Course									
	FS20.312	Accident Investigations	2	1	-	3	3	25	25	50
	FS20.314	Forensic Serology	2	1	-	3	3	25	25	50
	FS20.316	Forensic Serology Practical	0	0	4	2	4	25	25	50
	FS20.318	Summer internship*	-	-	-	4	-	-	-	100
	Ability Enhancement Elective (Skill Based)									
	FL	Foreign Language-VI	3	-	-	3	3	25	25	50
		Sub Total				**31**				
		Proficiency (Non credit)				1				

Credit Summary:

Final Credits Summary								
S.N.	**Particulars**	**Credits Semester wise**						
		I	II	III	IV	V	VI	Total
1.	Core Courses	14	14	13	14	15	16	86
2.	Discipline Specific Elective Courses	0	0	0	0	12	12	24
3.	Generic Elective Courses	12	6	6	6	0	0	30
4.	Ability Enhancement Compulsory Courses	2	4	0	0	0	0	6
5.	Ability Enhancement Elective (Skill Based)	3	3	6	6	3	3	24
Total		28	24	25	26	27	28	170

6.	SEFS(Non-Credit Compulsory)	1	1	1	1	1	1	6

FIRST SEMESTER

FS20.101	**Introduction to Forensic Science and Criminology**	**3-1-0-4**
Objective:	To learn about various aspects of Criminology and Forensic Science	
Unit 1	**Basics of Criminology, Types of Crime and Criminal Behavior** Definition: Crime, Criminal and Criminology; Criminology as Science, The field and scope of Criminology; Methods and Techniques in Criminology; Victimology; Classification of crimes; Theories of Criminal behavior – classical, positivist, sociological; Concept of a criminal and classification of criminals. Organized crime; White – collar crimes/ Occupational crimes; Murders; Sexual offences; Terrorism; Serial Crimes; Crime against women and children.	**11**
Unit 2	**Juvenile Delinquency and Punishment** Definition, Types of Juvenile Delinquents ; Classification of Juvenile Delinquents; Factors in Juvenile Delinquency, Custody of juvenile delinquents; Juvenile courts procedure; behavior modification techniques; Preventive Programmes. Concept of punishment, kinds of punishments, capital punishment in India, Introduction to criminal Laws: IEA, IPC and CRPC	**11**
Unit 3	**Police Administration** State police forces – organisational structure, field establishment; Duties and Responsibilities of the Police, Code of Conduct for the Police; Role of police in regard to criminals and investigation; Police role in the society; Custodial crimes: Complaints against police personnel; Interrogation of suspects and offenders; interviewing the criminals; improving the Police force.	**10**
Unit 4	**Introduction to Forensic Science and History** Definition, description, principles, concept, need and scope of Forensic Science. Historical aspects of Forensic Science. Broad components of Criminal Justice System; Evidence Applicability in Court; Definition, Various types of evidences, the law of evidence, Expert's testimony and admissibility of scientific evidence in court of Law. Frye case and Duabert standard. Duties of forensic scientists. Code of conduct for forensic scientists. Qualifications of forensic scientists.	**10**
Unit 5	**Organizational set up of Forensic Science Laboratories in India** Forensic Science Laboratories: Main Authority, Organizational structure of Forensic Science Laboratory – roles and responsibilities, Sections/ Divisions, Services provided. Central Forensic Science Laboratories, State Forensic Science Laboratories, Government Examiners of Questioned Documents, Fingerprint Bureaus, National Crime Records Bureau, Police & Detective Training Schools, Bureau of Police	**10**

	Research & Development, Directorate of Forensic Science and Mobile Crime Laboratories. Police Academies. Police dogs.	
Course Outcome: After studying this paper the students will able to		
1	Summarize the concept of crime, criminal and criminal behavior	
2	Categorize various types of crimes and criminals	
3	Describe the concept of juvenile delinquency and associated challenges	
4	Summarize the concept of punishment	
5	Explain police administration and importance of criminal justice system	
6	Describe forensic science and its history & implementation in India	
Text Books		
1	Ahuja, Ram, Criminology, Rawat Publication, New Delhi, 2000.	
2	Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.	
Reference Books		
1	Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.	
2	Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.	
3	Abaadinsky, H., Organised Crime (2nd Edn.), Nelson – Hall, Chicago, 1998.	
4	Adler, F., Mueller, G. O. W. and Laufer, W. S., Crminology, McGraw – Hill, Boston, 1991.	

FS20.103	**CRIMINAL LAW-IPC/CrPC/IEA**	**3-1-0-4**
Objective:	To learn about various aspects of Criminal Law	
Unit 1	Indian Penal Code- Offence against Persons such as Culpable Homicide and Murder (Ss.299-304, 304 A & B and 307.), Hurt- Simple and Grievous (Ss.319-325), Kidnapping and Abduction. (359-363) and Rape (Ss.375, 376.) (b)	**11**
Unit 2	Indian Penal Code- Offences against property-Theft and Extortion (Ss.378-384), Robbery and Dacoity, (Ss.390, 391-395.), Cheating, Criminal trespass and House Breaking. (Ss.415-420, 441- 447), Sections pertaining to poisons; General exceptions, Offences against person, Offences against property, Attempt to suicide, Sexual offences.	**11**
Unit 3	Code of Criminal Procedure- Introduction, organization and powers of Criminal Law Courts in India, Police powers of arrest, search and seizure	**10**
Unit 4	Code of Criminal Procedure - Introduction and general idea of sections: 291-93, 154, 155, 156, 157, 158, 159, 160, 161, 162, 172, 173, 174, 175, And 176.	**10**
Unit 5	Indian Evidence Act-Admissions, Confessions, Dying Declarations. Of Experts, Oral and Documentary Evidence; Introduction and general idea of sections: 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, And 159	**10**
Course Outcome: After studying this paper the students will able to		
1	Learn functioning of Judicial system	
2	Understand IPC and sec. on crime against human and its punishments	
3	Understand IPC and sec. on crime against property and its punishments	
4	Understand CrPC and sec. understand police powers and related sec.	
5	Understand CrPC and sec. understand court powers and related sec.	
6	Understand IEA and various sec. on admissibility of evidence in court	
Text Books		
1	Ahuja, Ram, Criminology, Rawat Publication, New Delhi, 2000.	
2	Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.	

Reference Books	
1	Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
2	Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency-A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.
3	Abaadinsky, H., Organised Crime (2nd Edn.), Nelson – Hall, Chicago, 1998.

FS20.105	TRACE EVIDENCE ANALYSIS	3-1-0-4
Objective:	To learn about various aspects of Trace evidence analysis and techniques of analysis employed in a Forensic laboratory.	
Unit 1	**Introduction of Physical Evidences** Definition, Collection, packaging, preservation and forwarding of evidences: biological fluids, chemicals, poisons, firearms, fingerprints and tool marks; Linking a Crime Scene with the suspect through field notes, witnesses and interrogation, Reconstruction of crime scene and associative/ corroborative evidences.	**9**
Unit 2	**Crime and Suspect** Search and seizure, privilege against self – incrimination, subpoenas deposition, Miranda rights, condemned of court, FIR, types of cognizable and non-cognizable offences; Expert's Testimony: the role of the expert as witness; Acceptance of evidence in the Court of Law; McNaughton Rule; child witness in the court, admissibility of scientific evidence; Examination in the Court: Direct examination, cross – examination and re-examination of Prosecution lawyer and Defense lawyer and Court presentation, Law of evidence: testimonial and real evidence.	**10**
Unit 3	**Glass and Soil Examination** Glass: Types of glass and their composition. Determination of direction of impact: concentric fracture, cone fracture, radial fracture. Examination of glass: color, fluorescence, physical matching, density comparison, refractive index. Examination of soil, Color, density, size distribution of soil particles, mineral analysis and chemical analysis of soil, collection of preservations of soil. Analysis Techniques-Physical, Chemical, instrumental.	**15**
Unit 4	**Forensic Paint Examination** Paints: Types of paint and their composition, Forensic examination of paints: microscopic and macroscopic studies-pigment distribution, micro-chemical analysis, physical matching, solubility test, pyrolysis gas chromatography.	**8**
Unit 5	**Forensic Examination of Hair and Fiber** Hair: Structure of human and animal hair. Biochemistry of human and animal hair. Examination of Hair; Importance, nature, location, collection, evaluation; Fibers: Definition, types, structure and properties. Classification of fibers, preliminary examination, microscopic and chemical examination of fibers. Analysis Techniques-Physical, Chemical, Instrumental.	**10**

Course Outcome: After studying this paper the students will able to	
1	Interpret various types of physical evidences found at a crime scene and explain the collection, packaging of an evidences.
2	Categorize various types of crime and correlate it with the case study.
3	Describe the composition and collection and examination of soil, Glass evidences
4	Describe the composition and collection and examination of Paint evidence.
5	Differentiate between Hairs and Fibers.
6	Describe Expert's Testimony and court admissibility of an Evidences.
Text Books	
1	Saferstein, R., Criminalistics, An Introduction of Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
2	Sharma, B.R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd., New Delhi, 2001.

Reference Books	
1	Working Procedure Manual: Physics BPR&D Publication, 2000.
2	B.Caddy;Forensic Examination of Glass and Paints Analysis and Interpretation ISBN 0784 05749, 2001.
3	James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4	David A. Crown; The Forensic Examination of paints and pigments, Taylor & Francis, Ny, 2003.
5	Jay A. Siegel, Pekka J Saukko and Geoffrey C. kooupfer; Encyclopedia of Forensic Science, Academic Press,2000.
6	DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalistics, McGraw Hill, New York, 1983.

TRACE EVIDENCE ANALYSIS IN LAB

FS20.107 **0-0-4-2**

1. Physical Analysis of Glass-Density
2. Physical Analysis of Glass-RI
3. Physical Analysis of Soil-Density
4. Analysis of Microscopic Glass Chip
5. Microscopic Examination of Hair
6. Microscopic Examination of Fiber
7. Fabric Count
8. Instrumental analysis of Paint Chip
9. Instrumental analysis of Paint Smear
10. Microscopic Examination of Paint Chip

GENERIC ELECTIVE COURSES

BS20.10	**Cell Biology**	**4-0-0-4**
Objective:		
Unit 1	**Cell:** Introduction and classification of organisms by structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.	[10]
Unit 2	**Membrane Vacuolar system, cytoskeleton and cell motility:** Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.	[10]
Unit 3	**Lysosomes:** Vacuoles and microbodies: Structure and functions. Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and	[20]

	function, chromosomes and their structure.	
Unit 4	**Extracellular Matrix:** Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.	[10]
Unit 5	**Cancer:** Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.	[02]
Text Books		
1	Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.	
2	De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.	
Reference Books		
1	Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.	
2	Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco**.**	

BS20.103 **Cell Biology Laboratory** **0-0-4-2**

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

BS20.109	**Chemistry I**	**4-0-0-4**
Objective:		
Unit 1	**Atomic Structure and Chemical Bonding:** Bohr's theory and its limitations, atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, Valence bond Theory and its limitations, Valence shell electron pair repulsion theory. MO theory, homonuclear (B_2, C_2, N_2 and O_2) and heteronuclear (CO and NO) diatomic molecules, percentage ionic character, radius ratio effect and coordination number, lattice energy and Born Haber cycle, polarizing power and polarisability of ions, Fajan's rule.	**11**
Unit 2	**Chemical Kinetics, Catalysis and Electrochemistry:**Rate of reaction, factors influencing the rate of reaction. Mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order and half-life. Theories of chemical kinetics: effect of temperature on rate of reaction, Arrhenius equation,	**10**

	collision theory, transition state theory. Catalysis & types of catalysis, Mechanism of catalysis, Enzyme catalysis. Specific and equivalent conductance, migration of ions and Kohlrausch law, SHE , reference electrodes, standard electrode potential, Nernst equation, electrochemical series and its significance. Electrolytic and Galvanic cells, conductometric and potentiometr	
Unit 3	**Fundamentals of Organic Chemistry and Stereochemistry**: Types of reagents, electrophiles and nucleophiles, inductive effect, resonance effect and hyperconjugation. Types of organic reactions. Reactive intermediates - carbocations, carbanions and free radicals. Optical Isomerism-Elements of symmetry, molecular chirality, enantiomers, optical activity, chiral and achiral molecules with two stereogeniccentres, diastereomers, resolution of enantiomers, inversion, retention. Sequence rules, D & L and R & S systems of nomenclature. Geometric Isomerism: cis-trans and E-Z nomenclature. Conformational isomerism: Conformational analysis of ethane and n-butane by the Newman projection	**10**
Unit 4	**Hydrocarbons** Preparation and reactions of alkanes, alkenes and alkynes. Special emphasis tocatalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (partial catalytic hydrogenation) and trans alkenes (Birch reduction), cis-addition to alkenes (alk. KMnO4)and trans-addition (bromine), Markownikoff's and anti-Markownikoff's rule. Acidity of alkynes, hydroboration-oxidation, metal-ammonia reduction, and polymerization of alkynes. Preparation and reactions of alkyl halides. Williamson's ether synthesis: Mechanisms of nucleophilic substitution SN^1 and SN^2 **Arenes and Aromaticity**: Structure of benzene:Kekule structure, resonance structure, MO picture. Aromaticity: Huckel's rule, Aromatic electrophilic substitution: Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts reaction.	**13**
Unit 5	**Ultraviolet and Infrared spectroscopy:** Electromagnetic radiation,Absorption laws (Beer Lambert Law), types of electronic transitions, Concept of chromophore and auxochrome. Types of shifts, Application of Woodward Rules for calculation of λ_{max} for conjugated dienes: homoannular and heteroannular, Extended conjugated systems.Molecular vibrations, fundamental bands, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds.	**8**

Text Books	
1	Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.
2	P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
3	P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.
4	P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
5	R L Madan, Physical Chemistry, McGraw Hill Education
Reference Books	
1	F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
2	Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3	Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed.

	2006, S. Chand & Co. Ltd.
4	Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).
5	F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
6	Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.

CH20.115 Chemistry Laboratory I 0-0-4-2

1. Purification of a given organic sample solid/liquid through crystallization.
2. Preparation of standard solutions of different Molarity/Normality of titrants.
3. Determination of the melting points of organic compounds
4. Determination of optical activity by using polarimeter
5. To determine the specific reaction rate of the hydrolysis of methyacetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
6. To determine the viscosity of a given liquid.
7. To determine the λ max of $KMnO_4$ solution using colorimeter.
8. To perform pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

ABILITY ENHANCEMENT COMPULSORY COURSE

EL20.109	**Foundation Course in English**	**2-0-0-2**
Objective:	Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.	
Unit 1	**Sentence Structure:** Elements of a sentence (Subject, verb, object, complement and adjunct) **Articles:** Definite and Indefinite & omission of articles	**5**
Unit 2	**Transformation of Sentence Structure:** Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	**5**
Unit 3	**Correct Usage of Language:** Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need) **Common Errors in Effective Communication:** How to avoid common sentence – structural errors, vocabulary and pronunciation	**6**
Unit 4	**Writing Skills:** Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing	**6**
Unit 5	**Reading Comprehension:** Efficient reading and note taking	**4**
Course Outcome: The student will be able to:		
1	Learn the essentials of English Grammar.	
2	Apply the rules of grammar to use flawless English in speech and writing.	
3	Analyze, identify and rectify the common errors in speech and writing.	
4	Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.	
5	Evaluate a piece of writing keeping in mind all the rules of grammar studied.	
6	Read and comprehend English	
Text Books:		
1	Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)	
2	Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.	
Reference Books:		
1	Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.	
2	Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.	
3	Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.	

4	Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

SECOND SEMESTER

FS20.102	CRIME SCENE INVESTIGATION	4-1-0-5
Objective:	To learn about various aspects of crime scene investigation	
Unit 1	**Crime Scene** Defining a crime scene, Importance, problem, location and processing of Crime Scene and Crime scene Management. Reasons for committing crime in India.	**10**
Unit 2	**Types of Crime Scenes** Types of crime scenes: Primary, Secondary, Indoor, Outdoor. Role of different agencies involved in crime scene management: Police, Medico legal experts, Judicial officers.	**15**
Unit 3	**Recording the Scene of Crime** Barricading of crime scene; Documenting crime scene: Crime scene photography and videography, Crime scene notes. Crime scene sketching: Indoor and outdoor, triangulation method, baseline method, polar coordinate method. Search: definition, objectives, search patterns – Strip method, grid method, zone/quadrant method, spiral method (Inward and outward), wheel method.	**18**
Unit 4	**Physical Evidences** Definition, types of physical evidences, Collection, packaging, preservation and forwarding of physical evidences, Chain of custody.	**12**
Unit 5	**Crime scene reconstruction** Crime scene reconstruction: Introduction, importance, nature and principles: recognition, identification, individualization and reconstruction, stages: data collection, conjecture, hypothesis formulation, testing, theory formation.	**10**
Course Outcome: After studying this paper the students will able to		
1	Explain nature and problems of crime scene.	
2	Categorize various types of crime scenes.	
3	Create crime scene field notes, sketches and photographs.	
4	Interpret various types of physical evidences found at a crime scene.	
5	Use procedures of crime scene reconstruction.	
6	Analyze scene of crime and evidences.	
Text Books		
1	Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.	
2	James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.	
Reference Books		
1	DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.	
2	W.J. Tilstone (2013), M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton.	
3	A Scientific Method Approach; Robert C. Shaler, CRC Press, 2012.	
4	Crime Reconstruction, W Jerrychisum and Brent and Turvy, Elsevier Academic Press, 2011.	
5	Pepper, I.K. (2010) Crime Scene Investigation: Methods and Procedures, 2nd Edition, Open University Press.	
6	DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.	

CRIME SCENE INVESTIGATION PRACTICAL

FS20.104 **0-0-4-2**

1. Securing the crime scene, clothing, and plan for crime scene management.
2. Demonstration of photography of scene of crime and evidences.
3. Searching and Listing of evidences at indoor crime scene. ‘
4. Searching and Listing of evidences at outdoor crime scene.
5. Sketching of Crime scene by triangulation method.
6. Sketching of Crime scene by baseline method.
7. Sketching of Crime scene by Polar coordinate method.
8. Evidence collection, preservation, packaging, sealing and labeling of physical evidences.
9. Evidence collection, preservation, packaging, sealing and labeling of biological evidences.
10. Demonstration of reconstruction of scene of crime.

FS20.106	**FORENSIC PSYCHOLOGY**	**4-1-0-5**
Objective:	To learn about various aspects of Forensic Psychology	
Unit 1	**Basics of Forensic Psychology** Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology and law. Ethical issues in forensic psychology. Assessment of mental competency. Mental disorders and forensic psychology.	**12**
Unit 2	**Psychology of evidence** Eyewitness testimony, confession evidence. Criminal profiling. Psychology in the courtroom, with special reference to Section 84 IPC.	**14**
Unit 3	**Psychology and Criminal Behavior** Psychopathology and personality disorder. Psychological assessment and its importance. Serial murderers. Psychology of terrorism. Biological factors and crime – social learning theories, psycho-social factors, abuse.	**11**
Unit 4	**Juvenile delinquency** Theories of offending (social cognition, moral reasoning), Child abuse (physical, sexual, emotional), juvenile sex offenders, legal controversies.	**11**
Unit 5	**Detection of Deception** Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis. Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test. Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues	**17**
Course Outcome: After studying this paper the students will		
1	Understand of forensic psychology and its applications.	
2	Interpret legal aspects of forensic psychology.	
3	Explain the significance of criminal profiling.	
4	Understand the importance of psychological assessment in gauging criminal behavior.	
5	Describe tools and techniques required for detection of deception.	
6	Assess advanced forensic techniques like polygraphy, narco analysis and brain electrical oscillation signatures	
Text Books		
1	A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, The Foundation Press, Inc., New York (1995).	
2	R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).	
Reference Books		
1	1. J.C. DeLadurantey and D.R. Sullivan, Criminal Investigation Standards, Harper & Row, New York (1980).	
2	2. J. Niehaus, Investigative Forensic Hypnosis, CRC Press, Boca Raton (1999).	

FORENSIC PSYCHOLOGY PRACTICAL

FS20.108 **0-0-4-2**

1. To cite a crime case where legal procedures pertaining to psychic behavior had to be invoked.
2. To prepare a report on relationship between mental disorders and forensic psychology.
3. To review a crime case involving serial murders. Comment on the psychological traits of the accused.
4. To cite a crime case involving a juvenile and argue for and against lowering the age for categorizing an individual as juvenile.
5. To study a criminal case in which hypnosis was used as a means to detect deception.
6. To prepare a case report on thematic appreciation test.
7. To prepare a case report on Minnesota multiphasic personality inventory test.
8. To prepare a case report on thematic appreciation test.
9. To prepare a case report on word association test.
10. To prepare a case report on Bhatia's battery of performance test of intelligence.
11. To cite a criminal case in which narco analysis was used as a means to detect deception.

GENERIC ELECTIVE COURSES

CH 20.114	**Chemistry II**	**4-0-0-4**
Objective:		
Unit 1	Periodic Properties, Coordination Compounds and Acid-Base Concept: Atomic and ionic radii, ionization energy, electron affinity and electronegativity. Properties of s, p, d and f block elements. Werner's coordination theory effective atomic number concept and isomerism in coordination compounds. Arrhenius, Bronsted-Lowry, and Lewis concepts of acids and bases.	**10**
Unit 2	Thermodynamics, Equilibrium and Photochemistry: Concept of heat, q, work, w, internal energy, U, and statement of first law, Second Law: Concept of entropy. Free energy change in a chemical reaction. Thermodynamic derivation of the law of mass action. Le Chatelier's principle. Strong, moderate and weak electrolytes, pH scale, common ion effect and Buffer solutions. Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Jablonski diagram, description of fluorescence, phosphorescence, photochemistry of carbonyl compounds, Norrish type-I and Norrish type II cleavage examples, quantum efficiency and quantum yield.	**12**
Unit 3	Functional groups (i) Alcohols: Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Reactions: With sodium, HX (Lucas test), esterification and oxidation. (ii) Phenols: Preparation: from Cumene hydroperoxide method and diazonium salts. Comparative acidic strength of alcohols and phenols, Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Mechanisms of Fries rearrangement, Claisen rearrangement and Reimer Tiemann reaction. (iii) Aldehydes and Ketones: Synthesis of aldehydes and ketones from acid chlorides and nitriles.Reactions: with HCN, $NaHSO_3$ and NH_2-G derivatives. Aldol Condensation, Cannizzaro's reaction, Clemensen reduction and Wolff Kishner reduction. (iv) Carboxylic acids and their derivatives: Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction. Carboxylic acid derivatives: Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids. Reactions: Comparative study of nucleophilicity of acyl derivatives.	**20**

	(v)Amines and Diazonium Salts: Amines: Preparation from Hofmann Bromamide reaction. Reactions: Carbylamine test, Hinsberg test, with HNO2. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol and dyes.	
Unit 4	^{1}HNMR Spectroscopy and Mass Spectrometry: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant, Interpretation of NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. Mass Spectrometry:Basic principle, Instrumentation, Ion production (EI and CI techniques), molecular ion peak, base peak, nitrogen rule, McLafferty rearrangement, modes of fragmentation, metastable peak.	**10**
Text Books		
1	Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.	
2	P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.	
3	P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.	
4	P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.	
5	R L Madan, Physical Chemistry, McGraw Hill Education	
Reference Books		
1	F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.	
2	Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.	
3	Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.	
4	Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).	

CH 20.116 **Chemistry Laboratory II** **0-0-4-2**

Section A: Physical Chemistry

1. Study of the solubility of benzoic acid in water and determination of H.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Inorganic Chemistry

4. Preparation of hexamminenickel(II)chloride
5. Preparation of Potassium tris-oxalatoferrate(III)
6. Preparation of potassium-chromium alum, $KCr(SO_4)2•12H_2O$
7. Preparation of coordination compound, $[Ni(NH_3)_6]I_2$

Section C: Organic Chemistry

8. Systematic Qualitative organic analyses of organic compounds possessing monofunctional groups (Alcohols, Phenols, Carbonyl, - COOH) and preparation of one suitable derivative.
9. Separation of a Two Component Mixture Using Extraction Techniques
10. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
    (a)Bromination of Phenol/Aniline
    (b)Benzoylation of amines/phenols
    (c)Oxime and 2,4 dinitrophenylhydrazone of aldehyde/ketone

ABILITY ENHANCEMENT COMPULSORY COURSE

CH20.114	Environmental Studies	4-0-0-4
Objective	To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.	
Unit 1	Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	**9**
Unit 2	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
Unit 3	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
Unit 4	Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
Unit 5	Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**
Unit 6	Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	**7**
Unit 7	Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	**6**
Unit 8	Field work: Visit to an area to document environmental assets;	**5**

	river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	
Course Outcome	After completion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.	
	Text Books: 1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt. 2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press. 3. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge. 4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press. 5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006. 6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37. 7. McCully, P.1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books. 8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century. **Reference Books:** 1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons. 2. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent. 3. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders. 4. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton. 5. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.	

THIRD SEMESTER

FS20.102	FORENSIC BIOLOGY	3-1-0-4
Objective:	To learn about various aspects of Forensic Biology	
Unit 1	**Biological Evidence** Nature and importance of biological evidence. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Comparison of hair samples. Morphology and biochemistry of human hair. Comparison of human and animal hair.	**10**
Unit 2	**Biological Evidence II** Types and identification of microbial organisms of forensic significance. Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.	**8**
Unit 3	**Wildlife Forensics** Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.	**12**
Unit 4	**Forensic Botany** Introduction to Forensic Botany, Plants as Evidence, Evidence Collection and analysis, Moss as evidence, forensic microscopy, Palynology, phytoforensics, algae in forensics investigations,	**10**
Unit 5	**Forensic Entomology** Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations	**10**
Course Outcome: After studying this paper the students will		
1	Explain the significance of biological and serological evidence.	
2	Explain the forensic importance of hair evidence.	
3	Explain the importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.	
4	Describe the role of wildlife forensics in conserving natural resources.	
5	Describe the role of forensic entomology in death investigations	
6	Explain the use of Forensic Botany in forensic investigations	
Text Books		
1	L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988).	
2	R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993).	
Reference Books		
1	S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971).	
2	R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993).	
3	G.T. Duncan and M.I. Tracey, Serology and DNA typing in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).	

FORENSIC BIOLOGY PRACTICALS

FS20.203 **0-0-4-2**

1. To examine hair morphology and determine the species to which the hair belongs.
2. To prepare slides of scale pattern of human hair.
3. To examine human hair for cortex and medulla.
4. To carry out microscopic examination of pollen grains.
5. To carry out microscopic examination of diatoms.
6. To cite a crime case in which diatoms have served as forensic evidence.
7. To prepare a case report on forensic entomology.
8. To prepare a case report on problems of wildlife forensics.

FS20.205	Forensic Anthropology and Personal Identification	4-1-0-5
Objective:	To learn about various aspects of Forensic Anthropology & Forensic Odontology	
Unit 1	**Significance of Forensic Anthropology** Definition, scope and application of Forensic Anthropology. Study of Human Skeleton. Nature, formation and identification of human bones. Estimation of age, race, sex and stature from skeletal material – skull, pelvis, long bones.	**13**
Unit 2	**Personal Identification-I** Importance and need for personal identification, cases that will require personal identification. Somatoscopy – observation of hair on head, forehead, eyes, root of nose, nasal bridge, nasal tip, lips, chin, Darwin's tubercle, ear lobes, supra-orbital ridges, physiognomic ear breadth, circumference of head, prognathism. Scar marks, occupational marks and tattoo marks. Human Body physique – classification: Viola, Sheldon, Heath-Carter. Genetic and congenital anomalies – causes, types, identification and their forensic significance.	**13**
Unit 3	**Personal Identification-II** Somatometry – measurements of head, face, nose, cheek, ear, hand and foot, body weight, height. Indices - cephalic index, nasal index, cranial index, upper facial index. Study of burned bones and bone fragments in mass disasters; Establishment of Partial and Complete identity of skeletal material and dead bodies.	**12**
Unit 4	**Facial Reconstruction** Facial superimposition techniques, Craniofacial superimposition techniques – photographic superimposition. Facial reconstruction and its importance. Importance of tissue depth in facial reconstruction. Use of somatoscopic and craniometric methods in reconstruction.	**13**
Unit 5	**Forensic Odontology** Development, scope and role of forensic odontology in mass disaster and anthropology. Introduction to human dentition, structure of teeth, Types and functions of teeth and their comparative anatomy. Estimation of age from teeth. Bite Marks: Types of bite marks; collection and preservation and photography of bite mark evidence, forensic importance of bite marks.	**14**
Course Outcome: After studying this paper the students will able to		
1	Explain the importance of Forensic Anthropology	
2	Assess the age, sex, race and stature of unknown individuals based on anthropological evidence	
3	Assess the identity of an unknown individual based on Somatoscopy	
4	Assess the identity of an unknown individual based on Somatometry	
5	Explain the facial reconstruction process for personal identification	

6	Explain the use of Odontology in forensic science
Text Books	
1	The Use of Forensic Anthropology by Robert B. Pickering, David Bachman, CRC Press (2009)
2	Human Body Measurement: Concepts and Applications by S. P. Singh, Promila Mehta; PHI Learning Pvt. Ltd. (2009)
Reference Books	
1	Fundamentals of Forensic Anthropology (Advances in Human Biology)-Wiley-Liss (2006) Linda L. Klepinger
2	Steven N. Byers, Introduction to Forensic Anthropology, Routledge, Taylor & Francis Group, [5th Edition] 2017
3	A textbook of Medical Jurisprudence and Toxicology by Dr. Jaising P. Modi; Lexis Nexis Butterworths (1957); 24th Edition (2012)
4	Max M. Houck and Jay A. Siegel, Fundamentals of Forensic Science [3rd Edition], Academic Press, Oxford, 2015
5	Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000
6	James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003
7	Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001
8	Richard Saferstein; Forensic Science Hand Book; Ed.; Prentice – Hall, Englewood Cliff, New jersey; (1982)

FORENSIC ANTHROPOLOGY PRACTICALS

FS20.207 **0-0-4-2**

1. To determine of age from skull and teeth.
2. To determine of sex from skull.
3. To determine sex from pelvis.
4. To study identification and description of bones and their measurements.
5. To investigate the differences between animal and human bones.
6. To perform somatometric measurements on living subjects.
7. To carry out craniometric measurements of human skull.
8. To estimate stature from long bone length.

GENERIC ELECTIVE COURSES

BS20.201	**Molecular Biology**	**4-0-0-4**
Objective:		
Unit 1	**DNA structure and replication:** DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-priming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.	**15**
Unit 2	**DNA damage, repair and homologous recombination:** DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.	**10**
Unit 3	**Transcription and RNA processing:** RNA structure and types of RNA,Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA:5'cap formation,	**15**

	polyadenylation, splicing, rRNA and tRNA splicing.	
Unit 4	**Regulation of gene expression and translation:** Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Fidelity of translation, Inhibitors of translation.	**10**
Unit 5	Post translational modifications of proteins.	**2**
Text Books		
1	Karp,G.(2010).Cell and Molecular Biology: Concepts and Experiments.VI Edition. John Wiley & Sons. Inc.	
2	De Robertis, E.D.P.and De Robertis, E.M.F.(2006). Cell and Molecular	
Reference Books		
1	Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.	
2	Becker,W.M.,Kleinsmith, L.J., Hardin .J.and Bertoni,G.P. (2009).The World of the Cell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.	
3	Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R.,(2008) Molecular Biology of the Gene (VI Edition.).Cold Spring Harbour Lab. Press, Pearson Pub.	

BS20.203 Molecular Biology Laboratory 4-0-0-2

1. Preparation of solutions for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA.
5. Preparation of restriction enzyme digests of DNA samples.
6. Demonstration of AMES test or reverse mutation for carcinogenicity

FOURTH SEMESTER

FS20.202	Forensic Toxicology	4-1-0-5
Objective:	To learn about various aspects of Forensic Toxicology	
Unit 1	**Toxicology and Drugs of Abuse** Definition, dosage, administration of poisons, Classification of poisons on analytical basis and medical basis; Sedatives, Narcotics, Stimulants and Hallucinogens, Drug Addiction and its signs and symptoms, Drug Toxicity; Drugs and Crime; NDPS Act, 1985; The role of drug recognition expert, Interpreting drug findings	**13**
Unit 2	**Toxicology of Alcohol** Introduction to Forensic Pharmacology, Pharmacodynamics and Pharmacokinetics; Fate of ethyl alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, analysis of blood for alcohol	**13**
Unit 3	**Metallic Poisons, Barbiturates and Corrosive Poisons** Arsenic, Mercury: Nature, administration, symptoms, postmortem findings, Detection and medicolegal aspects; Barbiturates: Classification, administration, symptoms, postmortem findings, detection and medico-legal aspects; Corrosive poisons: Acids- HCl, H_2SO_4, HNO_3 and Alkalis- NaOH, KOH	**13**
Unit 4	**Insecticides, Volatile Poisons** Organophosphorous compounds, Organochloro Compounds and Carbamates: Nature, administration, symptoms, post-mortem findings, isolation, detection, estimation and medico-legal findings; Volatile Poisons: Methyl alcohol, Chloroform. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings	**13**
Unit 5	**Miscellaneous Poisons** Animal poisons: Snake; Vegetable Poisons: Opium, Cannabis, Dhatura, Oleander, Abrus precatrious, etc. Nature, administration, symptoms, post-mortem findings, isolation, detection and estimation, medico-legal findings	**13**
Course Outcome:		
1	Explain the effects of various types of drugs on human body	
2	Describe the toxicology of ethyl alcohol and its detection	
3	Describe the toxicology of metallic poisons, barbiturates and corrosive poisons	
4	Describe the toxicology of various categories of insecticides and volatile poisons	
5	Describe the toxicology of animal and plant poisons	
6	Analyze the cases of poisoning on the basis of laboratory, clinical and postmortem findings	
Text Books		
1	A Textbook of Modern Toxicology 4th ed. - Ernest Hodgson Wiley [2010]	
2	Textbook of Forensic Medicine and Toxicology, P C Dikshit, Peepee publishers and distributors (P) Ltd. [2010]	
Reference Books		
1	Clarke's Analytical Forensic Toxicology – Edited by Sue Jickells and Adam Negrusz; Pharmaceutical Press [2008]	
2	PRINCIPLES OF TOXICOLOGY Environmental and Industrial Applications, 2nd ed., Edited by Phillip L. Williams, Robert C. James and Stephen M. Roberts; Wiley [2000]	
3	Benjamin, D. M., Forensic Pharmacology. In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentic-Hall, Englewood Cliffs, New Jersey, 1993	
4	Caplan, Y. H., The Determination of Alcohol in Blood and Breath, In Forensic Science Handbook (vol – 3), Saferstein, R. (Ed.), Prentice Hall, Englewood Cliffs, New Jersey, 1982	
5	Karch, S. B., The Pathology of Drug Abuse. (2nd Edn.) CRC Press, Boca Raton, Florida, 1996	

FORENSIC TOXICOLOGY PRACTICAL

FS20.204 **0-0-4-2**

1. Analysis of metallic poisons
2. Analysis of volatile and non-volatile poisons
3. TLC of insecticides, Barbiturates and other drugs
4. Analysis of vegetable poisons
5. TLC of different kinds of inks
6. Lab Tests for Hallucinogens

FS20.206	**FINGERPRINT SCIENCE**	**4-1-0-5**
Objective:	To learn about various aspects of Fingerprinting	
Unit 1	**History and Introduction** Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation.	**10**
Unit 2	**Class and Individual Characteristics** Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints.	**12**
Unit 3	**Classification of Fingerprints** Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC	**15**
Unit 4	**Fingerprint Developmental techniques** Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.	**15**
Unit 5	**Other Impressions** Importance of footprints. Casting of foot prints, Electrostatic lifting of latent foot prints. Palm prints. Lip prints - Nature, location, collection and examination of lip prints. Ear prints and their significance.	**13**
Course Outcome: At the completion of the course, student will be able to		
1	Learn origin and history of fingerprint	
2	Understand the principles of fingerprinting and significance in criminal investigation	
3	Learn and identify types of fingerprints and fingerprints characteristics and Learn classification of fingerprints	
4	Learn to Collect, lift and preserve fingerprints and Comprehend various physical and chemical fingerprint development techniques	
5	Learn photography of fingerprints and presentation of fingerprints in court	
6	Learn history and development and understand working of AFIS and understand functioning of various biometric systems	
Text Books		
1	Nath, S., Fingerprint Identification, CRC Press, 2nd edition, 2002.	
2	Champhod, C., Fingerprint and other ridge skin impressions, CRC Press, 2004.	
Reference Books		
1	James, S. H. and Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigation Techniques, CRC Press, London, 2003.	
2	Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998	
3	Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.	

FINGERPRINT SCIENCE PRACTICALS

FS20.208 **0-0-4-2**

1. To record plain and rolled fingerprints.
2. To carry out ten digit classification of fingerprints.
3. To identify different fingerprint patterns.
4. To identify core and delta.
5. To carry out ridge tracing and ridge counting. 6. To investigate physical methods of fingerprint detection.
6. To investigate chemical methods of fingerprint detection.
7. To use different light sources for enhancing developed fingerprints.
8. To prepare cast of foot prints

GENERIC ELECTIVE COURSES

BS20.202	**Mammalian Physiology**	**3-0-0-3**
Objective:		
Unit 1	**Digestion and Respiration:** Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice.	**05**
Unit 2	**Respiration**: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.	**04**
Unit 3	**Circulation:** Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heartbeat.	**10**
Unit 4	**Muscle physiology and osmoregulation:** Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.	**10**
Unit 5	**Nervous and endocrine coordination:** Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, salutatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands–Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.	**10**
Text Books		
1	Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd./W.B. Saunders Company.	
2	Tortora, G.J. & Grabowski,S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons, Inc.	
Reference Books		
1		
2		

BS20.204 **Mammalian Physiology Laboratory** **0-0-4-2**

1. Finding the coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.
4. Determination of TLC and DLC.
5. Demonstration of action of an enzyme.
6. Determination of Haemoglobin.

FIFTH SEMESTER

FS20.301	DNA PROFILING	4-1-0-5
Objective:	To learn about various aspects of DNA profiling	
Unit 1	**Basic Principles** DNA as biological blueprint of life. Extraction of DNA for analysis. Quantitation of DNA – yield gel quantitation and slot blot quantitation. Mitochondrial DNA – sequence analysis.	**12**
Unit 2	**Forensic DNA Typing-I** Collection of specimens. Polymerase chain reaction – historical perspective, sequence polymorphisms, individualization of evidence. Short tandem repeats (STR) – role of fluorescent dyes, nature of STR loci.	**14**
Unit 3	**Forensic DNA Typing-II** Restriction fragment length polymorphism (RFLP) – genetic markers used in RFLP, typing procedure and interpretation of results. Touch DNA.	**12**
Unit 4	**Parentage Testing** Principles of heredity. Genetics of paternity. DNA testing in disputed paternity. Mandelian laws of parentage testing. Mathematical basis of parentage identification. Missing body cases. Reference populations and databases.	**14**
Unit 5	**Report Writing in DNA profiling cases** Role of DNA typing in identifying unrecognizable bodies. Allele frequency determination. Hardy-Weinberg law. Probability determination in a population database.	**13**

Course Outcome:	
1	Understand the DNA fingerprint, and related macro molecules
2	Extract DNA from various biological samples
3	Understand principles and working of various DNA fingerprinting steps
4	Learn various techniques of DNA fingerprinting
5	Apply techniques of DNA fingerprinting to paternity testing and personal identification
6	Learn various aspects of DNA fingerprinting
Text Books	
1	Norah Rudin and Keith Inman (2nd Edition) An Introduction to Forensic DNA Analysis, CRC Press, New York, 2002
2	John M. Butler (1st Edition) Fundamentals of Forensic DNA Typing, Academic Press, 2005.
Reference Books	
1	Sharma, B. R. (3rd Edition) Forensic Science in Criminal Investigation and Trials, Universal Law Publishing Co. Ltd. New Delhi, 2001

DNA PROFILING LAB

FS20.303 **0-0-4-2**

1. To carry out the separation of amino acids by thin layer chromatography.
2. To carry out extraction of DNA from body fluids.
3. To preparation of gel plates for electrophoresis.
4. To carry out electrophoresis for separation of enzymes.
5. To prepare a report on the role of DNA typing in solving paternity disputes.

FS20.305	FORENSIC MEDICINE	3-1-0-4
Objective:	To learn about various aspects of Forensic medicine	
Unit 1	**Death Investigations** Fundamental aspects and scope of forensic medicine. Approaching the crime scene of death. Obtaining firsthand information from the caller. Rendering medical assistance to the victim, if alive. Protecting life. Recording dying declaration. Identifying witnesses and, if possible, suspect. Interviewing onlookers and segregating possible witnesses.	**12**
Unit 2	Suspect in custody – initial interrogation and searching for evidence. Miranda warning card. Assessing the crime scene. Request for forensic team. Importance of command post and log book. Management of crowd and media. Importance of taking notes. Items to be a part of noting. Documenting the death scene. Processing evidence. Evaluation of injuries. Importance of canvass form. Indexing the death investigation.	**10**
Unit 3	Handling buried body cases – search for buried bodies, methods of exhumation. Suicide cases – evaluating the type of injuries, gauging the psychological state of victim, suicide notes.	**8**
Unit 4	**Autopsy** Forensic pathology. Medico-legal aspects of death. Causes of death. Determination of time since death. Investigation of sexual offences. Death by drowning. Injuries..	**10**
Unit 5	**Injuries** Types and classification of injuries. Antemortem and post mortem injuries. Aging of injuries. Artificial injuries.	**10**
Course Outcome: After studying this paper the students will		
1	Understand the duties of the first responding officer in homicide or suicide cases.	
2	Categorize the steps involved in processing the death scene.	
3	Explain the importance of ascertaining whether the crime was staged to appear as suicide or accident.	
4	Explain the importance of bloodstain patterns in reconstructing the crime scene.	
5	Describe the importance of autopsy	
6	Describe the importance of forensic odontology	
Text Books		
1	K. Smyth, The Cause of Death, Van Nostrand and Company, New York (1982).	
2	M. Bernstein, Forensic odontology in, Introduction to Forensic Sciences, 2nd Ed., W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).	
Reference Books		
1	J. Dix, Handbook for Death Scene Investigations, CRC Press, Boca Raton (1999).	
2	H.B. Baldwin and C.P. May in, Encyclopedia in Forensic Science, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).	

FORENSIC MEDICINE PRACTICAL

FS20.307 **0-0-4-2**

1. To design a questionnaire for the first responder to the death scene.
2. To design a protocol to deal with the media at the crime scene.
3. To design a checklist for the forensic scientists at the death scene.
4. To design a canvass form giving description of an unidentified victim.
5. To analyze and preserve bite marks.

RM20.301	Introduction to Research Methodology	2-0-0-2
Objective:		
Unit 1	Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
Unit 2	Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
Unit 3	Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
Unit 4	Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation -Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
Unit 5	Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Text Books		
1	Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.	
2	Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India	
Reference Books		
1	Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India	Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
2	Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India	Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India

Discipline Specific Elective Course

FS20.309	Digital Forensics	3-1-0-4
Objective:	To learn various aspects of digital forensic investigations	
Unit 1	Fundamentals and Concepts Fundamentals of computers, Hardware and accessories – development of hard disk, physical construction, CHS and LBA addressing, encoding methods and formats. Memory and processor. Methods of storing data. Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating system. Introduction to network, network architecture, LAN, WAN and MAN.	**10**
Unit 2	Computer Crimes Introduction to Digital Forensics, Definition and types of computer crimes. Distinction between computer crimes and conventional crimes. Reasons for commission of computer crimes. Breaching security and operation of digital systems. Computer virus, and computer worm – Trojan horse, trap door, super zapping, logic bombs. Types of computer crimes – computer stalking, pornography, hacking, crimes related to intellectual property rights, computer terrorism, hate speech, private and national security in cyber space. An overview of hacking, spamming, phishing and stalking.	**10**
Unit 3	Computer Forensics Investigations Process of computer forensics and digital investigations, Seizure of suspected computer. Preparation required prior to seizure. Protocol to be taken at the scene. Extraction of information from the hard disk. Treatment of exhibits. Creating bitstream of the original media. Collection and seizure of magnetic media. Electronic media, handling, collection, search and storage. Legal and privacy issues. Examining forensically sterile media. Restoration of deleted files. Password cracking and E-mail tracking. Encryption and decryption methods. Tracking users.	**11**
Unit 4	Analysis of electronic media Processing of various types digital evidence such as digital images, audio, video, text, system artifacts. Data acquisition and authentication process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.	**11**
Unit 5	Digital Forensic Tools Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Intrusion Detection Systems, Encase and FTK tools, Anti Forensics and probable counters, retrieving information	**10**
Course Outcome:		
1	Understand the basics of computer and associated terminologies	
2	Classify computer crimes	
3	Summarize the process of Computer/Digital Forensic investigation	
4	Utilize the data acquisition, data encryption, data authentication, data recovery and data mining processes	
5	Understand the working of various hardware and software based Digital Forensic tools	
6	Analyze the electronic media using Digital Forensic tools	
Text Books		
1	Digital Forensics with Open Source tools, Cory Altheide, Harlan Carvey, Syngress 2011	
2	Computer Crime and Computer Forensics, Dr. R K Tewari, P K Sastry, K V Ravikumar, SSB 2002	
Reference Books		
1	Computer Forensics and Investigations, Nelson, Phillips Enfinger, Steuart, IE 2009	
2	Cert-In Guidelines	
3	Fred Cohen, Digital Forensic Evidence Examination, 5th Edition 2013	
4	The Basics of Digital Forensics: Primer of getting started in Digital Forensics, Syngress 2nd Ed. 2015	

5	R.K. Tiwari, P.K. Sastry and K.V. Ravikumar, Computer Crimes and Computer Forensics, Select Publishers, New Delhi (2003)
6	C.B. Leshin, Internet Investigations in Criminal Justice, Prentice Hall, New Jersey (1997)
7	E. Casey, Digital Evidence and Computer Crime, Academic Press, London (2000)

Digital Forensics Practical

FS20.311 **0-0-4-2**

1. To identify, seize and preserve digital evidence from crime scenes.
2. To detect deletions, obliterations and modifications of files using encase software.
3. To trace routes followed by e-mails and chats.
4. To identify the IP address of the sender of e-mails.
5. To demonstrate concealment techniques using cryptographic PGP.
6. To identify encrypted files.
7. To identify hidden files.
8. To use digital signatures for securing e-mail and online transactions.
9. To acquire data from PCs/laptops/HDDs/USBs, pen drives, memory cards and SIM cards.
10. To use symmetric and asymmetric keys for protection of digital record.
11. To carry out imaging of hard disks.

FS20.313	**Forensic Photography, Digital Imaging and Portrait Parley**	**3-1-0-4**
Objective:	To learn various aspects of photography and the application of photographic techniques at crime scenes and legal contexts	
Unit 1	**Basics of Photography** Photography: Basic principles and techniques Analogue photography: cameras, light and lenses, filters, shutter, depth of field, dynamic range, exposure, films, developing films and photo-printing, Different kinds of developers and fixtures, linkage of cameras and film negatives.	**11**
Unit 2	**Digital Photography** Digital cameras, Digital image fundamentals - digital Image through scanner and digital camera, Concept of gray levels, Gray level to binary image conversion. Sensors-CCD and CMOS, storage and media, pixels and resolution, monitors, printers and scanners, digital imaging, file formats and compression, digital watermarking, linkage of digital cameras/digital images and sensor noise.	**11**
Unit 3	**Advanced Photography Techniques** Crime scene photography: Still photography and Videography/ high speed videography of various crime scenes Laboratory photography and evidence documentation, Macrophotography, Aerial and Underwater photography, Surveillance photography, Photomicrography, Photogrammetry, Legal aspects of visual evidence.	**10**
Unit 4	**Digital Image Processing** Sampling and quantization, Interpolation, Histogram Equalization, Imaging Geometry, Image Transform, Image enhancement, Point processing, Histogram processing, Spatial filtering, Morphological processing, Image Segmentation, Edge detection	**11**
Unit 5	**Portrait Parley** Composite Imagery: Graphic images composed of individually described characteristics of the human face; Image Modification/Identification: Methods of manipulation, enhancement and comparison; Side-by-Side comparison, Demonstrative Evidence: Visual information used for court purposes; Reconstructive/Postmortem Drawings: Methods of identifying human remains in various conditions of decomposition	**9**

Course Outcome:	
1	Explain photography, various photographic techniques, film processing and photo-printing
2	Discuss digital photography, digital watermarking, digital imaging and videography
3	Determine important steps in crime scene, laboratory photography and other specialized techniques
4	Explain various steps of digital image processing
5	Infer the use of Portrait Parle in investigation
6	Explain demonstrative evidence and facial reconstruction techniques
Text Books	
1	The Practical Methodology of Forensic Photography 2nd Ed, David R. Redsicker, CRC Press [2001]
2	Russ, John C - Forensic Uses of Digital Imaging, Second Edition-CRC Press (2016)
Reference Books	
1	Understanding Forensic Digital Imaging. Herbert Blitzer, Karën Stein-Ferguson, Jeffrey Huang; Academic Press (2008)
2	Gonzales & Woods "Digital Image Processing" (3rd Addition) 2011
3	Henry Horeustein, Colour Photography A Working Manual; Little Brow Company, Boston; (1995)
4	B.H.E. Jacobson, Sidney Ray GG Attridge, The Manual of Photograph Focal Press, London; (1998)
5	Jahne B; Digital Image Processing; Heidelberg Springer (1996)
6	Workinson, J; Art of Digital Video; Oxford Focal Press (1994)

DIGITAL IMAGING LAB

FS20.315 **0-0-4-2**

1. Simulated crime scene photography using digital camera
2. Digital photography of macroscopic and microscopic exhibits
3. Digitizing Image using scanner and digital camera
4. Scaling image using Image processing software
5. Filtering an image using Image processing software
6. Image Normalization using image processing software
7. Image Enhancement using image processing software
8. To conduct portrait parley using software

SIXTH SEMESTER

FS20.302	INSTRUMENTATION IN FORENSIC SCIENCE	3-1-0-4
Objective:	To strengthen concepts in the basic principles and working mechanism of various instruments used in forensic analysis of exhibits and enable them to appreciate the significance of basic physical and biochemical phenomena underlying the instrumentation.	
Unit 1	**General Physical Concepts** Interaction between matter and radiation – absorption and emission. Electromagnetic radiation, wavelength and frequency. Principles and application of fluorescence, mass, density, gradient analysis, refractive index in Forensic Science.	**5**
Unit 2	**Spectroscopy** Spectroscopic methods. Fundamental principles and forensic applications of Ultraviolet-visible spectroscopy, infrared spectroscopy, atomic absorption spectroscopy, atomic emission spectroscopy and mass spectroscopy. X-ray spectrometry. Colorimetric analysis and Lambert-Beer law.	**15**
Unit 3	**Centrifugation Techniques** Centrifugation: Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges.	**10**
Unit 4	**Microscopy** Fundamental principles. Different types of microscopes: Simple and Compound microscope, Comparison microscope, Phase contrast microscope, Stereoscopic microscope, Polarizing microscope, Fluorescent Microscopy, Electron microscope. Forensic applications of microscopy.	**10**
Unit 5	**Chromatography** Sample preparation for chromatographic and spectroscopic evidence. Chromatographic methods. Fundamental principles and forensic applications of thin layer chromatography, gas chromatography and liquid chromatography.	**12**
Course Outcome:		
1	Describe the concepts of matter and radiation, various principles and application used in Forensic science.	
2	Explain various types of Spectroscopic methods.	
3	Classify different types of centrifugation.	
4	Explain the fundamental principles, working and an application of different types of microscopes.	
5	Explain the chromatographic methods and its Forensic applications.	
6	Examine the various type of samples by using different instrumental techniques.	
Text Books		
1	H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986).	
2	Skoog, Holler and Crouch; "Principles of Instrumental Analysis", 7th Edition, 2017.	
Reference Books		
1.	Chapmen J R; Practical Organic Mass Spectrometry - A Guide for Chemical and Biochemical Analysis, Wiley & Sons, NY (1993).	
2.	Mendham et al., Vogel's Quantitative Chemical Analysis, Pearson Education Ltd., 2009.	
3.	N. Gray, Instrumental Methods of Analysis, 1st Edition, CBS Publisher, 2011.	
4.	G.R Chatwal & S.K Anand;" Instrumental Methods of Chemical Analysis", Himalaya Publ. House, 2004.	
5.	V.B Patania; "Spectroscopy", Campus Books International, 2004.	
6.	R.S Khandpur; "Handbook of Analytical Instruments", Tata Mac Graw Hill Publ. Co., 2004.	

INSTRUMENTATION PRACTICAL

FS20.304 **0-0-4-2**

1. To determine the concentration of a colored compound by colorimetry analysis.
2. To carry out thin layer chromatography of ink samples.
3. To carry out separation of organic compounds by paper chromatography.
4. To carry out Qualitative Analysis using UV-Visible Spectrometer

5. To carry out Quantitative Analysis using UV-Visible Spectrometer

FS20.306	Questioned Document Examination	3-1-0-4
Objective:	To learn various aspects of questioned document examination	
Unit 1	**Introduction to Questioned Documents** Documents and Questioned documents: various types, Forgery and its types, characteristic features of genuine handwriting/ signatures, characteristic components of forged documents and their examination, Procedure adopted for collection of standards for comparison of documents, admittedly genuine documents/signature/writing, contemporaneous documents/ signature/writing, specimen signature/writings.	**9**
Unit 2	**Principle of Handwriting Identification** Introduction of Handwriting, Physiology of Handwriting, Handwriting characteristics: Class and individual characteristics, Natural variations in handwriting, causes of variations, Disguised writings, features of disguised writings and its examination, Principle of handwriting identification, Tampered Documents: addition, alteration, erasure, obliteration, interlineation, page substitution, secret writing. Examination of the documents for the ink, paper, photocopies/Xerox, printouts and scanned documents. Automated Signature Verification System.	**11**
Unit 3	**Various Questioned Documents Cases** Disputed documents - wills, deeds, cheques, suicide letters, anonymous letters, threatening letters, stamps fraud, counterfeit currencies, fake paintings and printing, ATM and Credit card frauds, fake rubber stamps and seals, Tampered documents, charred documents, torn documents, Computer generated/ electronic documents/ typed and photocopied documents.	**10**
Unit 4	**Forensic Examination of Documents** Examination of security documents. Examination of Printed Matter, Examination of built-up documents, Determination of sequence of strokes, Identification of typist: Use of Forensic Stylistics, Examination of other mechanical impressions, Examination of paper, inks, writing instruments and various other components of documents.	**11**
Unit 5	**Instrumentation in Questioned Documents** Document photography using Camera, Color filters, Various light sources based on: Angle of incidence (Transmitted light, Oblique light etc) and Wavelength (UV and IR radiations etc), Apparatus for specialized photographic techniques; magnifying glasses, illuminated torch, measuring equipment, geometrical requirements, Compound microscope, Stereo microscope, Video Spectral Comparator, Docu-centre, Projectina, ESDA, Paper Chromatography, Thin Layer Chromatography.	**11**
Course Outcome:		
1	Compare handwriting exemplars	
2	Explain history and terminologies related to Questioned Document Examination, physiology of handwriting and the process of identification	
3	Explain the working and characteristics of machines used to produce documents	
4	Describe forgery and signature verification	
5	Examine various aspects of documents including specific components such as printing, seals, inks et cetera for legal purposes	
6	Apply photography and instrumentation in Questioned Document Examination	
Text Books		
1	Huber, A. R. Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London	
2	Kelly, J. S. Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group	
Reference Books		

1	Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998
2	Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997
3	Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982
4	Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971
5	Koppenhaver, K. M. (2007). Forensic Document Examination. In Humana Press
6	Ron N. Morris, Forensic Handwriting Identification: Fundamental Concepts and Principles, Academic Press, 1st ed. (2000)
7	David Ellen Scientific Examination of Documents, Second edition Taylor & Francis Forensic Science Series
8	Forensic Linguistics - Advances in Forensic Stylistics - G. McMenamin (CRC, 2002)

QUESTIONED DOCUMENT EXAMINATION PRACTICAL

FS20.308 **0-0-4-2**

1. Analysis of Class and Individual Characteristics of Handwriting
2. Comparison of Handwriting exemplars
3. Author Identification
4. Signature Verification
5. Detection of Free Hand Forgery
6. Detection of forgery by simulation
7. Detection of forgery by tracing
8. Ink Identification
9. Paper fiber analysis
10. Examination and photography of security features in Indian Rupee Note of any denomination
11. Examination and photography of security features in Indian Passport
12. Determination of sequence of strokes
13. Identification of inkjet printing on a document from laser printing/photocopy

FS20.310	**Forensic Ballistics**	**3-1-04**
Objective:	To learn about various aspects of Forensic Ballistics	
Unit 1	**Firearms** History and development of firearms. Classification of firearms. Weapon types and their operation. Firing mechanisms of different firearms. Internal ballistics – Definition, ignition of propellants, shape and size of propellants, manner of burning, and various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting.	**13**
Unit 2	**External Ballistics** Vacuum trajectory, effect of air resistance on trajectory, base drag, drop, drift, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistic data.	**12**
Unit 3	**Terminal Ballistics** Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, tumbling of bullets, effect of instability of bullet, effect of intermediate targets, and influence of range. Ricochet and its effects, stopping power	**12**
Unit 4	**Ammunition** Types of ammunition. Constructional features and characteristics of different	**14**

	types of cartridges and bullets. Primers and priming compounds. Projectiles. Head stamp markings on ammunitions. Different types of marks produced during firing process on cartridge – firing pin marks, breech face marks, chamber marks, extractor and ejector marks.	
Unit 5	**Firearm Evidence** Matching of bullets and cartridge cases in regular firearms. Identification of bullets, pellets and wads fired from improvised, country made firearms. Automated method of bullet and cartridge case comparison. Determination of range of fire and time of fire. Mechanisms of formation of gunshot residues. Methods of analysis of gunshot residues from shooting hands and targets, with special reference to clothing. Identification and nature of firearms injuries. Reconstruction with respect to accident, suicide, murder and self-defense.	**14**
Course Outcome:		
1	Develop understanding of components and working of firearms	
2	Analyze fired ammunition for firearm linkage	
3	Learn and analyze appearance of gunshot wound	
4	Comprehend reconstruction of crime scene	
5	Develop understanding of analysis of firearm injuries	
6	Learn and analyze tool marks and its comparison techniques ,Understand techniques of impression evidences examination and interpretation	
Text Books		
1	B.J. Heard, Handbook of Firearms and Ballistics, Wiley and Sons, Chichester (1997).	
2	W.F. Rowe, Firearms identification, Forensic Science Handbook, Vol. 2, R. Saferstein (Ed.), Prentice Hall, New Jersey (1988).	
Reference Books		
1	A.J. Schwoeble and D.L. Exline, Current Methods in Forensic Gunshot Residue Analysis, CRC Press, Boca Raton (2000).	
2	E. Elaad in Encyclopedia of Forensic Science, Volume 2, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).	

DISCIPLINE SPECIFIC ELECTIVE COURSE

FS20.312	**ACCIDENT INVESTIGATIONS**	**2-1-0-3**
Objective:	To learn about various aspects of accident investigation	
Unit 1	**Motor Vehicle Accidents I** Accident scene. Sources of forensic information. Eyewitness accounts. Extent of vehicle damage. Visibility conditions.	**8**
Unit 2	**Motor Vehicle Accidents II** Photography of accident site. Estimation of speed. Tire marks, skid marks, scuff marks. Maintenance of vehicles. Abandoned vehicles. Importance of air bags. Railway accidents.	**6**
Unit 3	**Accident Analysis I** Pre-crash movement. Post-crash movement. Collision model. Gauging driver's reaction. Occupants' kinematics.	**8**
Unit 4	**Accident Analysis II** Types of injuries resulting from accident. Biomechanics of injuries. Hit and run investigations. Trace evidence at accident sites	**9**
Unit 5	**Tachographs** Forensic significance of tachograph data. Tachograph charts. Principles of chart analysis. Accuracy of speed record. Tire slip effects. Falsification and diagnostic signals. Route tracing	**8**
Course Outcome:		
1	Develop understanding of motor vehicle accidents investigation	
2	Learn documentation of vehicle accident scene	
3	Analyze accident scene	

4	Analyze injuries in accident victims
5	Understand Tachographs and its forensic significance
6	Analyze Tachographs
Text Books	
1	T.S. Ferry, Modern Accident Investigation and Analysis, Wiley, New York (1988).
2	D. Lowe, The Tachograph, 2nd Edition, Kogan Page, London (1989).
Reference Books	
1	T.L. Bohan and A.C. Damask, Forensic Accident Investigation: Motor Vehicles, Michie Butterworth, Charlottesville (1995).
2	S.C. Batterman and S.D. Batterman in Encyclopedia of Forensic Sciences, Volume 1, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).

FS20.314	**FORENSIC SEROLOGY**	**2-1-0-3**
Objective:	To study various aspects of serological evidence and its forensic analysis	
Unit 1	**Forensic Importance of Body fluids I** Common body fluids. Composition and functions of blood. Collection and preservation of blood evidence. Distinction between human and non-human blood. Determination of blood groups. Antigens and antibodies. Forensic characterization of bloodstains.	**8**
Unit 2	**Forensic Importance of Body fluids II** Typing of dried stains. Blood enzymes and proteins. Semen. Forensic significance of semen. Composition, functions and morphology of spermatozoa. Collection, evaluation and tests for identification of semen. Individualization on the basis of semen examination. Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications.	**6**
Unit 3	**Genetic Marker Analysis** Cellular antigens. ABO blood groups. Extracellular proteins and intracellular enzymes. Significance of genetic marker typing data. Sexual assault investigations.	**8**
Unit 4	**Bloodstain Pattern Analysis I** Bloodstain characteristics. Impact bloodstain patterns. Cast-off bloodstain patterns. Projected bloodstain patterns. Contact bloodstain patterns. Blood trails. Bloodstain drying times.	**9**
Unit 5	**Bloodstain Pattern Analysis II** Documentation of bloodstain pattern evidence. Crime scene reconstruction with the aid of bloodstain pattern analysis.	**8**
Course Outcome:		
1	Explain the significance of serological evidence.	
2	Explain the importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.	
3	Understand the usefulness of genetic markers in forensic investigations.	
4	Understand functions of genetic markers	
5	Describe forensic importance of bloodstain patterns	
6	Learn recording of blood stain pattern analysis	
Text Books		
1	W.G. Eckert and S.H. James, Interpretation of Bloodstain Evidence at Crime Scenes, CRC Press, Boca Raton (1989).	
2	G.T. Duncan and M.I. Tracey in Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).	
Reference Books		
1	R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).	
2	T. Bevel and R.M. Gardner, Bloodstain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).	

FORENSIC SEROLOGY PRACTICAL

FS20.316 **0-0-4-2**

1. To determine blood group from fresh blood samples.
2. To determine blood group from dried blood sample.
3. To carry out the crystal test on a blood sample.
4. To identify blood samples by chemical tests.
5. To identify the given stain as saliva.
6. To identify the given stain as urine.
7. To carry out cross-over electrophoresis.
8. To study the correlation between impact angle and shape of bloodstain.
9. To identify the point of convergence from the bloodstain patterns.

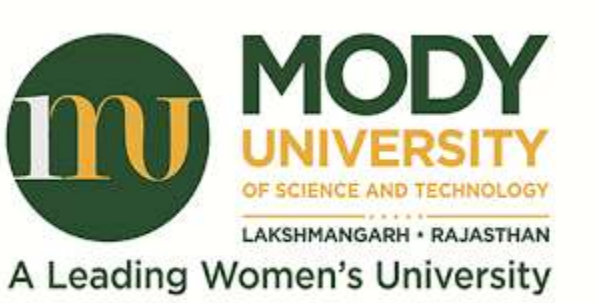
SUMMER INTERNSHIP

FS20.318 **Credits: 4**

Each student will be given a short term lab attachment during the summer vacation after completing two years of the course. They are supposed to submit a project report based on the lab visit they conduct. The same shall be evaluated out of a maximum marks of 100 and the student may be evaluated on Content, Presentation and Viva.

The presentation should preferably be performed in front of a panel.

School of Liberal Arts and Sciences



B.Sc.(Physics,Chemistry,Mathematics)

Curricular Structure
Academic Session :2020-21 onwards

BSc (Physics, Chemistry, Mathematics)
Academic Session (2020-21 onwards)

Programme	**Level:**	**No. of Seats:**30	**Duration: Three Years (Six Semesters)**

Undergraduate

Programme Educational Objectives:

- Acquaint the student with the functional and structural basis of the areas under physics, chemistry and Mathematics
- Develop critical, analytical and problem solving skills by applying the principles of Chemistry, Physics and Mathematics.
- Apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics, Chemistry and Mathematics.

Programme Outcome:

The student should be able to

- Acquire
  - (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics like Astrophysics, Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics, Analytical dynamics, Space science, and its linkages with related disciplinary areas / subjects like Chemistry, Mathematics, Life sciences, Environmental sciences, Atmospheric Physics, Computer science, Information Technology;
  - (ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;
  - (iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.
- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data / information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

- Demonstrate relevant generic skills and global competencies such as
  - (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;
  - (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems; communication skills involving the ability to listen carefully, to read texts and research
  - (iii) papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
  - (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translate them with popular language when needed;
  - (v) ICT skills;
  - (vi) personal skills such as the ability to work both independently and in a group.
- Demonstrate professional behavior such as
  - (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
  - (ii) the ability to identify the potential ethical issues in work-related situations;
  - (iii) appreciation of intellectual property, environmental and sustainability issues;
  - (iv) promoting safe learning and working environment.

Scope:

This course forms the basis of science and comprises of subjects like physics, chemistry, and mathematics .There are various options available for the students, they can go for master degree in Sciences , go in a research area and can even look for professional job oriented courses.

Input Qualification:

A pass in 10+2 examination from CBSE, or its equivalent from any recognized Board, in Science stream with mathematic with adequate proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed.

Credit Summary:

Year	Semester	DSC			DSE			AECC	SEC	Total
		P	C	M	P	C	M			
First	Autumn	6	6	6	-	-	-	2	3	23
	Spring	6	6	6	-	-	-	4	3	25
Second	Autumn	6	6	6	-	-	-	--	6	24
	Spring	6	6	6	-	-	-	--	6	24

Third	Autumn	-	-	-	6	6	6	--	--	21
	Spring	-	-	-	6	6	6	--	--	21
	Total	**24**	**24**	**24**	**12**	**12**	**12**	**6**	**12**	**138**

BSc (Physics, Chemistry,Mathematics)
Academic Session (2020-21 onwards)

Year: First

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**CoreCourses**									
	MS20.101	Differential and Integral Calculus	5	1	-	6	3	25	25	50
	PH20.103	Mechanics	4	-	-	4	3	25	25	50
	CH20.101	Inorganic Chemistry-I	2	-	-	2	3	25	25	50
	CH20.103	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH20.111	Inorganic and Organic chemistry Laboratory -I	-	-	2	1	3	25	25	50
	PH20.105	Physics Laboratory I	-	-	4	2	4	25	25	50
	Ability Enhancement Compulsory Course									
	EL20.109	Foundation Course in English	2	-	-	2	3	25	25	50
	Skill Enhancement Course									
		Foreign Language-I	3	-	-	3	2	25	25	50
		Sub Total				**23**				
	SF 101	Personal Grooming, Fine Dining				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	MS20.102	Group Theory	5	1	–	6	3	25	25	50
	PH20.102	Electricity and Magnetism	4	-	-	4	3	25	25	50
	CH20.102	Inorganic Chemistry-II	2			2	3	25	25	50
	CH20.104	Physical Chemistry-I	3			3	3	25	25	50
	CH20.112	Inorganic and Physical Chemistry Laboratory-I			2	1	3	25	25	50
	PH20.106	Physics Laboratory II			4	2	4	25	25	50

	Ability Enhancement Compulsory Course									
	CH20.102	Environmental studies	4	-	-	4	3	25	25	50
	Skill Enhancement Course									
		Foreign Language-II	3	-	-	3	2	25	25	50
		Sub Total				**25**				
	SF 102	Social Grooming, Home & Decor and Business Communication				1				

Year: Second

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	MS20.201	Differential Equations	5	1	–	6	3	25	25	50
	PH20.209	Thermal Physics and Statistical Mechanics	4	-		4	3	25	25	50
	CH20.201	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH20.203	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH20.211	Organic and Physical Chemistry-I	-	-	2	1	3	25	25	50
	PH20.207	Physics Laboratory III	-	-	4	2	4	25	25	50
	Skill Enhancement Course									
		Foreign Language-III	3	-	-	3	2	25	25	50
		Mody University Elective-I	3	-	-	3	3	20	-	80
		Sub Total				**24**				
	SF 201	Personal Grooming, Fine Dining and Home Safety				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	MS20.202	Real Analysis	5	1	-	6	3	25	25	50
	PH20.204	Wave and Optics	4	-	-	4	3	25	25	50
	CH20.202	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH20.204	Organic Chemistry-III	3	-	-	3	3	25	25	50
	CH20.212	Inorganic and Organic chemistry Laboratory –II	-	-	2	1	3			
	PH20.208	Physics Laboratory IV	-	-	4	2	4	25	25	50
	Skill Enhancement Course									
		Foreign Language-IV	3	-	-	3	2	25	25	50
		Mody University Elective-II	3	-	-	3	3	20	-	80
		Sub Total				**24**				
	SF 202	Social Grooming and Professional Skills				1				

Year: Third

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Discipline Specific Elective Course**									
		DSE-1	3	–	–	3	3	25	25	50
		DSE-2	3	–	–	3	3	25	25	50
	PH20.301	Quantum Mechanics and Applications*	4	-	-	4	3	25	25	50
	CH20.301	Inorganic Chemistry-IV	3			3	3	25	25	50
	CH20.303	Physical Chemistry –III	2			2	3	25	25	50
	CH20.311	Inorganic and Physical chemistry Laboratory –II			2	1	4	25	25	50
	PH20.305	Physics Laboratory V*			4	2	4	25	25	50
	Skill Enhancement Course									
		Foreign Language-V	3	-	-	3	2	25	25	50
		Sub Total				**21**				
	GE301	Proficiency				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	Discipline Specific Elective Course									
		DSE-5	3	-	-	3	3	25	25	50
		DSE-6	3	-	-	3	3	25	25	50
	CH20.302	Organic Chemistry-IV	3			3	3	25	25	50
	CH20.304	Physical Chemistry –IV	2			2	3	25	25	50
	CH20.312	Organic and Physical chemistry Laboratory –II			2	1	3	25	25	50
	PH20.302	Solid State Physics*	4	-	-	4	3	25	25	50
	PH20.306	Physics Laboratory VI*	-	-	4	2	4	25	25	50
	Skill Enhancement Course									
		Foreign Language-VI	3	-	-	3	2	25	25	50
		Sub Total				**21**				
	GE 302	Proficiency				1				

Discipline Specific Electives(DSE)	
Choices for DSE-1 (choose one) **1.** MS20.305 Elementary Probability and Statistics **2.** MS20.307 Basics of Combinatorics	Choices for DSE-2 (choose one) **1.** MS20.309 Linear Programming **2.** MS20.311 Analytical Geometry
Choices for DSE-5 (choose one) **1.**MS20.306 Elementary Graph Theory **2.**MS20.308 Basics of Dynamics and Mechanics	Choices for DSE-6 (choose one) **1.** MS20.310 Basics of Vector Calculus **2.** MS20.312 Advance Linear Programming
Remarks: Discipline Specific Elective Courses Choice shall be allotted at the time of registration by the Department of Mathematics on the basis of availability of expertise.	

Physics Courses

PH20.103 **Mechanics** **4-0-0-4**

Course Objective: The objective of the course is to enhance the understanding of the basics of mechanics with the review of Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations.

Course Outcome: *The student will be able to:*

- *CO1:* Describe relative motion, Inertial and non-inertial reference frames.
- *CO2:* Articulate and describe parameters defining the motion of mechanical systems
- *CO3:* Study of the interaction of forces between solids in mechanical systems.
- *CO4:* Articulate and describe centre of mass of mechanical systems.
- *CO5:* Articulate and describe laws of motion and conservation principles.

Unit I	**Fundamentals of Dynamics:** Reference frames, Inertial frames, Galilean transformations, Galilean invariance, Review of Newton's Laws of Motion. Momentum of variable mass system: motion of rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D). **Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable, unstable and neutral equilibrium. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. **Collisions:** Elastic (1-D and 2-D) and inelastic collisions. Centre of Mass and Laboratory frames.	**12**
Unit II	**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia, theorem of parallel and perpendicular axes. Determination of moment of inertia of discrete and continuous objects [1-D, 2-D & 3-D (rectangular, cylindrical and spherical)]. Kinetic energy of rotation. Motion involving both translation and rotation.	**10**
Unit III	**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. **Motion of a particle under a central force field:** Two-body problem, its reduction to one-body problem and its solution. Reduction of angular momentum, kinetic energy and total energy. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit, Geosynchronous orbits.	**10**
Unit IV	**Oscillations:** Idea of SHM. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Compound pendulum. Damped oscillation. Forced oscillations: Transient and steady states, sharpness of resonance and Quality Factor. **Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.	**10**
Unit V	**Special Theory of Relativity:** Outcomes of Michelson-Morley Experiment. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity, Length contraction, Time dilation. Relativistic transformation of velocity, acceleration, frequency and wave number. Mass of relativistic particle. Mass-less Particles. Mass-energy Equivalence. Relativistic Doppler effect (transverse and longitudinal). Relativistic Kinematics (decay problems, inelastic collisions and Compton effect). Transformation of Energy and Momentum.	**10**

Text Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Reference Books:

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education

PH20.105: Objective of the course is to acquaint the students with the Experiments based on PH20.103. So majority of experiments should be based on this course.

PH20.102 Electricity and Magnetism 4-0-0-4

Course Objective: *The objective of the course is to expose the student to electrostatics and magnetostatics including Boundary value problems, the principles of electromagnetic induction. The student will be able to appreciate Maxwell's equations and analyze electrical circuits using network theorems.*

Course Outcome: *The student will be able to:*

- *CO1: Understand the relationship between electrical charge, electrical field, electrical potential, and magnetism.*
- *CO2: Calculate the magnitude and direction of the magnetic field for symmetric current distributions using the Law of Biot-Savart and Ampere's Law.*
- *CO3: Understand the various network theorems.*
- *CO4: Define the magnetic field and magnetic flux, solve technical problems.*
- *CO5: Understand the Maxwell's equation and its application in confinement and propagation of EMW.*

Unit I	**Electric Field and Electric Potential** Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force andTorque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.	**15**
Unit II	**Magnetic Field:** Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop.Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid.Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.	**10**
Unit III	**Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.	**10**
Unit IV	**Electrical Circuits**: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.	**7**
Unit V	**Maxwell Equations:** Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.	**10**

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Feynman Lectures Vol.2, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
4. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
5. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata McGraw

PH20.106: Objective of the course is to acquaint the students with the Experiments based on PH20.102. So majority of experiments should be based on this course.

PH20.209 **Thermal Physics and Statistical Mechanics** **4-0-0-4**

Course Objective: *The objective of this course is to understand basics of thermodynamic laws and entropy and Maxwell's thermodynamic equations using thermodynamic potentials and to understand the basics of statistical laws and Planck's quantum theory*

Course Outcome: *The student will be able to*

- *CO1: Define thermodynamic laws and various terminologies efficiently.*
- *CO2: Understand second law of thermodynamics with Carnot's cycle and entropy.*
- *CO3: Apply Maxwell equations for different problems.*
- *CO4: Illustrate basics of Statistical mechanics and postulate.*
- *CO5: Acquaint with Planck's explanation of Blackbody radiation*

Unit I	**Zeroth and First Law of Thermodynamics:** Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.	**10**
Unit II	**Second Law of Thermodynamics:** Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot‟s Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot‟s Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **Entropy:** Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.	**20**
Unit III	**Thermodynamic Potentials:** Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb‟s Free Energy. Their Definitions **Maxwell's Thermodynamic Relations**: Derivation of Maxwell‟s thermodynamic Relations and their applications, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Value of Cp-Cv, (3) Tds Equations, (4) Energy equations.	**6**
Unit IV	**Foundation of Statistical Mechanics:** Microstate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law,Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox	**8**
Unit V	**Blackbody Radiation**: Spectral Distribution of Black Body Radiation. Failure of classical statistics, Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3)Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.	**8**

Text Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Fundamentals of Statistical and Thermal Physics, Frederick Reif, 2009, Waveland Press

Reference Books:

1. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
2. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
3. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger,1988, Narosa.
4. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press

PH20.207: Objective of the course is to acquaint the students with the Experiments based on PH20.209. So majority of experiments should be based on this course.

PH20.204 **Wave and Optics** **4-0-0-4**

Course Objective: *The objective of the course is to acquaint the student with ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.*

Course Outcome: *The student will be able to:*

CO1: *Understand Simple harmonic oscillation and superposition principle.*
CO2: *Understand different types of waves and their velocities: Plane, Spherical, Transverse, Longitudinal.*
CO3: *Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.*
CO4: *Understand Interference as superposition of waves from coherent sources derived from same parent source.*
CO5: *Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand Fraunhoffer and Fresnel Diffraction.*

Unit I	**Superposition of Collinear Harmonic oscillations**: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses..	**10**
Unit II	**Wave Motion:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves **Velocity of Waves:** Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.	**10**
Unit III	**Superposition of Two Harmonic Waves**: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves	**10**
Unit IV	**Wave Optics:** Electromagnetic nature of light. Definition and properties of wave front.Huygens Principle. Temporal and Spatial Coherence. **Interference:** Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	**11**
Unit V	**Diffraction:** Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit. **Fraunhofer diffraction**: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **Fresnel Diffraction**: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.	**11**

Text Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Optics, AjoyGhatak, 2008, Tata McGraw Hill

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
4. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

PH20.208: Objective of the course is to acquaint the students with the Experiments based on PH20.204. So majority of experiments should be based on this course.

PH20.301 Quantum Mechanics and Applications 4-0-0-4

Course Objective: *After learning the elements of modern physics, in this course students would be exposed to more advanced concepts in quantum physics and their applications to problems of the sub atomic world.*

Course Outcome: *The Student will be able to learn*

- *CO1: Methods to solve time-dependent and time-independent Schrodinger equation.*
- *CO2: Quantum mechanics of simple harmonic oscillator.*
- *CO3: Non-relativistic hydrogen atom: spectrum and eigenfunctions.*
- *CO4: Angular momentum: Orbital angular momentum and spin angular momentum.*
- *CO5: Bosons and fermions - symmetric and anti-symmetric wave functions. Application to atomic systems*

Unit I	**Time dependent Schrodinger equation**: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions;Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **Time independent Schrodinger equation**-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.	**15**
Unit II	**General discussion of bound states in an arbitrary potential**- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.	**10**
Unit III	**Quantum theory of hydrogen-like atoms**: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.	**10**
Unit IV	**Atoms in Electric & Magnetic Fields**: Electron angular momentum. Spacequantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **Atoms in External Magnetic Fields**:- Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).	**10**
Unit V	**Many electron atoms**: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms- L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).	**7**

Text Books:

1. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India
2. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education

. **Reference Books**

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.
5. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.

PH20.305: Objective of the course is to acquaint the students with the Experiments based on PH20.301. So majority of experiments should be based on this course.

PH20.302 Solid State Physics 4-0-0-4

Course Objective: *The objective of the course is to acquaint the student with the introduction to the basic concepts and principles to understand the various properties exhibited by condensed matter, especially solids. The syllabus is specifically designed to guide the students to learn how to create a theoretical model for a particular property and appreciate the beauty that lies in these solids through their properties.*

Course Outcome: *The Student will be able to*

- *CO1: Understand structures in solids and their determination using XRD.*
- *CO2: Understand behavior of electrons in solids including the concept of energy bands.*
- *CO3: Understand Magnetic and dielectric properties of solids.*
- *CO4: Practice problem solving by using selected problems in solid state physics.*
- *CO5: Understand superconductivity basics.*

Unit I	**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.	**10**
Unit II	**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T3 law .	**8**
Unit III	**Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom.Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes. **Ferroelectric Properties of Materials:** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.	**14**
Unit IV	**Elementary band theory:** Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.	**10**
Unit V	**Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation)	**10**

Text Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India

Reference Books:

1. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
2. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
3. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
4. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
5. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

PH20.306: Objective of the course is to acquaint the students with the Experiments based on PH20.302. So majority of experiments should be based on this course.

PH20.105 Physics Laboratory I

1 To determine the moment of inertia of a flywheel about its own axis of rotation.
2 To determine the value of modulus of rigidity of a given wire by Maxwell needle.
2 To determine the value of Poisson's ratio for the material of given wire using Searl's method.
4 To determine the Young's modulus of material of a rectangular bar by bending.
5 To determine the viscosity of glycerin by Stoke's Law.
6 To convert a galvanometer into voltmeter of given range.
7 To determine the specific resistance of a given wire by using the Carey Foster's bridge.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

Proposed List of Experiments for Physics #

PH20.106 Physics Laboratory II

1 To plot graph showing the variation of magnetic field with distance along the axis of a circular coil carrying current and to estimate the radius of the coil.
2 To study the Faraday Law by determination of induced emf as a function of velocity of the magnet through a coil.
2 To determine the ballistic constant using the ballistic galvanometer.
4 To determine the Mutual Inductance using ballistic galvanometer.
5 To convert a galvanometer into an ammeter of a given range.
6 To determine the resolving power of a telescope.
7 To plot V-I Characteristics of PN Junction/ Zener Diode and find cut-in Voltage, static and dynamic resistances in both forward and reverse biased conditions.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

PH20.207 Physics Laboratory III

1 To determine the specific heat capacity of copper.

2 To determine the temperature coefficient of resistance of copper wire.

2 To measure the thermal relaxation time constant of a serial light bulb.

4 To determine the Stefan's law using a bulb.

5 To determine the capacitance of ceramic capacitor.

6 To determine the high resistance by the method of leakage of a condenser with the help of ballistic galvanometer.

7 To verify that impedance of a capacitance c varies as $Z_c = {}^{1}/_{2\pi fc}$ and to measure the value of the capacitance.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

PH20.208 Physics Laboratory IV

1 To determine the dispersive power of the material of a prism for violet and yellow colours of mercury light with the help of a spectrometer.

2 To determine the wavelength of sodium light with the help of Fresnel's bi-prism.

2 To determine the wavelength of sodium light with the help of Newton's ring experiment.

4 To determine the wavelength of the prominent lines of Mercury by plane diffraction grating.

5 To study the resonance in Series/ Parallel LCR circuits and determine its Q factor

6 To measure the period of oscillation of pendulum by changing the angle using the vibrational g pendulum.

7 To determine the specific rotation of a solution of cane sugar using Polarimeter.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

PH20.305 Physics Laboratory V

1 To study of material constant, temperature coefficient of current and Planck's constant.

2 To study the variation of resistivity with temperature and hence determines the energy band gap of the given semiconductor with help of four probe method.

2 To study the Photodiode, LED and LDR (Opto Electronics Device) characteristics.

4 To study the Photo Transistor and Opto-coupler characteristics.

5 To determine unknown Capacitance using De Sauty's bridge.

6 To show that the impedance of a coil of resistance R_L and self inductance L varies with frequency as $Z_{coil} = (R_L^2 + 4\pi^2 f^2 L^2)^{1/2}$ and to measure the self inductance.

7 To study the Basic logic gates (AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR) and verify the truth tables. Draw the equivalent circuit and verify the following theorems:
Single Variable Theorems, Multivariable Theorem, Demorgan's Theorem-I and II.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

PH20.306 Physics Laboratory VI

1 To determine the dielectric constant of a non polar liquid.

2 To study the B-H curve of hysteresis loop.

2 To determine the Hall coefficient for a given sample.

4 Draw the input and output characteristics of a PNP/ NPN transistor in common Base (CB) configuration.

5 To study the Full wave/ Bridge rectifiers.

6 To study the characteristics of JFET.

7 To study elliptically polarized light by means of a photoelectric cell.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

*Additional DSC of Physics may be opted in V and VI Semesters**

PH20.313 **Classical Dynamics*** **5-1-0-6**

Course Objective: *The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of*

problems, seen and unseen.

Unit I	**Classical Mechanics of Point Particles:** Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as coupled oscillators. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Poisson brackets. Canonical transformations.	**22**
Unit II	**Special Theory of Relativity:** Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energy-momentum relation.	**9**
Unit III	**Applications:** Doppler effect from a four- vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of **E** and **B**. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields.	**9**
Unit IV	**Relativistic kinematics:** Application to two-body decay of an unstable particle. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of **E** and **B**. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields	**15**
Unit V	**Electromagnetic radiation:** Review of retarded potentials. Potentials due to a moving charge: Lienard Wiechert potentials. Electric & Magnetic fields due to a moving charge: Power radiated, Larmor's formula and its relativistic generalisation.	**10**

Text Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon

Reference Books:

1. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley.
2. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
3. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
4. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press.

PH20.314 **Bio-Physics*** **5-1-0-6**

Course Objective: *The emphasis of the course is to make students familiar with interdisciplinary discipline and connect them towards biological aspects of*

Physics.

Unit I	**Building Blocks & Structure of Living State:** Atoms and ions, molecules essential for life, what is life. **Living state interactions:** Forces and molecular bonds, electric & thermal interactions, electric dipoles, casimir interactions, domains of physics in biology.	**15**
Unit II	**Heat Transfer in biomaterials:** Heat Transfer Mechanism, The Heat equation, Joule heating of tissue. **Living State Thermodynamics:** Thermodynamic equilibrium, fIrst law of thermodynamics and conservation of energy. Entropy and second law of thermodynamics, Physics of many particle systems, Two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein folding and unfolding.	**16**
Unit III	**Open systems and chemical thermodynamics:** Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin.	**9**
Unit IV	**Diffusion and transport** Maxwell-Boltzmann statistics, Fick's law of diffusion, sedimentation of Cell Cultures, diffusion in a centrifuge, diffusion in an electric field, Lateral diffusion in membranes, Navier stokes equation, low Reynold's Number Transport, Active and passive membrane transport.	**9**
Unit V	**Open systems and chemical thermodynamics:** Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin.	**16**

Text Books:

1. Introductory Biophysics, J. Claycomb, JQP Tran, Jones & Bartelett Publishers

Reference Books:

1. Aspects of Biophysics, Hughe S W, John Willy and Sons.
2. Essentials of Biophysics by P Narayanan, New Age International

EV20.102	***Environmental Studies***	**4-0-0-4**
Objective	To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.	
Unit1	Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept	**9**

	of sustainability and sustainable development.	
Unit2	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
Unit3	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification.Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation.Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
Unit 4	Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
Unit 5	Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**
Unit 6	Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	**7**
Unit 7	Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	**6**
Unit 8	Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	**5**
Course Outcome	Aftercompletion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.	

Suggested Readings

Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams(pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Refence Books:

1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
2. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
3. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
4. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
5. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
6. www.nacwc.nic.in 22.www.opcw.org

Mathematics Courses

MS20.101 Differential and Integral Calculus 5-1-0-6

Objective: To acquire fundamental knowledge of differential calculus and integral calculus and apply

in sciences and applied sciences.

1.	Differential Calculus I:Functions, Types of functions, Limits and continuity($\epsilon - \delta$ definition),Types of discontinuities, Higher order derivatives, Indeterminate forms,L-Hospital's rule, Leibniz rule , Points of extreme, Concavity and inflection points, Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series, Jacobeans, interdisciplinary applications.	**13**
2.	Differential Calculus II :Parallel and oblique asymptotes in Cartesian and Polar coordinates, Intersection of a curve with its asymptotes, application of differentiation in curve sketching/tracing in cartesian and polar coordinates, Tangent and normal-Introduction, Equation of tangent and normal, Angle of intersection of two curves, Suntangent and subnormal, Polarsubtangent and subnormal, Pedalequation; Curvature and Evolutes-Introduction, Center and radius of curvature in Cartesian and polar forms, Pedalcurve, Tangential polar formula, Chord of curvature, Evolutes and involutes, Newtonian method.	**13**
3.	Integral Calculus I: Review as a limiting sum of areas and the anti-derivative/ indefinite integral, the fundamental theorem of Calculus, Reduction formulae and its derivation and illustration for the type $\int \sin^n(x)dx$, $\int \cos^n(x)dx$, $\int \tan^n(x)dx$, $\int \sin^n(x)\cos^n(x)dx$, $\int sinnxdx$, $\int cosnxdx$, $\int tannxdx$, $\int secnxdx$, $\int (logx)^n dx$ etc.	**13**
4.	Integral Calculus II: Computing volumes by slicing, disk and washer method, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, area of surface of revolution Surface areas and volumes using Pappus-Guldinus theorems(with proof) and solid of revolution.	**13**
5.	Conic Section and Vector Functions: Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminate, polar equation of conics, Triple product, introduction, operations of vector functions, limit, continuity, differentiation and integration of vector functions, tangent and normal form of acceleration, modeling ballistics and planetary motion, Kepler's second law with interdisciplinary applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential calculus and integral calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson.
2. Dennis G. Zill and Warren S. Wright (2011), Single Variable Calculus, 4/e, Jones and Bartlett Learning.

Reference Books:

1. Mittal P.K. (2016), Mathematics for Degree Students, S.Chand and Company Pvt. Ltd.
2. Ramana B.V (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Jain and Iyengar (2004) Advanced Engineering Mathematics, Narosa Publishing House.
4. Mendelson (2016), Schaum's outline of Beginning Calculus, McGraw Hill Education.

MS20.102 **Group Theory** **5-1-0-6**

Objective: To acquire fundamental knowledge of group theory and apply in sciences and applied sciences.

1.	Preliminaries: Sets, Subsets, Relations, Equivalence classes, Functions, Equality and composition of mappings,Binarycompositions,Permutations,Cyclicpermutations,Cycles of a permutation, Disjoint permutations, Some results from number theory(Euclid's theorem and Basis representation theorem),The greatest common divisor, Prime numbers, Congruences, Chinese reminder theorem, proof of all properties and applications.	**13**
2.	Group-I: Algebraic Structure, Symmetries of a square, Dihedral groups, Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups, Order of an element of a group, proof of all properties and applications.	**13**
3.	Group-II: Subgroups and examples of subgroups, Theorems on subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups with theorems related to centralizer, normalizer, and center of a group, proof of all properties and applications.	**13**
4.	Cyclic Group and Cosets-I: Properties of cyclic groups, Classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, Even and odd permutations, proof of all properties and applications.	**13**
5.	Cyclic Group and Cosets-II: Alternating group, Definition and properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, proof of all properties and applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of group theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vashistha A.R.andVashisthaA.K (2015), Modern Algebra, Krishna Educational Publisher.
2. John B. Fraleigh (2014), A First Course In Abstract Algebra, Seventh Edition, Pearson.

Reference Books:

1. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.
2. Khanna and Bhambri(2016), A Course in Abstract Algebra, Fifth Edition, Vikas Publishing House Pvt. Ltd.
3. Michael Artin (2015), Algebra, Second Edition, Pearson.
4. Herstein I.N. (2006), Topics in Algebra, Second Edition, John Wiley and Sons.

MS20.201 Differential Equations **5-1-0-6**

Objective: To acquire fundamental knowledge of differential equations and apply in sciences and applied sciences.

1.	First Order Differential Equations-I: Basic concepts of differential equations, Definition, Order and degree of differential equation, general, particular, explicit, implicit and singular solution of differential equation, standard form, equations in which variables are separable, homogeneous and reducible to homogeneous differential equations, linear and reducible to linear (Bernoulli) differential equations, exact and reducible to exact differential equations, different methods of finding integrating factor of equation, equations of first order but not of the first degree, equations solvable for p, y and x , Clairaut's and Lagrange's equations.	**13**
2.	First Order Differential Equations-II: Existence and uniqueness theorm for first –order differential equations, Lipschitz condition and examples, Gronwall's inequality, continuous dependence and initial conditions, Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting. Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.	**13**
3.	Second and Higher Order Differential Equations: Linear differential equations with constant and variable coefficients (Euler Cauchy equation), different forms of complimentary functions and particular integrals, equations reducible to homogeneous liner form, change of independent variables, normal form and method of variation of parameters with proofs of all results.	**13**
4.	Differential Equation of other Types: Introduction, Equation of the type $\frac{d^n y}{dx^n} = f(x)$, Equation of the type $\frac{d^n y}{dx^n} = f(y)$, Equations which do not contain y directly, Equations which do not contain x directly,Equations whose solution is known, Normal form(removable of first derivative),Method of solving linear differential equations by changing the independent variable,Method of variation of parameters, Method of undetermined coefficients.	**13**
5.	Power Series Solution: Introduction, Review of power series, Ordinary and singular points of a differential equation, Power series solution about an ordinary point, Frobenius method series solution about a regular singular point.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential equations in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Sundarapandian (2012), Ordinary and Partial differential Equations, McGraw Hill Education.

2. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations, 18th Edition, S. Chand Limited.

Reference Books:

1. Nagle, Saff and Snider (2016), Fundamental of Differential Equations, 8th Edition, Pearson.
2. Simmons (2016), Differential Equations with Applications and Historical Notes, McGraw Hill Education.
3. Ramana B.V. (2007), Higher Engineering Mathematics, 2nd Edition, McGraw-Hill Publishing Company Limited, New Delhi.
4. Dennis G. Zill and Michael R Cullen (2009) , Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.

MS20.202 **Real Analysis** **5-1-0-6**

Objective: To acquire fundamental knowledge of real analysis and apply in sciences and applied sciences.

1.	The Real Numbers: Introduction, The set N of natural numbers, The set Z of Iintegers, The set Q of rational numbers, The set of real numbers R as a complete ordered field, Closed, open,semi-closed and semi-open intervals, Set bounded above, set bounded below, supremum and infimum of a set, the greatest and smallest members of a set, bounded and unbounded sets,Order-completeness of the set of real numbers,Equivalent description of the order-completeness, property of the set of real numbers,Explicit statement of the properties of the set of real numbers as a complete ordered field,Some important properties of the set of real numbers,The denseness property, the modulus, Principal of mathematical induction,Bernoulli's inequality.	**13**
2.	Neighborhoods and Limit Points: Introduction and properties of nbd, Limit points of a set and its properties, Properties of closed and open sets, properties of interior, exterior,andboundary points , properties of a closure of a set,Dense and perfect sets, compactsets, Countability of sets.	**13**
3.	Sequences: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.	**13**
4.	Infinite Series with Positive Terms: Infinite series, its convergence and sum,A necessary condition for the convergence of an infinite series, Cauchy's general principle of convergence of series, General test for the convergence of positive term series, convergence of geometric series and generalized harmonic series, Comparison tests for the convergence of positive term series, Comparison tests of first type, Practical comparision tests of the first type, Comparision tests of the second type: D'Alembert's ration test, Cauchy's nth root test, Rabbe's Test, Logarithmictest, DeMorgan's and Bertrand's test, Second logarithmic test, Kummer'stest, Gauss'stest, Cauchy's integral test, Cauchy's condensation test, auxiliary series.	**13**
5.	Infinite Series with Positive and Negative Terms: Introduction, Absolute convergence and conditional convergence, Cauchy principle of convergence for a series, Dirichlet'stheorem, Abel's theorem, Re-arrangements of series, Re-arrangements of a	**13**

conditional convergent series, Sauchy product of two infinite series.

Course Outcome: After completion of the course, students would be able to apply the knowledge of real analysis in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Gerald G. Bilodeau, Thie P. R., and Keough G.E. (2010), An Introduction to Analysis, 2nd Ed., Jones & Bartlett.
2. Malik S.C. and Arora S.(2010), Mathematical Analysis, 4th Edition New Age International Ltd.

Reference Books:

1. Royden H.L.(2017), Real Analysis, 2nd Edition, PHI.
2. Charles G. Denlinger (2014), Elements of Real Analysis, Jones and Bartlett Learning.
3. Apostle (1997), Mathematical Analysis, 2nd Edition, Narosa Publishing House.
4. Bartle R.G. and Sherbert D. R. (2002), Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.

MS20.305 Elementary Probability and Statistics 3-0-0-3

Objective: To acquire fundamental knowledge elementary probability and statisticsand apply in sciences and applied sciences.

1.	Basic Statistics: Mean, mode, median for grouped and ungrouped data, variance, standard deviation, dispersion and measures of dispersion, skewness and measures of skewness, moments proof of all properties and illustrations..	**07**
2.	Probability Theory: Recapitulation of basic probability theory, law of addition and law of multiplication, conditional probability, total probability, Bayes' theorem, proof of all properties and illustrations.	**08**
3.	Random Variables and Distribution-I: Discrete and continuous random variables, types of distribution, probability mass and density functions, mean variance and standard deviation of distribution, discrete distributions (binomial and Poisson), proof of all properties and applications.	**08**
4.	Random Variables and Distribution-II: Continuous distributions-Normal distribution, Uniform distribution and Exponential distribution, proof of all properties and illustrations.	**08**
5.	Hypothesis and Correlation-Regression: Simple and composite hypothesis, type I and type II errors, tests of significance, simple correlations, linear regression.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of elementary probability and statisticsin sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Elements of Probability and Statistics by A.P. Baisnab and Manoranjan Jas, TMH 2003.
2. Fundamental of Mathematical Statistics by Gupta and Kapoor, SCS Publisher, 2002.

3. Introduction to Probability and Statistics by J. Susan Milton and Jesse C. Arnold, Fourth Edition, McGraw Hill Education, 2016.

Reference Books:

1. Probability, Random Variables and Stochastic Processes by Papoulis, TMH.
2. Probability and Statistics (Schaum's outline Series) by Spiegel, TMH.
3. Mathematical Statistics with Applications by Miller and Freund's, 7th Edition, Pearson.

MS20.307 **Basics of Combinatorics** **3-0-0-3**

Objective: To acquire fundamental knowledge basics of Combinatorics and apply in sciences and applied sciences.

1.	**Relation and Function-I:**Definition, different forms, properties and operations on sets, principle of inclusion and exclusion, partition of a set, definition of relation, types of relation, composition, properties and graphical representation of relation, equivalence classes, Proof of all properties and illustrations.	**08**
2.	**Relation and Function-II:** Closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice and different forms, properties ,definition of function and different forms, composition and properties of functions, recursively defined functions, Proof of all properties and illustrations.	**08**
3.	**Induction:** Mathematical induction, strong induction and well-ordering, definition of recursive, structural induction, Proof of all properties and illustrations.	**08**
4.	**Counting:** Basics of counting, Pigeonhole principle,Generalized pigeonhole principle, Proof of all properties and illustrations.	**07**

5. **Counting:** Permutations and combinations, Binomial coefficients, Generalized permutations and combinations, Proof of all properties and illustrations. **08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of basics of Combinatoricsin sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory by Kenneth H. Rosen, Seventh Edition, TMH Education.
2. Discrete Mathematical Structure by Kolman, Busby and Ross, 6th Edition, PHI Learning.
3. Foundations of Discrete Mathematics by K.D. Joshi, New Age International Reprint 2002.

Reference Books:

1. Discrete Mathematical Structures with Application to Computer Science by Tremblay,McGraw Hill Education.
2. Elements of Discrete Mathematics by Liu and Mohapatra,McGraw Hill Education.

MS20.309 **Linear Programming** **3-0-0-3**

Objective: To acquire fundamental knowledge linear programming and apply in sciences and applied sciences.

1. Introduction:Origin and Development of OR, Meaning and Definition of OR, Different Phases of OR study, Methodology of OR, Scope and Limitations of OR, OR in decision making, Applications of OR with illustrations. **06**
2. **Linear Programming:** Linear combination of vectors, Linearly independent / dependent vectors, Basis of a vector space, Convex set and its properties, Extreme points, General **06**

	Linear programming problem (LPP), Standard and canonical form of LPP, Formulation of LPP in all possible domains, Proof of all properties with illustrations.	
3.	Simplex Method: Simplex table, Conditions for application of simplex method, Solution to maximization and minimization problems including the Big- M Method, Two phase method,Proof of all properties with illustrations.	**12**
4.	**Transportation Problem:** Methods of obtaining initial feasible solution by northwest-corner method, least cost method and Vogel approximation method, Optimal Solution of Transportation problems using Modi Method and stepping Stone method, Unbalanced Transportation Problems, Proof of all properties with illustrations.	**09**
5.	**Assignment Problem:** Mathematical formulation of Assignment Problem, Hungarian method for solving Assignment problem, Proof of all properties with illustrations.	**06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of linear programmingin sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Hira and Gupta (2014), Operations Research,Revised Edition, S. Chand and Company Ltd.
2. Hamdy A., Taha (2016), Operations Research: An Introduction, 10th Edition, Pearson.

Reference Books:

1. G. Hadley (2002), Linear Programming, Narosa Publishing House, New Delhi.
2. Hillier and. Lieberman (2009), Introduction to Operations Research, 9thEdition, Tata McGraw Hill, Singapore.
3. Sharma S. D .and Himanshu Sharma (2004), Operations Research: Theory, Methods and Applications, 14th edition, KedarNath Ram Nath.
4. Kanti Swarup, PK Gupta and Manmohan (2001), Operations Research, 9th Edition, Sultan Chand andSons,New Delhi

MS20.311 **Analytical Geometry** **3-0-0-3**

Objective: To acquire fundamental knowledge analytical geometry and apply in sciences and applied sciences.

1.	**Plane:** Definition and different form of planes, angle between two planes, perpendicular distance of a point from a plane, plane through intersection of two planes, bisectors of two intersecting planes, locus of a plane, intersection of three planes.	**06**

2.	**Straight Line:**Definition anddifferent form of straight line, angle between two lines, distance of a point from a straight line, image of a point and straight line in a plane, co planarity of straight lines, shortest distance between two skew lines.	**07**
3.	**Sphere:** Different form of sphere, plane section of a sphere, intersection of two spheres, sphere through a given circle, intersection of a straight line and sphere, tangent planes and normal, touching spheres and condition of orthogonal spheres.	**08**
4.	**Conicoids I:** Different form of cone, equation of the cone with given vertex and a given conic for its base, angle between the lines in which a plane cuts a cone, tangent lines and tangent plane, reciprocal con, right circular con, different form of cylinder, equation of tangent plane, enveloping cylinder, right circular cylinder.	**09**
5.	**Conicoids II:** Ellipsoid, hyperboloid of one and two sheets, elliptic paraboloid , hyperbolic paraboloid, tangent plane , equation of normal, director sphere, polar plane and pole of the plane.	**09**

Course Outcome: After completion of the course, students would be able to apply the knowledge of analytical geometryin sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Analytic Geometry by Gordon Fuller and Dalton Tarwater,Pearson; 7th edition.
2. Elementary Treatise on Co-Ordinate Geometry of Three Dimensions by R.J.T. Bell, Macmillan India Ltd., 1994.
3. Analytical Solid Geometry by Shanti Narayan, S. Chand & Company, New Delhi.

Reference Books:

1. Analytic Solid Geometry by Deepak Chatterjee, PHI Learning Private Ltd., New Delhi.
2. Analytical Geometry of Two and Three Dimensions by H.M. Vasavada, 1992.

Objective: To acquire fundamental knowledge elementary graph theory and apply in sciences and applied sciences.

1.	**Graphs-I:** Introduction, definition and applications of graphs, finite and infinite graphs, null graph, sub graphs, incidence and degree, isolated vertex, pendant vertex, walk, path and circuits, connected graphs, disconnected graphs and components, proofs of all properties with illustartions.	**07**
2.	**Graphs-II:** Isomorphism, Euler graphs, operations on graphs, Hamiltonian paths and circuits, the travelling sales man problem, matrix representation of graphs, properties and some standard theorems on graphs, proof of all properties with illustrations..	**08**
3.	**Directed Graphs:** Definition, in-degree, out-degree, isomorphic digraphs, types of digraphs, digraph and binary relations, relation matrices, directed paths and connectedness, Euler digraphs, fundamental circuits in digraphs, properties and some standard theorems on digraphs.	**08**
4.	**Trees:** Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees,rank,nullity and cyclomatic number, Kruskal's algorithm and Prim's algorithm.	**08**
5.	**Cut-Sets and Cut-Vertices:** Cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism, some standard theorems.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of elementary graph theoryin sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Graph Theory with Applications to Engineering and Computer Science by Narsingh Deo, 2001, PHI.
2. Introduction to Graph Theory by Chartland, McGraw Hill Education.
3. Introduction to Graph theory by West, 2nd Edition, PHI Learning.

Reference Books:

1. Introduction to Graph Theory by Wilson, 4th Edition, Pearson.
2. Handbook of Graph Theory by Jonathan L.G., and Yellen J., CRC Press, 2004.
3. Theory of Graphs by Ore O., Volume 38, American Mathematical Society, Colloquium Publications, 1991.

MS20.308 **Basics of Dynamics and Mechanics** **3-0-0-3**

Objective: To acquire fundamental knowledge basics of dynamics and mechanics and apply in sciences and applied sciences.

1.	Velocity and acceleration: Velocity and acceleration along radial, transverse, tangential and normal directions. Relative velocity and acceleration.	**07**
2.	Rectilinear Motion: Simple Harmonic Motion, Motion under inverse square law, Motion under different laws.	**08**
3.	Coplanar Forces: Resultant force and resultant couple, Special cases, Varignon's theorem, Necessary and sufficient conditions of equilibrium. Equilibrium equations of the first, second and third kind. General conditions of equilibrium of a body under several coplanar forces,	**08**
4.	Friction and Virtual work: Contact force between bodies, Coulomb's laws of static Friction and dynamic friction. The angle and cone of friction, the equilibrium region. Workless constraints - examples, virtual displacements and virtual work. The principle of virtual work,	**08**
5.	Rigid Body Dynamics: Moments and product of inertia, Theorems of parallel and perpendicular axes, Principal axis, Kinetic energy of body rotating about a fixed point.	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of basics of dynamics and mechanics in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. S. L. Loney: An Elementary Treatise on the Dynamics of a Particle and aRigid Bodies, Cambridge University Press,1956
2. S. L. Loney: An Elementary Treatise on Statics, Cambridge: University Press,1912
3. F. Chorlton: Dynamics, CBS Publishers, NewDelhi, 2002
4. D. C. Gokhroo: Statics, Navkar prakashan, Edition, 2007
5. D. T. Greenwood: Principle of Dynamics, Prentice Hall, 1987

Reference Books:

1. H. Goldstein, C. Poole and J. Safko: Classical Mechanics, 3rd Edition, Addition Wesley(2002)
2. F. Grantmacher: Lecture in analytical Mechanics, MirPublication, 2013
3. R.D. Gregory: Classical mechanics, Cambridge UP, 2006
4. Timoshenko and Young: Engineering Mechanics, Mcgraw Hill, 2017
5. K. R. Symon: Mechanics, Addison Wesley, 1971

MS20.310 **Basics of Vector Calculus** **3-0-0-3**

Objective: To acquire fundamental knowledge basics of vector calculus and apply in sciences and applied sciences.

1.	Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors.	**07**
2.	Vector Differentiation-I: Vector algebra, operations with vectors, scalar and vector product of three vectors, product of four vectors, reciprocal vectors, scalar-valued functions over the plane and the space, vector function of a scalar variable, curves and paths, vector differentiation, proof of all properties and illustrations.	**08**
3.	Vector Differentiation-II: Directional derivative, gradient of a scalar function, conservative field, divergence, curl, related properties of gradient, divergence and curl of sums, second order differential operator, cylindrical and spherical coordinates,	**08**
4.	Vector Integration-I: Integration of a vector function of a scalar argument, line integral, work done , potential, conservative field and area, surface integrals, surface area and flux,proofs of all properties and illustrations.	**08**
5.	Vector Integration-II: Volume integrals, Proof Green's theorem in plane, transformation between line integral and double integral, area in Cartesian and polar coordinate, Proof's Stoke's theorem, Gauss divergence theorem with proof, illustrations of all theorems..	**08**

Course Outcome: After completion of the course, students would be able to apply the knowledge of basics of vector calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vector Analysis (Schaum's outlines Series) by Spiegel, MC Graw Hill Education.
2. A Text Book of Vector Calculus by Shanti Narayna, S. Chand & Co., New Delhi.
3. Theory and Problems of Advanced Calculus by Murrary R. Spiegal, Schaum's Publishing Company, New York.
4. Higher Engineering Mathematics by B.V. Ramana, TMH,2006.

Reference Books:

1. Introduction to Vector Analysis by N. Saran and S.N. Nigam, Pothishala Pvt. Ltd., Allahabad.
2. Thomas Calculus by Thomas, 11 Editions, Pearson.
3. A Text Book on Vector Calculus by G. Paria, Scholar's Publishing House, Indore.

MS20.312 **Advanced Linear Programming** **3-0-0-3**

Objective: To acquire fundamental knowledge advanced linear programming and apply in sciences and applied sciences.

1. Duality: Definition of duality Definition of the dual problem, Primal-dual relationships, solution of LPP by duality, Dual Simplex Method,Proof of all properties with illustrations. **[08]**
2. Integer Linear Programming: Introduction, Integer programming formulation, The Branch and Bound Technique, Proof of all properties with illustrations.. **[08]**
3. Sensitivity analysis: Shadow Price, Graphical and simplex method based approach for changes in cost and resource vector, Proof of all properties with illustrations.. **[08]**
4. Game Theory: Introduction, Terminologies of Game Theory, Game with pure strategies, Game with mixed strategies, Dominance Property, Graphical method for $2 \times n$ or $m \times 2$ Games, Linear Programming Approach for Game Theory, Proof of all properties with illustrations.. **[08]**
5. Sequencing and Scheduling Problems: Introduction of Job Sequencing, Optimal Solution [i.e. job sequences, total elapsed time, idle time for every machine] of (n-Jobs 2-Machines, n-jobs 3-Machines, n-jobs m-Machines, 2-Jobs n- Machines), Proof of all properties with illustrations. **[07]**

Course Outcome: After completion of the course, students would be able to apply the knowledge of advanced linear programming in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

3. Hira and Gupta (2014), Operations Research, Revised Edition, S. Chand and Company Ltd.
4. Hamdy A., Taha (2016), Operations Research: An Introduction, 10th Edition, Pearson.

Reference Books:

5. G. Hadley (2002), Linear Programming, Narosa Publishing House, New Delhi.

6. Hillier and. Lieberman (2009), Introduction to Operations Research, 9th Edition, Tata McGraw Hill, Singapore.
7. Sharma S. D .and Himanshu Sharma (2004), Operations Research: Theory, Methods and Applications, 14th edition, KedarNath Ram Nath.
8. Kanti Swarup, PK Gupta and Manmohan (2001), Operations Research, 9th Edition, Sultan Chand andSons,New Delhi

Chemistry Courses

CH 20.101	**Inorganic Chemistry-I**	**2-0-0-2**
Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, normal and orthogonal wave functions, quantum numbers and their significance, sign of wave functions, radial and angular wave function, radial probability distribution curves, shapes of s, p, d and f orbitals, Aufbau's principle and its limitations, Pauli's exclusion principle, Hund's rule of maximum multiplicity, variation of orbital energy with atomic number, electronic configurations of the elements and ions.		**[7]**
Chemical Bonding: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories.		**[7]**
Chemistry of *s*- Block Elements: Electronic configurations, diagonal relationships, solvation and complexation tendencies including their functions in biosystems.		**[4]**
Periodicity of p-block elements: Periodicity in properties of p-block elements, Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.		**[4]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds (XeF2, XeF4, XeF6, XeOF4, XeO2F2, XeO3). Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd

CH 20.103 **Organic Chemistry-I** **3-0-0-3**

Fundamentals of Organic Chemistry: Hybridization, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance, Hyperconjugation, charge-transfer compounds and field effects. **[7]**

Cleavage of Bonds: Homolysis and Heterolysis, Nucleophiles and electrophiles, shape and stability order of reactive Intermediates: Carbocations, Carbanions and free radicals.Strength of organic acids and bases: Comparative study with emphasis on factors affectingpK values.

Stereochemistry: Conformations with respect to ethane, n-butane and cyclohexane. Interconversion of WedgeFormula, Newmann, Sawhorse and Fischer representations. Concept of chirality and Elements of symmetry. Configuration: Geometrical and Optical isomerism; Enantiomerism,Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S and E / Z nomenclature . **[8]**

Chemistry of Alkanes and Alkenes: Preparation,Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. **[8]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.
3.McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.

CH20.102 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry. **[5]**

Chemistry of Elements of Second and Third Transition Series:General characteristics, comparative treatment with their 3d- analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry. **[4]**

Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes. **[7]**

Chemistry of Lanthanide and Actinide Elements: Electronic configuration, oxidation states and ionic, atomic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. Preparation of transuranic elements, Chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides. **[10]**

Suggested Readings:

Text Books:

1. P.L. Soni, Text Book of Inorganic Chemistry, 1999, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

1. F.A. Cotton. G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry 5rd Ed. 2005, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.

CH20.104	**Physical Chemistry-I**	**3-0-0-3**
Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect).		**[9]**
Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases.		**[6]**
Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).		**[7]**
Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore.		**[4]**
Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counters, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state.		**[3]**
Spectroscopy: Electromagnetic radiation of the spectrum, basic features of different spectrometers, Rotational Spectrum -Diatomic molecules, idea of vibrational frequencies of different functional groups. Raman Spectrum concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules.		**[4]**
Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).		**[6]**

Suggested Readings:

Text Books:

1. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
2. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

1. P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
3.Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4.Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

CH 20.201	**Organic Chemistry-II**	**3-0-0-3**
Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π^* and n-π^* transitions, effect of conjugation, Concept of		**[6]**

chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated dienes and enones.

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[5]**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers. **[4]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.

CH20.203 **Physical Chemistry-II** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. Definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, Kirchoff's equation. Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Nernst heat theorem, concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction- differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD.
2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

1. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co.
3. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd

CH20.202	**Inorganic Chemistry-III**	**2-0-0-2**

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Hard and Soft Acids and Bases (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness. **[8]**

Oxidation and Reduction: Oxidation and reduction potential, applications of electrochemical series. Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. P. L.Soni, Text Book of Inorganic Chemistry, 2005, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2004, RBD.

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 4th Ed. 2005, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
3. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2003, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH 20.204	Organic Chemistry-III	3-0-0-3

Nuclear magnetic resonance (NMR) spectroscopy: Proton magnetic resonance (^{1}H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques. **[9]**

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Organic Synthesis via Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate; the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes. Alkylation and acylation of enamines. **[4]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.

CH20.301 Inorganic Chemistry-IV 3-0-0-3

Thermodynamic and Kinetic Aspects of Metal Complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, determination of composition of complex by Job's method and mole ratio method substitution reactions of square planar complexes. **[7]**

Metal-ligand Bonding in Transition Metal complexes: Limitations of valence bond theory, an elementary idea of crystal-field theory, crystal-field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters. Magnetic Properties of Transition Metal Complexes, Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes. **[10]**

Electron Spectra of Transition Metal Complexes: Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion. **[8]**

Volumetric Estimation: Theory of oxidation-reduction titrations and complexometric titrations. **[3]**

Organometallic Chemistry: Definition, nomenclature and classification of organometallic compounds, applications of alkyls and aryls of Li, Al, Hg, Sn and Ti and the nature of bonding in metal carbonyls. **[4]**

Bioinorganic Chemistry: Essential and trace elements to Biological processes, metalloporphyrins. Biological role of alkali and alkaline eath metal ions.Nitrogen fixation. **[4]**

Silicones and Phosphazenes: Silicones and phosphazenes as examples of inorganic polymers. **[3]**

Suggested Readings:

Text Books:

1. P. L. Soni, Text Book of Inorganic Chemistry, 2008, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2009, RBD.

Reference Books:

1. F.A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry 3rd Ed. 1995, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
3. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2009, S. Chand & Co. Ltd.
4. Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co. Ltd.

CH20.303 **Physical Chemistry-III** **2-0-0-2**

Phase Equilibrium: Degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system-water, CO_2 and S systems, Phase equilibria of two component system-solid-liquid equilibria, simple eutectic Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point ($NaCl-H_2O$), ($FeCl_3-H_2O$) and ($CuSO_4-H_2O$) system, Freezing mixtures, acetone-dry ice. Liquid-liquid mixtures-ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes-$HCl-H_2O$ and ethanol-water systems. Partially miscible liquids-Phenol-water, trimethylamine-water nicotine- water systems. Lower and upper consolute temperature, Effect of impurity on consolute temperature. Immiscible liquids, steam distillation. Nernst distribution law-thermodynamic derivation, applications. **[10]**

Chemical and ionic Equilibrium: Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction isotherm and reaction isochore-Clapeyron equation, Clausius-Clapeyron equation and their applications. **[6]**

Strong, moderate and weak electrolytes, degree of ionization, pH scale, common ion effect, Buffer solutions and applications of solubility product principle.

Elementary Quantum Mechanics: Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids,Compton effect. De Broglie hypothesis, Heisenberg's uncertainty principle, Schrodinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, basic ideas-criteria for forming M.O. from A.O., construction of M.O.'s by LCAO-H_2^+ ion, calculation of energy levels from wave functions, Hybrid orbitals-sp, sp^2, sp^3, calculation of coefficients of A.O.'s used in these hybrid orbitals. **[5]**

Physical Properties and Molecular Structure: Optical activity, polarization-(Clausius-Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment- temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties-paramagnetism, diamagnetism and ferromagnetism. **[5]**

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B.Sc. Part III, 2009, RBD.
2. K. R. Genwa, Physical Chemistry B.Sc. Part III, 2008, RBD.
3. P.W. Atkins, The elements of Physical Chemistry, 5th Ed. 2004, Oxford.
4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
5. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co
6. Giri, Bajpai and Pandey, Practical Chemistry, reprint 2009, S. Chand & Co. Ltd.

CH20.302 **Organic Chemistry-IV** **3-0-0-3**

Heterocyclic Compounds: Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Only one method of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Comparison in basicity of pyridine, piperidine and pyrrole. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. **[7]**

Organometallic and Organosulphur Compounds: Organomagnesium Compounds: the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions Organosulphur: Nomenclature, structural features. Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine. **[6]**

Amines: *Preparation*: from Gabriel's Phthalimide synthesis, Hofmann Bromamidereaction. *Reactions:* Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, Schotten – Baumann Reaction and formation of diazonium salts. **[4]**

Carbohydrates: Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharide. Erythro and threo diastereomers. Conversion of glucose into mannose. Cyclic structure of D (+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination. **[7]**

Amino Acids, Peptides, Proteins and Nucleic Acids: Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins. solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids: Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA. **[7]**

Fats, Oils, Detergents and Synthetic Dyes: Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value, soaps, synthetic detergents, alkyl and aryl sulphonates. **[8]**

Dyes: Colour and constitution (electronic concept). Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Suggested Readings:

Text Books:

1. P. L. Soni and H.M. Chawla, Text Book of Organic Chemistry, 28th Ed.1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005, S. Chand & Co. Ltd.
3. Giri, Bajpai and Pandey, Practical Chemistry, reprint, 2005, S. Chand & Co. Ltd.

CH20.304 Physical Chemistry-IV **2-0-0-2**

Colloidal State: Definition, classification of colloids. Solids in liquids (sols): properties-kinetic, optical and electrical; stability of colloids, protective action. Hardy-Schulze law, gold number. Liquids in solids (gels): classification, preparation and properties, inhibition, general application of colloids. Liquids in liquids (emulsions): types of emulsions, preparation, emulsifier. **[6]**

Solutions: Dilute Solutions and Colligative Properties: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solution, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure, elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular **[8]**

weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

Electrochemistry: Specific and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory and its limitations, weak and strong electrolytes. Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation (elementary treatment). Transport number-definition, determination by Hittorf and moving boundary method. Applications of conductivity measurements: determination of degree of dissociation, K_a of acids, solubility product of the sparingly soluble salt, conductometric titrations. Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation and computation of cell E.M.F. and its measurement, single electrode potential, SHE , reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K). Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations. Definition of pH and pKa, determination of pH using hydrogen quinhydrone and glass electrodes. **[12]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD.
2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD.
3. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford.
4. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co.
5. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd

CH 20.111	Inorganic and Organic Chemistry Laboratory-I	0-0-2-1

Perform any EIGHT experiments from the below list.

1-4.To analyze the given mixture containing four radicals (two acidic and two basic) including interfering acid radicals- fluoride, borate, oxalate, phosphate and excluding insoluble. (Four mixture)

1. Preparation of standard solutions of different Molarity/Normality of titrants.
2. Purification of a given organic sample solid/liquid through crystallization or distillation and ascertaining their purity through melting point or boiling point.
3. To study the process of sublimation of camphor and phthalic acid.
4. Systematic identification-I (detection of extra elements, functional groups: To determine the functional group of the given organic compound through element detection and functional group analysis: Carboxylic Acid, alcoholic, phenolic, ester, aldehydic, ketonic, carbohydrate, amide, anilide, nitro and hydrocarbon.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
2. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
3. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

CH20.112	Inorganic and Physical Chemistry Laboratory-I	0-0-2-1

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
3. Determination of Hardness of water by EDTA method.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
6. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
7. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
8. To determine the surface tension of a given liquid by drop number method.
9. To determine the viscosity of a given liquid.
10. To determine the specific refractivity of a given liquid.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
6. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
7. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

CH 20.211	Organic and Physical Chemistry Laboratory-I	0-0-2-1

1. Systematic identification-II: To identify the given organic compound through element detection, functional group analysis and confirmative test and preparation of at least one pure solid derivative.Any six organic compounds may be identified, like Naphthalene, m-dinitrobenzene, resorcinol, α-naphthol, β-naphthol, benzophenone, benzaldehyde, benzoic acid, salicyclic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline, glucose.
2. To determine the CST of phenol – water system.
3. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process.
4. To determine the enthalpy of neutralization of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
5. To determine the enthalpy of solution of solid calcium chloride.
6. To study the distribution of iodine between water and CCl_4.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
2. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
3. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

CH20.212	Inorganic and Organic Chemistry Laboratory-II	0-0-2-1

1. Estimation of Ni(II) using dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN.
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
4. Quantitative estimation of copper-Zinc of the following mixture by volumetric and gravimetric methods
5. Quantitative estimation of Zinc-nickel of the following mixture by volumetric and gravimetric methods
6. Steam distillation (non evaluative) Naphthalene from its suspension in water Separation of o- and p-nitrophenols
7. Column chromatography (non evaluative) Separation of fluorescein and methylene blue. Separation of leaf pigments from spinach leaves.
8. Determination of Rf values and identification of organic compounds.
9. Separation of green leaf pigments (spinach leaves may be used) by paper chromatographic method (b) Separation of a mixture of coloured organic compounds using common organic solventsby TLC.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
6. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

CH 20.311	Inorganic and Physical Chemistry Laboratory-II	0-0-2-1

1. Preparationofsodiumtrioxalatoferrate(III)$Na_3[Fe(C_2O_4)_3]$.
2. PreparationofNi-DMGcomplex$[Ni(DMG)_2]$.
3. Preparationofcoppertetraamminecomplex $[Cu(NH_3)_3]SO_4$.
4. Preparationofcis-andtrans-bisoxalatodiaquachromate(III)ion.
5. PreparationofPyridine complex of copper.
6. To determine the CST of phenol – water system.
7. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process
8. To determine the enthalpy of neutralisation of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base
9. To determine the enthalpy of solution of solid calcium chloride
10. To study the distribution of iodine between water and CCl_4.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

CH 20.312	Organic and Physical Chemistry Laboratory-II	0-0-2-1

1. Synthesis of the following organic compounds:
(a) To prepare o-chlorobenzoic acid from anthranilic acid.
(b) To prepare p-bromoaniline from p-bromoacetanilide.
(c) To prepare m-nitroaniline from m-dinitrobenzene.
(d) To prepare S-Benzyl-iso-thiouronium chloride from thiourea.
2. To determine the strength of the given acid solution (mono and dibasic acid) conductometrically.
3. To determine the solubility and solubility product of a sparingly soluble electrolyte conductometrically.
4. To determine the strength of given acid solution (mono and dibasic acid)/$KMnO_4$ – Mohr salt potentiometrically.
5. To determine the molecular weight of a non-volatile solute by Rast method.
6. To standardize the given acid solution (mono and dibasic acid) pH metrically.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
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Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

Department of Physics

School of Liberal Arts and Sciences

B.Sc. (Hons) Physics

Curricular Structure and Syllabus
Academic Session: 2020-21 onwards

Department of Physics

The department of physics of School of Liberal Arts and Sciences at Mody University of Science and Technology offers rich and comprehensive programs in physics and has developed a strong positive teaching and research environment. The programs are designed to prepare the students not only for the advanced graduate studies in physics, but also for employment upon graduation in physics and other disciplines related to science and technology. The physics laboratories are spacious and well equipped with the numerous experiments to elucidate concepts, to develop understanding of the inductive approach and the significance of a physical measurement, and to provide some practice in experimental techniques and methods.

Vision:

To encourage women to get involved in physics by offering rich and comprehensive programs through positive teaching learning and strong research environment that promotes their career development in physics.

Mission:

- To impart quality education in physics by providing state of the art facilities at UG,PG and Doctoral level
- To promotes the highest ethical principles in scientific research, critical thinking, and openness to social, scientific, technological and educational changes.
- To build an environment to create and propagate innovative technologies for the economic development.

B.Sc. (Hons) Physics
Academic Session:2020-21 onwards

Programme **Level:** **No. of Seats:** 20 **Duration: Three Years (Six Semesters)**

Undergraduate

Programme Educational Objectives:

- Motivate and inspire the students to create deep interest in Physics, to develop broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.
- Learn, design and perform experiments in the laboratories to demonstrate the concepts, principles and theories learned in the classrooms.
- Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
- Expose the student to the vast scope of Physics as a theoretical and experimental science with applications in solving most of the problems in nature.
- Emphasize the discipline of Physics to be the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.
- Emphasize the importance of Physics as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment**.**

Programme Outcome:

Some of the characteristic attributes of a graduate in Physics are

- **Disciplinary knowledge and skills:** Capable of demonstrating
  (i) good knowledge and understanding of major concepts, theoretical principles and experimental findings in Physics and its different and other related fields of study, including broader interdisciplinary subfields.
  (ii) ability to use modern instrumentation and laboratory techniques to design and perform experiments is highly desirable in almost all the fields of Physics .
- **Skilled communicator:** Ability to transmit complex technical information relating all areas in Physics in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding.
- **Critical thinker and problem solver:** Ability to employ critical thinking and efficient problem solving skills in all the basic areas of Physics.
- **Sense of inquiry:** Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Physics, and planning, executing and reporting the results of a theoretical or experimental investigation.
- **Team player/worker**: Capable of working effectively in diverse teams in both classroom, laboratory, Physics workshop and in industry and field-based situations.
- **Skilled project manager:** Capable of identifying/mobilizing appropriate resources required for a project, and manage a project through to completion, while observing responsible andethical scientific conduct; and safety and laboratory hygiene regulations and practices.
- **Digitally Efficient*:*** Capable of using computers for simulation studies in Physics and computation and appropriate software for numerical and statistical analysis of data.
- **Ethical awareness / reasoning*:*** The graduate should be capable of demonstrating ability tothink and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing

plagiarism, not adhering to intellectual property rights, and adopting objectives, unbiased and truthful actions in all aspects of work.

- **National and international perspective*:*** The graduates should be able to develop a nationalas well as international perspective for their career in the chosen field of the academic activities. They should prepare themselves during their most formative years for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest and future expertise.
- **Lifelong learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and reskilling in all areas of Physics.

Programme Specific Outcome:

The student graduating with the Degree B.Sc (Honours) Physics should be able to

- Acquire
  - (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics
  - (ii) procedural knowledge that creates different types of professionals related to thedisciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;
  - (iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments inthe field of Physics.
- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.
- Demonstrate relevant generic skills and global competencies such as
  - (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinaryarea boundaries;
  - (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems;
  - (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
  - (iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics and ability to translatethem with popular language when needed;
  - (v) ICT skills;
  - (vi) personal skills such as the ability to work both independently and in a group.
- Demonstrate professional behavior such as
  - (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
  - (ii) the ability to identify the potential ethical issues in work-related situations;
  - (iii) appreciation of intellectual property, environmental and sustainability issues; and promoting safe learning and working environment.

Scope:

The course offers adequate scope with regard to higher education as well as career openings both in public as well as private sector enterprises. There exist ample master level courses for candidates who are interested in higher education. Apart from this, the candidate can seek career opportunities in Research organizations, and other related areas. Higher education after B. Sc Physics increases the proximity to get in to a high designation job with rewarding compensation packages.

Input Qualification:

Candidate must qualify 10+2 examination from CBSE, or its equivalent from any recognized Board, in Science stream with Mathematics with adequate proficiency in English.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed.

Credit Summary:

Year	Semester	Core	DSE	GE	AECC	SEC	Total
First	Autumn	12	--	6	2	3	23
	Spring	12	--	6	4	3	25
Second	Autumn	19	--	6	--	6	31
	Spring	17	--	6	--	6	29
Third	Autumn	12	12	--	--	3	27
	Spring	12	12	--	--	3	27
	Total	**84**	**24**	**24**	**6**	**12**	**162**

Course Summary:

Year	Semester	Core course	DSC	GE	AECC	SEC	Total
First	Autumn	**CC-I** Mathematical Physics-I **CC-II** Mechanics	--	**GE-I** Differential and Integral Calculus **OR** Inorganic Chemistry-I Organic Chemistry-I	**AECC-I** Foundation Course in English	**SEC-I** Foreign Language-I	5/6
	Spring	**CC-III** Electricity and Magnetism **CC-IV** Elements of Modern Physics	--	**GE-II** Group Theory **OR** Inorganic Chemistry-II Physical Chemistry-I	**AECC-II** Environment Studies	**SEC-II** Foreign Language-II	5/6
Second	Autumn	**CC-V** Mathematical Physics II **CC-VI** Thermal Physics **CC-VII** Digital Systems and Applications	--	**GE-III** Differential Equation **OR** Physical Chemistry-II Organic Chemistry-II	--	**SEC-III** Foreign Language-III **SEC-IV** Mody University Elective-I	6/7
	Spring	**CC-VIII** Mathematical Physics III **CC-IX** Wave and Optics **CC-X** Analog Systems and Applications	--	**GE-IV** Real Analysis **OR** Inorganic Chemistry-III Organic Chemistry-III	--	**SEC-V** Foreign Language-IV **SEC-VI** Mody University Elective-II	6/7
Third	Autumn	**CC-XI** Quantum Mechanics and Applications **CC-XII** Statistical Mechanics	**DSE-I** Nuclear and Particle Physics **DSE-II** Computational Physics	--	--	**SEC-VII** Research Methodology **SEC-VIII** Foreign Language-V	6
	Spring	**CC-XIII** Solid State Physics **CC-XIV** Electromagnetic Theory	**DSE-III** Nano Materials and Applications **DSE-IV** Project	--	--	**SEC-IX** Foreign Language-VI	5
	Total	**14**	**4**	**4 /8**	**2**	**9**	**33/37**

B.Sc. (Hons) Physics
Academic Session (2020-21 onwards)

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	PH20.101	Mathematical Physics-I	5	1	-	6	3	25	25	50
	PH20.103	Mechanics	4	-	-	4	3	25	25	50
	PH20.105	Physics Laboratory I	-	-	4	2	4	25	25	50
	Generic Elective Course									
	MS20.101	Differential and Integral Calculus	5	1	–	6	3	25	25	50
	OR									
	CH20.101	Inorganic Chemistry-I	2			2	3	25	25	50
	CH20.103	Organic Chemistry-I	3			3	3	25	25	50
	CH20.111	Inorganic and Organic chemistry Laboratory -I			2	1	3	25	25	50
	Ability Enhancement Compulsory Course									
	EL20.109	Foundation Course in English	2	-	-	2	3	25	25	50
	Skill Enhancement Course									
		Foreign Language-I	3	-	-	3	2	25	25	50
		Sub Total				**23**				
	SF 101	Personal Grooming, Fine Dining				1				

Year: First

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	PH20.102	Electricity and Magnetism	4	-	-	4	3	25	25	50
	PH20.104	Elements of Modern Physics	5	1	-	6	3	25	25	50
	PH20.106	Physics Laboratory II	-	-	4	2	4	25	25	50
	Generic Elective Course									
	MS20.102	Group Theory	5	1	–	6	3	25	25	50
	OR									
	CH20.102	Inorganic Chemistry-II	2			2	3	25	25	50
	CH20.104	Physical Chemistry-I	3			3	3	25	25	50
	CH20.112	Inorganic and Physical Chemistry Laboratory-I			2	1	3	25	25	50
	Ability Enhancement Compulsory Course									
	EV20.102	Environmental studies	4	-	-	4	3	25	25	50
	Skill Enhancement Course									
		Foreign Language-II	3	-	-	3	2	25	25	50
		Sub Total				**25**				

	SF 102	Social Grooming, Home & Decor and Business Communication(Non Credit)				1				

B.Sc. (Hons) Physics
Academic Session(2020-21 onwards)

Year: Second

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	PH20.201	Mathematical Physics II	5	1		6	3	25	25	50
	PH20.203	Thermal Physics	5	1	-	6	3	25	25	50
	PH20.205	Digital Systems and Applications	4	1	-	5		25	25	50
	PH20.207	Physics Laboratory III	-	-	4	2	4	25	25	50
	Generic Elective Course									
	MS20.201	Differential Equation	5	1	–	6	3	25	25	50
		OR								
	CH20.201	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH20.203	Physical Chemistry-II	2	-	-	2	3	25	25	50
	CH20.211	Organic and Physical Chemistry-I	-	-	2	1	3	25	25	50
	Skill Enhancement Course									
		Foreign Language-III	3	-	-	3	2	25	25	50
		Mody University Elective-I	3	-	-	3	3	20	-	80
		Sub Total				**31**				
	SF 201	Personal Grooming, Fine Dining and Home Safety				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	PH20.202	Mathematical Physics III	5	1	-	6	3	25	25	50
	PH20.204	Wave and Optics	4	-	-	4	3	25	25	50
	PH20.206	Analog Systems and Applications	4	1	-	5	3	25	25	50
	PH20.208	Physics Laboratory IV	-	-	4	2	4	25	25	50
	Generic Elective Course									
	MS20.202	Real Analysis	5	1	-	6	3	25	25	50
		OR								
	CH20.202	Inorganic Chemistry-III	2	-	-	2	3	25	25	50
	CH20.204	Organic Chemistry-III	3	-	-	3	3	25	25	50
	CH20.212	Inorganic and Organic chemistry Laboratory –II	-	-	2	1	3			
	Skill Enhancement Course									
		Foreign Language-IV	3	-	-	3	2	25	25	50
		Mody University Elective-II	3	-	-	3	3	20	-	80
		Sub Total				**29**				

	SF 202	Social Grooming and Professional Skills				1				

B.Sc. (Hons) Physics
Academic Session (2020-21 onwards)

Year: Third

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Autumn Semester	**Core Courses**									
	PH20.301	Quantum Mechanics and Applications	4	-	-	4	3	25	25	50
	PH20.303	Statistical Mechanics	5	1	-	6	3	25	25	50
	PH20.305	Physics Laboratory V	-	-	4	2	4	25	25	50
	Discipline Specific Elective Course									
	PH20.307	Nuclear and Particle Physics*	5	1	-	6	3	25	25	50
	PH20.309	Computational Physics	2	-	-	2	3	25	25	50
	PH20.311	Computational Laboratory	-	-	4	2	4	25	25	50
	RM20.301	Research Methodology	2			2	3	25	25	50
	Skill Enhancement Course									
		Foreign Language-V	3	-	-	3	2	25	25	50
		Sub Total				**27**				
	GE20.301	Proficiency (Non-credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW	MTE	ETE
Spring Semester	**Core Courses**									
	PH20.302	Solid State Physics	4	-	-	4	3	25	25	50
	PH20.304	Electromagnetic Theory	5	1	-	6	3	25	25	50
	PH20.306	Physics Laboratory VI	-	-	4	2	4	25	25	50
	Discipline Specific Elective Course									
	PH20.308	Nano Materials and Applications**	4	-	-	4	3	25	25	50
	PH20.310	Electronics Laboratory**	-	-	4	2	4	25	25	50
	PH20.312	Project	-	-	-	6	-	-	-	100
	Skill Enhancement Course									
		Foreign Language-VI	3	-	-	3	2	25	25	50
		Sub Total				**27**				
	GE20.302	Proficiency (Non-credit)				1				

PH20.101 **Mathematical Physics-I** **5-1-0-6**

Course Objective: *The objective of the course is to develop mathematical skills in the student which enables them to apply in solving the problems of interest to physicists.*

Course Outcome: *The student will be able to:*

CO1: Understand derivatives, integrals and vector calculus.
CO2: Solve first and second order differential equations and apply these to physics problems.
CO3: Understand the concept of gradient of scalar field and divergence and curl of vector fields.
CO4: Perform line, surface and volume integration and apply Green's, Stokes' and Gauss's Theorems to compute these integrals.
CO5: Apply curvilinear coordinates to problems with spherical and cylindrical symmetries.

Unit I	**Calculus:** Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials, Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **Vector Calculus:** Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.	**12**
Unit II	**First Order Differential Equations:** First order differential Equations: Variable separable, homogeneous, non-homogeneous, exact and inexact differential equations and Integrating Factors. Application to physics problems. **Second Order Differential equations:** Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.	**20**
Unit III	**Vector Differentiation:** Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities, Gradient, divergence, curl and Laplacian in spherical and cylindrical coordinates.	**16**
Unit IV	**Vector Integration:** Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications.	**10**
Unit V	**Orthogonal Curvilinear Coordinates:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	**7**

Text Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.

Reference Books:

1. Differential Equations, George F. Simmons, 2007, McGraw Hill.
2. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
3. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
4. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.
5. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
6. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press

PH20.103 **Mechanics** **4-0-0-4**

Course Objective: The objective of the course is to enhance the understanding of the basics of mechanics with the review of Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations.

Course Outcome: *The student will be able to:*

- *CO1:* Describe relative motion, Inertial and non-inertial reference frames.
- *CO2:* Articulate and describe parameters defining the motion of mechanical systems
- *CO3:* Study of the interaction of forces between solids in mechanical systems.
- *CO4:* Articulate and describe centre of mass of mechanical systems.
- *CO5:* Articulate and describe laws of motion and conservation principles.

Unit I	**Fundamentals of Dynamics:** Reference frames, Inertial frames, Galilean transformations, Galilean invariance, Review of Newton's Laws of Motion. Momentum of variable mass system: motion of rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D). **Work and Energy:** Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable, unstable and neutral equilibrium. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. **Collisions:** Elastic (1-D and 2-D) and inelastic collisions. Centre of Mass and Laboratory frames.	**12**
Unit II	**Rotational Dynamics:** Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of inertia, theorem of parallel and perpendicular axes. Determination of moment of inertia of discrete and continuous objects [1-D, 2-D & 3-D (rectangular, cylindrical and spherical)]. Kinetic energy of rotation. Motion involving both translation and rotation.	**10**
Unit III	**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. **Motion of a particle under a central force field:** Two-body problem, its reduction to one-body problem and its solution. Reduction of angular momentum, kinetic energy and total energy. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit, Geosynchronous orbits.	**10**
Unit IV	**Oscillations:** Idea of SHM. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Compound pendulum. Damped oscillation. Forced oscillations: Transient and steady states, sharpness of resonance and Quality Factor. **Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.	**10**
Unit V	**Special Theory of Relativity:** Outcomes of Michelson-Morley Experiment. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity, Length contraction, Time dilation. Relativistic transformation of velocity, acceleration, frequency and wave number. Mass of relativistic particle. Mass-less Particles. Mass-energy Equivalence. Relativistic Doppler effect (transverse and longitudinal). Relativistic Kinematics (decay problems, inelastic collisions and Compton effect). Transformation of Energy and Momentum.	**10**

Text Books:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

Reference Books:

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education

PH20.105: Objective of the course is to acquaint the students with the Experiments based on PH20.103. So majority of experiments should be based on this course.

PH20.102 **Electricity and Magnetism** **4-0-0-4**

Course Objective: *The objective of the course is to expose the student to electrostatics and magnetostatics including Boundary value problems, the principles of electromagnetic induction. The student will be able to appreciate Maxwell's equations and analyze electrical circuits using network theorems.*

Course Outcome: *The student will be able to:*

- *CO1: Understand the relationship between electrical charge, electrical field, electrical potential, and magnetism.*
- *CO2: Calculate the magnitude and direction of the magnetic field for symmetric current distributions using the Law of Biot-Savart and Ampere's Law.*
- *CO3: Understand the various network theorems.*
- *CO4: Define the magnetic field and magnetic flux, solve technical problems.*
- *CO5: Understand the Maxwell's equation and its application in confinement and propagation of EMW.*

Unit I	**Electric Field and Electric Potential** Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force andTorque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.	**15**
Unit II	**Magnetic Field:** Magnetic force between current elements and definition of Magnetic Field **B**. Biot-Savart's Law and its simple applications: straight wire and circular loop.Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.	**10**
Unit III	**Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.	**10**
Unit IV	**Electrical Circuits**: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.	**7**
Unit V	**Maxwell Equations:** Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.	**10**

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
4. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
5. Electricity, Magnetism & Electromagnetic Theory, S.Mahajanand Choudhury, 2012, Tata

PH20.104 **Elements of Modern Physics** **5-1-0-6**

Course Objective: *The objective of the course is to provide the physical and mathematical foundations necessary to understand various topics in modern physics which help them to explore atoms, molecules, photons, nuclei and elementary particles.*

Course Outcome: *The student will be able to*

CO1: *Understand inadequacies of classical mechanics and historical development of quantum mechanics.*
CO2: *Understand the concept of wave particle duality.*
CO3: *Formulate Schrodinger equation and the idea of probability interpretation associated with wave-functions.*
CO4: *Explore the properties of nuclei and structure of atomic nucleus.*
CO5: *Understand the theory and properties of laser.*

Unit I	Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. DeBroglie wavelength and matter waves; Davisson-Germer experiment. Wave descriptionof particles by wave packets. Group and Phase velocities and relation between them.Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.	**15**
Unit II	Position measurement- gamma ray microscope thought experiment; Wave-particleduality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pairof variables): Derivation from Wave Packets impossibility of a particle following atrajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range ofan interaction.	**15**
Unit III	Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunneling in one dimension-across a step potential & rectangular potential barrier	**15**
Unit IV	Size and structure of atomic nucleus and its relation with atomic weight; Impossibility ofan electron being in the nucleus as a consequence of the uncertainty principle. Nature ofnuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and bindingenergy, Nuclear Shell Model and magic numbers.	**10**
Unit V	**Lasers:** Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level.Lasers. Ruby Laser and He-Ne Laser.	**10**

Text Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010,Cengage Learning.

Reference Books:

1. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill2.
2. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
3. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
4. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W.Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
5. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.

PH20.106: Objective of the course is to acquaint the students with the Experiments based on PH20.102 and PH20.104. So majority of experiments should be based on this course.

PH20.201 Mathematical Physics II 5-1-0-6

Course Objective: *The objective of the course is to equip students with the mathematical tools required to solve a wide range of physics problems.*

Course Outcome: *The student will be able to*

- *CO1: Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc.*
- *CO2: Obtain power series solution of differential equation of second order with variable coefficient using Frobenius method.*
- *CO3: Understand properties and applications of special functions like Legendre polynomials, Bessel functions and their differential equations*
- *CO4: Learn about gamma and beta functions and their applications.*
- *CO5: Solve linear partial differential equations of second order with separation of variable method.*

Unit I	**Fourier Series**: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.	**15**
Unit II	**Frobenius Method and Special Functions**: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality.	**25**
Unit III	**Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).	**5**
Unit IV	**Theory of Errors:** Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.	**5**
Unit V	**Partial Differential Equations**: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes.	**15**

Text Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.

Reference Books:

1. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
3. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
4. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

PH20.203 **Thermal Physics** **5-1-0-6**

Course Objective: *The objective of this course is to understand basics of thermodynamic laws and entropy and Maxwell's thermodynamic equations using thermodynamic potentials and their applications along with kinetic theory and liquefaction of gases*

Course Outcome: *The student will be able to*

- *CO1: Define thermodynamic laws and various terminology efficiently.*
- *CO2: Understand second law of thermodynamics with Carnot's cycle and entropy.*
- *CO3: Apply Maxwell equations for different problems*
- *CO4: Determine Maxwell-Boltzmann distribution in kinetic theory of gases.*
- *CO5: Design various types of cooling systems .*

Unit I	**Zeroth and First Law of Thermodynamics:** Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.	**10**
Unit II	**Second Law of Thermodynamics:** Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot‟s Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot‟s Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **Entropy:** Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.	**20**
Unit III	**Thermodynamic Potentials:** Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb‟s Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. **Maxwell's Thermodynamic Relations**: Derivation of Maxwell‟s thermodynamic Relations and their applications, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Value of Cp-Cv, (3) Tds Equations, (4) Energy equations.	**10**
Unit IV	**Kinetic Theory of Gases** **Distribution of Velocities**: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. **Molecular Collisions**: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.	**15**
Unit V	**Real Gases:** Behavior of Real Gases: Deviations from the Ideal Gas Equation. Andrew‟s Experiments on CO2 Gas. Virial Equation. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. van der Waal‟s Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves.p-V Diagrams. Free Adiabatic Expansion of a Perfect Gas. Joule- Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and vander Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.	**10**

Text Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill

Reference Books:

1. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
2. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
3. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger,1988, Narosa.
4. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press

PH20.205 Digital Systems and Applications 4-1-0-5

Course Objective: *The objective of the course is to enable the student with the introduction of the concept of Boolean algebra and the basic digital electronics.*

Course Outcome: *Student will be able to:*

- *CO1: Understand CRO basic and IC fabrication.*
- *CO2: Understand the logical behavior of digital circuits*
- *CO3: Understand the advantages and disadvantages of programmable logic devices*
- *CO4: Know how to describe digital hardware using a software-style language*
- *CO5: Understand how a basic microprocessor can be built from standard building blocks.*

Unit I	**Introduction to CRO:** Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2)Measurement of Voltage, Current, Frequency, and Phase Difference.	**3**
Unit II	**Integrated Circuits** (Qualitative treatment only): Active & Passive components.Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.	**9**
Unit III	**Digital Circuits:** Difference between Analog and Digital Circuits. Binary Numbers.Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. **Boolean algebra:** De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms, .Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **Arithmetic Circuits:** Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor	**9**
Unit IV	**Data processing circuits**: Basic idea of Multiplexers, De-multiplexers, Decoders,Encoders.. **Sequential Circuits:** SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered)Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop. **Timers**: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. **Shift registers:** Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). **Counters(4 bits):** Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.	**19**
Unit V	**Computer Organization**: Input/Output Devices. Data storage (idea of RAM and ROM).Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map. **Intel 8085 Microprocessor Architecture:** Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI. **Introduction to Assembly Language:** 1 byte, 2 byte & 3 byte instructions	**12**

Text Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed.,2011, Tata McGraw.
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd

Reference Books:

1. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
2. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
3. Logic circuit design, Shimon P. Vingron, 2012, Springer.
4. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.

5. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

PH20.207: Objective of the course is to acquaint the students with the Experiments based on PH20.203 and PH20.205. So majority of experiments should be based on these courses.

PH20.202 Mathematical Physics III 5-1-0-6

Course Objective: *The objective of the course is to State and derive various theorems in complex variables followed by evaluations of Fourier and Laplace transforms of functions along with properties of Dirac-delta function and to find applications of these approaches in different problems.*

Course Outcome: *Student will be able to*

- *CO1: Understand and interpret an analytic function.*
- *CO2: Derive and apply different theorems of complex variable in solving various problems.*
- *CO3: Evaluate Fourier transforms and find their applications.*
- *CO4: Evaluate Laplace transforms and find their applications.*
- *CO5: Acquaint with Dirac delta function its properties and various forms.*

Unit I	**Complex Analysis:** Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De-Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Equations. Examples of analytic functions. Singularities: poles, removable singularity, essential singularity, branch points, branch cut.	**15**
Unit II	Integration of a function of a complex variable. Cauchy-Goursat Theorem, Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application of Contour Integration in solving Definite Integrals.	**15**
Unit III	**Fourier Transforms:** Fourier Integral theorem (Statement only). Fourier Transform (FT). Examples: FT of single pulse, trigonometric, exponential and Gaussian functions. FT of derivatives, Inverse FT, Convolution theorem. Properties of FT s (translation, change of scale, complex conjugation, etc.). Solution of one dimensional Wave Equation using FT. Fourier Sine Transform (FST) and Fourier Cosine Transform (FCT).	**15**
Unit IV	**Laplace Transforms:** Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations, Coupled differential equations of 1st order. Solution of 1-D heat equation (semi-infinite bar) using LT.	**15**
Unit V	Dirac delta function: Definition and properties. Representation of Dirac delta function as a Fourier Integral. Laplace and Fourier Transform of Dirac delta function	**5**

Text Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications

Reference Books:

1. Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
2. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan,1940, Jones & Bartlett

PH20.204 **Wave and Optics** **4-0-0-4**

Course Objective: *The objective of the course is to acquaint the student with ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.*

Course Outcome: *The student will be able to:*

CO1: Understand Simple harmonic oscillation and superposition principle.
CO2: Understand different types of waves and their velocities: Plane, Spherical, Transverse, Longitudinal.
CO3: Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.
CO4: Understand Interference as superposition of waves from coherent sources derived from same parent source.
CO5: Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand Fraunhoffer and Fresnel Diffraction.

Unit I	**Superposition of Collinear Harmonic oscillations**: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses..	**10**
Unit II	**Wave Motion:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves **Velocity of Waves:** Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.	**10**
Unit III	**Superposition of Two Harmonic Waves**: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves	**10**
Unit IV	**Wave Optics:** Electromagnetic nature of light. Definition and properties of wave front.Huygens Principle. Temporal and Spatial Coherence. **Interference:** Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **Interferometer**: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.	**11**
Unit V	**Diffraction:** Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula and its application to rectangular slit. **Fraunhofer diffraction**: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **Fresnel Diffraction**: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.	**11**

Text Books:

1. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
2. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
4. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

PH20.208: Objective of the course is to acquaint the students with the Experiments based on PH20.204 and PH20.206. So majority of experiments should be based on these courses.

PH20.206 Analog Systems and Applications 4-1-0-5

Course Objective: *This course introduces the concept of semiconductor devices and their applications. It also emphasizes on understanding of amplifiers, oscillators, operational amplifier and their applications*

Course Outcome: *The Student will be able to*

- *CO1: Characteristics and working of pn junction., two terminal devices: Rectifier diodes, Zener diode, photodiode etc*
- *CO2: NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.*
- *CO3: CE and two stage RC coupled transistor amplifier using h-parameter model of the transistor.*
- *CO4: Designing of different types of oscillators and their stabilities.*
- *CO5: Ideal and practical op-amps: Characteristics and applications.*

Unit I	**Semiconductor Diodes:** P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. **Two-terminal Devices and their Applications:** (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.	**10**
Unit II	**Bipolar Junction transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions.	**10**
Unit III	**Amplifiers:** Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers. **Coupled Amplifier:** RC-coupled amplifier and its frequency response. **Feedback in Amplifiers:** Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.	**15**
Unit IV	**Sinusoidal Oscillators:** Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	**5**
Unit V	**Operational Amplifiers (Black Box approach):** Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. **Applications of Op-Amps:** (1) Inverting and non-inverting amplifiers, (2) Adder, (3)Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. **Conversion:** Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)	**12**

Text Books:

1. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
2. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc Graw Hill
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
5. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
6. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India

PH20.301 **Quantum Mechanics and Applications** **4-0-0-4**

Course Objective: *After learning the elements of modern physics, in this course students would be exposed to more advanced concepts in quantum physics and their applications to problems of the sub atomic world.*

Course Outcome: *The Student will be able to learn*

- *CO1: Methods to solve time-dependent and time-independent Schrodinger equation.*
- *CO2: Quantum mechanics of simple harmonic oscillator.*
- *CO3: Non-relativistic hydrogen atom: spectrum and eigenfunctions.*
- *CO4: Angular momentum: Orbital angular momentum and spin angular momentum.*
- *CO5: Bosons and fermions - symmetric and anti-symmetric wave functions. Application to atomic systems*

Unit I	**Time dependent Schrodinger equation**: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **Time independent Schrodinger equation**-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.	**15**
Unit II	**General discussion of bound states in an arbitrary potential**- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.	**10**
Unit III	**Quantum theory of hydrogen-like atoms**: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.	**10**
Unit IV	**Atoms in Electric & Magnetic Fields**: Electron angular momentum. Spacequantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **Atoms in External Magnetic Fields**:- Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).	**10**
Unit V	**Many electron atoms**: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms- L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and AlkaliAtoms (Na etc.).	**7**

Text Books:

1. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India
2. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education

. **Reference Books**

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.

3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press.
5. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.

PH20.303 Statistical Mechanics 5-1-0-6

Course Objective: *The objective of the course is to enable the students to understand basics of classical statistics with applications in classical theory of radiations and quantum statistics with quantum theory of radiations.*

Course Outcome: *The student will be able to*

CO1: *Assess the basic concept of ideal gas and Gibb's paradox*
CO2: *Apply classical theory to radiation*
CO3: *Deduce the radiation laws using quantum theory.*
CO4: *Outline the features and applications of Bose-Einstein's statistics.*
CO5: *Apply the Fermi- Dirac distribution to model Outline the features and applications of Fermi-Dirac statistics*

Unit I	**Classical Statistics:** Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.	**15**
Unit II	**Classical Theory of Radiation:** Properties of Thermal Radiation. Blackbody Radiation.Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe.	**10**
Unit III	**Quantum Theory of Radiation:** Spectral Distribution of Black Body Radiation.Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3)Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.	**10**
Unit IV	**Bose-Einstein Statistics:** B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas.Bose derivation of Planck's law.	**15**
Unit V	**Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.	**15**

Text Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press
2. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall

Reference Books:

1. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
2. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W.
3. Sears and Gerhard L. Salinger, 1986, Narosa.
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer

5. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

PH20.307 **Nuclear and Particle Physics** **5-1-0-6**

Course Objective: The objective of the course is to impart the understanding of subatomic particles and their properties. The students will learn how cutting-edge research is trying to answer the big questions about our universe. In addition they will learn how new ideas tofind their way from fundamental research to specific applications that have practical value

Course Outcome: Students will be able to:

CO1: Understand the basic properties of nucleus and nuclear models to study the nuclear structure properties.
CO2: Understand the various aspects of nuclear reactions will give idea how nuclear power can be generated.
CO3: Explore Nuclear fission and fusion.
CO4: Understand the various decay processes and related laws
CO5: Explore basic of elementary particles

Unit I	**General Properties of Nuclei:** Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density, matter density (experimental determination of each), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/Z plot, angular momentum, parity, magnetic moment, electric moments. **Nuclear Models:** Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, nucleon separation energies (up to two nucleons), Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure and the basic assumptions of shell model.	**15**
Unit II	**Particle Accelerators:** Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons (Principal, construction, working, advantages and disadvantages). **Particle physics:** Particle interactions (concept of different types of forces), basic features, Cosmic Rays, types of particles and its families, Conservation Laws (energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness) concept of quark model, color quantum number and gluons.	**15**
Unit III	**Interaction of Nuclear Radiation with matter:** Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter (photoelectric effect, Compton scattering, pair production), neutron interaction with matter. **Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector	**15**
Unit IV	**Radioactivity decay:** Decay rate and equilibrium (Secular and Transient) (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy, decay Chains. (b) β- decay: energy kinematics for β-decay, β-spectrum, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission from the excited state of the nucleus & kinematics, internal conversion.	**12**
Unit V	**Nuclear Reactions:** Types of Reactions, units of related physical quantities, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).	**8**

Text Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).

Reference Books:

1. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
2. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
3. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons

4. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).

PH20.309	**Computational Physics**	**2-0-0-2**
Course Objective:	*The objectives of the course is to enable the student to solve and represent concept of physics into mathematical outcome and pictorial representation.*	
Course Outcome:	*The student will be able to:*	
CO1:	*Understand the flow charts and algorithms.*	
CO2:	*Understand the basic concepts of programming language.*	
CO3:	*Apply the computer programming for solving the physics' problems.*	
CO4:	*Learn the scientific word processor tools.*	
CO5:	*Apply the word processor tools for writing research articles and dissertations.*	
Unit I	**Introduction to MATLAB Programming:** Concept of plow chart and algorithms, Basics of MATLAB programming, Array operations in MATLAB, Loops and execution control, Working with files: Scripts and Functions, Plotting and program output	**8**
Unit II	**Application of Matlab in solving problems of Physics**: Matrix operations, Numerical Differentiation and Integration, Linear Equations, Regression and Interpolation, Ordinary Differential Equations (ODE).	**8**
Unit III	**Scientific word processing: Introduction to LaTeX:** TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages.	**4**
Unit IV	**Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, List making environments, Fonts, Picture environment and colors, errors.	**4**
Unit V	**Application of Latex:** Writing a research paper, a report, a dissertation and a book.	**2**

Text Books:

1. Fausett L.V. (2007) Applied Numerical Analysis Using MATLAB, 2nd Ed., Pearson Education.
2. Chapra S.C. (2012) Applied Numerical methods with Matlab for Engineers and Scientists, McGraw Hill.
3. Leslie L. (1994) LaTeX–A Document Preparation System", Second Edition, Addison-Wesley.

Reference Books:

1. Sastry S.S. (2013) Introductory methods of numerical analysis-V Ed., Prentice Hall.
2. Pratap R. (2010) Getting started with MATLAB, Oxford Higher Education.

PH20.305: Objective of the course is to acquaint the students with the Experiments based on PH20.301, PH20.303 and PH20.307 So majority of experiments should be based on these courses.

PH20.311: Objective of the course is to acquaint the students with the Experiments based on PH20.309. So majority of experiments should be based on this course.

PH20.302 Solid State Physics 4-0-0-4

Course Objective: *The objective of the course is to acquaint the student with the introduction to the basic concepts and principles to understand the various properties exhibited by condensed matter, especially solids. The syllabus is specifically designed to guide the students to learn how to create a theoretical model for a particular property and appreciate the beauty that lies in these solids through their properties.*

Course Outcome: *The Student will be able to*

- *CO1: Understand structures in solids and their determination using XRD.*
- *CO2: Understand behavior of electrons in solids including the concept of energy bands.*
- *CO3: Understand Magnetic and dielectric properties of solids.*
- *CO4: Practice problem solving by using selected problems in solid state physics.*
- *CO5: Understand superconductivity basics.*

Unit I	**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.	**10**
Unit II	**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T3 law .	**8**
Unit III	**Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom.Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes. **Ferroelectric Properties of Materials:** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.	**14**
Unit IV	**Elementary band theory:** Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient.	**10**
Unit V	**Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation)	**10**

Text Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India

Reference Books:

1. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
2. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
3. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer

4. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
5. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

PH20.304 **Electromagnetic Theory** **5-1-0-6**

Course Objective: *The objective of the course is to enable the student to understand Maxwell's equations, propagation of electromagnetic (em) waves in different media, production and detection of different types of polarized em waves, general informatios of waveguides and fibre optics.*

Course Outcome: *The Student will be able to*

CO1: *Apply vector calculus to understand the behavior of static electric in standard configurations*
CO2: *Apply vector calculus to understand the behavior ofmagnetic fields in standard configurations*
CO3: *Describe and analyze electromagnetic wave propagation in free-space*
CO4: *Describe and analyze transmission lines, wave guides.*
CO5: *Understand the basic of fiber optics.*

Unit I	**EM Wave Propagation in Unbounded Media:** Plane em waves through vacuum and isotropic dielectric medium: transverse nature, refractive index, dielectric constant, wave impedance. Plane em waves through conducting medium: relaxation time, skin depth, attenuation constant. Wave propagation through dilute plasma: electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth.	**15**
Unit II	**EM Waves in Bounded Media:** Boundary conditions at a plane interface between two media. Reflection & Refraction of plane em waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence)	**12**
Unit III	**Polarization of EM Waves:** Propagation of em waves in an Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Description of Linear, Circular and Elliptical Polarization. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light	**18**
Unit IV	**Rotatory Polarization:** Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.	**10**
Unit V	**Wave Guides:** Planar optical wave guides. Planar dielectric wave guide ($-d/2 < x < d/2$). Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission. **Optical Fibres:** Acceptance Angle, Numerical Aperture. Step and Graded Index fibres (Definitions Only). Single and Multiple Mode Fibres.	**10**

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.

Reference Books

1. Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.
2. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning

4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

PH20.308 Nano Materials and Applications 4-0-0-4

Course Objective: *The objective of the course is to enable the student to understand basics of nano-scale materials and nano-structured systems with their optical and electronic properties for device based applications.*

Course Outcome: *The Student will be able to*

- *CO1: Apply quantum mechanical approach to understand nanoscale systems*
- *CO2: Analyze the synthesis and characterization techniques of nano-structure materials*
- *CO3: Understand the optical properties of nanostructures*
- *CO4: Demonstrate electronic transport in nanostructures*
- *CO5: Find the applications of nano-materials in nano-scale devices*

Unit I	**Nanoscale Systems:** Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods)**,** Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.	**10**
Unit II	**Synthesis of Nanostructure Materials:** Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots. **Characterization:** X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.	**14**
Unit III	**Optical Properties:** Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.	**10**
Unit IV	**Electron Transport**: Carrier transport in nanostrcutures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities:Deep level and surface defects	**8**
Unit V	**Applications:** Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation).CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers,optical switching and optical data storage. Magnetic quantum well; magnetic dots -magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).	**10**

Text Books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)

Reference Books:

1. K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).
2. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

3. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).
4. Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

PH20.306: Objective of the course is to acquaint the students with the Experiments based on PH20.302 and PH20.304. So majority of experiments should be based on these courses.

PH20.310: Objective of the course is to acquaint the students with the Experiments based on Electronics.

RM20.301 ***Research Methodology*** **2-0-0-2**

Objective: To acquire fundamental knowledge research methodology and apply in liberal arts, sciences and applied sciences.

1.	Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
2.	Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
3.	Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
4.	Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation -Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
5.	Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome: After completion of the course, students would be able to apply the knowledge of research methodology in liberal arts, sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Suggested Readings:

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.)

Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences.

PH20.105 Physics Laboratory I

1 To determine the moment of inertia of a flywheel about its own axis of rotation.
2 To determine the value of modulus of rigidity of a given wire by Maxwell needle.
2 To determine the value of Poisson's ratio for the material of given wire using Searl's method.
4 To determine the Young's modulus of material of a rectangular bar by bending.
5 To determine the viscosity of glycerin by Stoke's Law.
6 To convert a galvanometer into voltmeter of given range.
7 To determine the specific resistance of a given wire by using the Carey Foster's bridge.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

Proposed List of Experiments for Physics #

PH20.106 Physics Laboratory II

1 To plot graph showing the variation of magnetic field with distance along the axis of a circular coil carrying current and to estimate the radius of the coil.
2 To study the Faraday Law by determination of induced emf as a function of velocity of the magnet through a coil.
2 To determine the ballistic constant using the ballistic galvanometer.
4 To determine the Mutual Inductance using ballistic galvanometer.
5 To convert a galvanometer into an ammeter of a given range.
6 To determine the resolving power of a telescope.
7 To plot V-I Characteristics of PN Junction/ Zener Diode and find cut-in Voltage, static and dynamic resistances in both forward and reverse biased conditions.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

.	PH20.207	Physics Laboratory III
1	To determine the specific heat capacity of copper.	
2	To determine the temperature coefficient of resistance of copper wire.	
2	To measure the thermal relaxation time constant of a serial light bulb.	
4	To determine the Stefan's law using a bulb.	
5	To determine the capacitance of ceramic capacitor.	
6	To determine the high resistance by the method of leakage of a condenser with the help of ballistic galvanometer.	
7	To verify that impedance of a capacitance c varies as $Z_c = {}^{1}/_{2\pi fc}$ and to measure the value of the capacitance.	

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

PH20.305 Physics Laboratory V

PH20.208 Physics Laboratory IV

1 To determine the dispersive power of the material of a prism for violet and yellow colours of mercury light with the help of a spectrometer.

2 To determine the wavelength of sodium light with the help of Fresnel's bi-prism.

2 To determine the wavelength of sodium light with the help of Newton's ring experiment.

4 To determine the wavelength of the prominent lines of Mercury by plane diffraction grating.

5 To study the resonance in Series/ Parallel LCR circuits and determine its Q factor

6 To measure the period of oscillation of pendulum by changing the angle using the vibrational g pendulum.

7 To determine the specific rotation of a solution of cane sugar using Polarimeter.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

1 To study of material constant, temperature coefficient of current and Planck's constant.

2 To study the variation of resistivity with temperature and hence determines the energy band gap of the given semiconductor with help of four probe method.

2 To study the Photodiode, LED and LDR (Opto Electronics Device) characteristics.

4 To study the Photo Transistor and Opto-coupler characteristics.

5 To determine unknown Capacitance using De Sauty's bridge.

6 To show that the impedance of a coil of resistance R_L and self inductance L varies with frequency as $Z_{coil} = (R_L^2 + 4\pi^2 f^2 L^2)^{1/2}$ and to measure the self inductance.

7 To study the Basic logic gates (AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR) and verify the truth tables. Draw the equivalent circuit and verify the following theorems:
Single Variable Theorems, Multivariable Theorem, Demorgan's Theorem-I and II.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

. PH20.306 Physics Laboratory VI

1 To determine the dielectric constant of a non polar liquid.

2 To study the B-H curve of hysteresis loop.

2 To determine the Hall coefficient for a given sample.

4 Draw the input and output characteristics of a PNP/ NPN transistor in common Base (CB) configuration.

5 To study the Full wave/ Bridge rectifiers.

6 To study the characteristics of JFET.

7 To study elliptically polarized light by means of a photoelectric cell.

#Total 8 to 10 experiments are to be performed in each laboratory course. Additional experiments may be added as per the requirement of course curriculum.

Additional DSC of Physics may be Opted in V and VI Semesters

PH20.313 **Classical Dynamics*** **5-1-0-6**

Course Objective: *The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.*

Unit I	**Classical Mechanics of Point Particles:** Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as coupled oscillators. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Poisson brackets. Canonical transformations.	**22**
Unit II	**Special Theory of Relativity:** Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energy-momentum relation.	**9**
Unit III	**Applications:** Doppler effect from a four- vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of **E** and **B**. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields.	**9**
Unit IV	**Relativistic kinematics:** Application to two-body decay of an unstable particle. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of **E** and **B**. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form. Motion of charged particles in external electric and magnetic fields	**15**
Unit V	**Electromagnetic radiation:** Review of retarded potentials. Potentials due to a moving charge: Lienard Wiechert potentials. Electric & Magnetic fields due to a moving charge: Power radiated, Larmor's formula and its relativistic generalisation.	**10**

Text Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon

Reference Books:

1. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley.
2. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
3. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
4. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press.

PH20.314 **Bio-Physics**** **5-1-0-6**

Course Objective: *The emphasis of the course is to make students familiar with interdisciplinary discipline and connect them towards biological aspects of Physics.*

Unit I	**Building Blocks & Structure of Living State:** Atoms and ions, molecules essential for life, what is life. **Living state interactions:** Forces and molecular bonds, electric & thermal interactions, electric dipoles, casimir interactions, domains of physics in biology.	**15**
Unit II	**Heat Transfer in biomaterials:** Heat Transfer Mechanism, The Heat equation, Joule heating of tissue. **Living State Thermodynamics:** Thermodynamic equilibrium, fIrst law of thermodynamics and conservation of energy. Entropy and second law of thermodynamics, Physics of many particle systems, Two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein folding and unfolding.	**16**
Unit III	**Open systems and chemical thermodynamics:** Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin.	**9**
Unit IV	**Diffusion and transport** Maxwell-Boltzmann statistics, Fick's law of diffusion, sedimentation of Cell Cultures, diffusion in a centrifuge, diffusion in an electric field, Lateral diffusion in membranes, Navier stokes equation, low Reynold's Number Transport, Active and passive membrane transport.	**9**
Unit V	**Open systems and chemical thermodynamics:** Enthalpy, Gibbs Free Energy and chemical potential, activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Hemoglobin.	**16**

Text Books:

1. Introductory Biophysics, J. Claycomb, JQP Tran, Jones & Bartelett Publishers

Reference Books:

1. Aspects of Biophysics, Hughe S W, John Willy and Sons.
2. Essentials of Biophysics by P Narayanan, New Age International

EV20.102	***Environmental Studies***	**4-0-0-4**
Objective	To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.	
Unit1	Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	**9**
Unit2	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	**10**
Unit3	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification.Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation.Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	**08**
Unit 4	Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	**08**
Unit 5	Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	**8**
Unit 6	Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	**7**
Unit 7	Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	**6**
Unit 8	Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	**5**

Course Outcome

Aftercompletion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.

SuggestedReadings
Text Books:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37.
7. McCully, P.1996. Rivers no more: the environmental effects of dams(pp. 29-64). Zed Books.
8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Refence Books:

1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
2. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
3. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.
4. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
5. World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.
6. www.nacwc.nic.in 22.www.opcw.org

Mathematics Courses

MS20.101 Differential and Integral Calculus 5-1-0-6

Objective: To acquire fundamental knowledge of differential calculus and integral calculus and apply in sciences and applied sciences.

1.	Differential Calculus I:Functions, Types of functions, Limits and continuity($\epsilon - \delta$ definition),Types of discontinuities, Higher order derivatives, Indeterminate forms,L-Hospital's rule, Leibniz rule , Points of extreme, Concavity and inflection points, Rolle's theorem, Mean value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series, Jacobeans, interdisciplinary applications.	**13**
2.	Differential Calculus II :Parallel and oblique asymptotes in Cartesian and Polar coordinates, Intersection of a curve with its asymptotes, application of differentiation in curve sketching/tracing in cartesian and polar coordinates, Tangent and normal-Introduction, Equation of tangent and normal, Angle of intersection of two curves, Suntangent and subnormal, Polarsub tangent and subnormal, Pedalequation; Curvature and Evolutes-Introduction, Center and radius of curvature in Cartesian and polar forms, Pedalcurve, Tangential polar formula, Chord of curvature, Evolutes and involutes, Newtonian method.	**13**
3.	Integral Calculus I: Review as a limiting sum of areas and the anti-derivative/ indefinite integral, the fundamental theorem of Calculus, Reduction formulae and its derivation and illustration for the type $\int \sin^n(x)dx$, $\int \cos^n(x)dx$, $\int \tan^n(x)dx$, $\int \sin^n(x)\cos^n(x)dx$,$\int sinnxdx$,$\int cosnxdx$, $\int tannxdx$, $\int secnxdx$, $\int (logx)^n dx$ etc.	**13**
4.	Integral Calculus II: Computing volumes by slicing, disk and washer method, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, area of surface of revolution Surface areas and volumes using Pappus-Guldinus theorems(with proof) and solid of revolution.	**13**
5.	Conic Section and Vector Functions: Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminate, polar equation of conics, Triple product, introduction, operations of vector functions, limit, continuity, differentiation and integration of vector functions, tangent and normal form of acceleration, modeling ballistics and planetary motion, Kepler's second law with interdisciplinary applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential calculus and integral calculus in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Thomas and Weir (2017), Thomas Calculus, 13e, Pearson.

2. Dennis G. Zill and Warren S. Wright (2011), Single Variable Calculus, 4/e, Jones and Bartlett Learning.

Reference Books:

1. Mittal P.K. (2016), Mathematics for Degree Students, S.Chand and Company Pvt. Ltd.
2. Ramana B.V (2008), Higher Engineering Mathematics, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Jain and Iyengar (2004) Advanced Engineering Mathematics, Narosa Publishing House.
4. Mendelson (2016), Schaum's outline of Beginning Calculus, McGraw Hill Education.

MS20.102 **Group Theory** **5-1-0-6**

Objective: To acquire fundamental knowledge of group theory and apply in sciences and applied sciences.

1.	Preliminaries: Sets, Subsets, Relations, Equivalence classes, Functions, Equality and composition of mappings,Binarycompositions,Permutations,Cyclicpermutations,Cycles of a permutation, Disjoint permutations, Some results from number theory(Euclid's theorem and Basis representation theorem),The greatest common divisor, Prime numbers, Congruences, Chinese reminder theorem, proof of all properties and applications.	**13**
2.	Group-I: Algebraic Structure, Symmetries of a square, Dihedral groups, Definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), Elementary properties of groups, Order of an element of a group, proof of all properties and applications.	**13**
3.	Group-II: Subgroups and examples of subgroups, Theorems on subgroups, Centralizer, Normalizer, Center of a group, Product of two subgroups with theorems related to centralizer, normalizer, and center of a group, proof of all properties and applications.	**13**
4.	Cyclic Group and Cosets-I: Properties of cyclic groups, Classification of subgroups of cyclic groups, Cycle notation for permutations, properties of permutations, Even and odd permutations, proof of all properties and applications.	**13**
5.	Cyclic Group and Cosets-II: Alternating group, Definition and properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem, proof of all properties and applications.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of group theory in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Vashistha A.R.andVashisthaA.K (2015), Modern Algebra, Krishna Educational Publisher.
2. John B. Fraleigh (2014), A First Course In Abstract Algebra, Seventh Edition, Pearson.

Reference Books:

1. Joseph A. Gallian (2012), Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House.
2. Khanna and Bhambri(2016), A Course in Abstract Algebra, Fifth Edition, Vikas Publishing House Pvt. Ltd.
3. Michael Artin (2015), Algebra, Second Edition, Pearson.
4. Herstein I.N. (2006), Topics in Algebra, Second Edition, John Wiley and Sons.

MS20.201 **Differential Equations** **5-1-0-6**

Objective: To acquire fundamental knowledge of differential equations and apply in sciences and applied sciences.

1.	First Order Differential Equations-I: Basic concepts of differential equations, Definition, Order and degree of differential equation, general, particular, explicit, implicit and singular solution of differential equation, standard form, equations in which variables are separable, homogeneous and reducible to homogeneous differential equations, linear and reducible to linear (Bernoulli) differential equations, exact and reducible to exact differential equations, different methods of finding integrating factor of equation, equations of first order but not of the first degree, equations solvable for p, y and x , Clairaut's and Lagrange's equations.	**13**
2.	First Order Differential Equations-II: Existence and uniqueness theorem for first –order differential equations, Lipschitz condition and examples, Gronwall's inequality, continuous dependence and initial conditions, Introduction to compartmental model, exponential decay model, lake pollution model (case study of Lake Burley Griffin), drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), exponential growth of population, limited growth of population, limited growth with harvesting. Equilibrium points, Interpretation of the phase plane, predatory-prey model and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.	**13**
3.	Second and Higher Order Differential Equations: Linear differential equations with constant and variable coefficients (Euler Cauchy equation), different forms of complimentary functions and particular integrals, equations reducible to homogeneous liner form, change of independent variables, normal form and method of variation of parameters with proofs of all results.	**13**
4.	Differential Equation of other Types: Introduction, Equation of the type $\frac{d^n y}{dx^n} = f(x)$, Equation of the type $\frac{d^n y}{dx^n} = f(y)$, Equations which do not contain y directly, Equations which do not contain x directly,Equations whose solution is known, Normal	**13**

form(removable of first derivative),Method of solving linear differential equations by changing the independent variable,Method of variation of parameters, Method of undetermined coefficients.

5. Power Series Solution: Introduction, Review of power series, Ordinary and singular points of a differential equation, Power series solution about an ordinary point, Frobenius method series solution about a regular singular point. **13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of differential equations in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Sundarapandian (2012), Ordinary and Partial differential Equations, McGraw Hill Education.
2. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations, 18th Edition, S. Chand Limited.

Reference Books:

1. Nagle, Saff and Snider (2016), Fundamental of Differential Equations, 8th Edition, Pearson.
2. Simmons (2016), Differential Equations with Applications and Historical Notes, McGraw Hill Education.
3. Ramana B.V. (2007), Higher Engineering Mathematics, 2nd Edition, McGraw-Hill Publishing Company Limited, New Delhi.
4. Dennis G. Zill and Michael R Cullen (2009) , Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.

MS20.202 **Real Analysis** **5-1-0-6**

Objective: To acquire fundamental knowledge of real analysis and apply in sciences and applied sciences.

1. The Real Numbers: Introduction, The set N of natural numbers, The set Z of Iintegers, The set Q of rational numbers, The set of real numbers R as a complete ordered field, Closed, open,semi-closed and semi-open intervals, Set bounded above, set bounded below, supremum and infimum of a set, the greatest and smallest members of a set, bounded and unbounded sets, Order-completeness of the set of real numbers, Equivalent description of the order-completeness, property of the set of real numbers, Explicit statement of the properties of the set of real numbers as a complete ordered field, Some important properties of the set of real numbers, The denseness property, the modulus, Principal of mathematical induction, Bernoulli's inequality. **13**
2. Neighborhoods and Limit Points: Introduction and properties of nbd, Limit points of a set and its properties, Properties of closed and open sets, properties of interior, exterior,andboundary points , properties of a closure of a set, Dense and perfect sets, compactsets, Countability of sets. **13**
3. Sequences: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion. **13**

4.	Infinite Series with Positive Terms: Infinite series, its convergence and sum, A necessary condition for the convergence of an infinite series, Cauchy's general principle of convergence of series, General test for the convergence of positive term series, convergence of geometric series and generalized harmonic series, Comparision tests for the convergence of positive term series, Comparison tests of first type, Practical comparision tests of the first type, Comparision tests of the second type: D'Alembert's ration test, Cauchy's nth root test, Rabbe'sTest, Logarithmictest,DeMorgan's and Bertrand's test, Second logarithmic test, Kummer'stest, Gauss's test, Cauchy's integral test, Cauchy's condensation test, auxiliary series.	**13**
5.	Infinite Series with Positive and Negative Terms: Introduction, Absolute convergence and conditional convergence, Cauchy principle of convergence for a series, Dirichlet's theorem, Abel's theorem, Re-arrangements of series, Re-arrangements of a conditional convergent series, Sauchy product of two infinite series.	**13**

Course Outcome: After completion of the course, students would be able to apply the knowledge of real analysis in sciences and applied sciences with solve curriculum problems with respect to remember, understand, apply, analyse, evaluate and create.

Text Books:

1. Gerald G. Bilodeau, Thie P. R., and Keough G.E. (2010), An Introduction to Analysis, 2nd Ed., Jones & Bartlett.
2. Malik S.C. and Arora S.(2010), Mathematical Analysis, 4th Edition New Age International Ltd.

Reference Books:

1. Royden H.L.(2017), Real Analysis, 2nd Edition, PHI.
2. Charles G. Denlinger (2014), Elements of Real Analysis, Jones and Bartlett Learning.
3. Apostle (1997), Mathematical Analysis, 2nd Edition, Narosa Publishing House.
4. Bartle R.G. and Sherbert D. R. (2002), Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore.

Reference Books:

1. G. Hadley (2002), Linear Programming, Narosa Publishing House, New Delhi.
2. Hillier and. Lieberman (2009), Introduction to Operations Research, 9thEdition, Tata McGraw Hill, Singapore.
3. Sharma S. D .and Himanshu Sharma (2004), Operations Research: Theory, Methods and Applications, 14th edition, KedarNath Ram Nath.
4. Kanti Swarup, PK Gupta and Manmohan (2001), Operations Research, 9th Edition, Sultan Chand andSons,New Delhi

Chemistry Courses

CH 20.101 **Inorganic Chemistry-I** **2-0-0-2**

Atomic Structure: Bohr's theory, its limitations and atomic spectrum of hydrogen atom, Idea of de Broglie matter wave, Heisenberg's uncertainty principle and its significance, Schrodinger's wave equation, significance of ψ and ψ^2, normal and orthogonal wave functions, quantum numbers and their significance, sign of wave functions, radial and angular wave function, radial probability distribution curves, shapes of s, p, d and f orbitals, Aufbau's principle and its limitations, Pauli's exclusion principle, Hund's rule of maximum multiplicity, variation of orbital energy with atomic number, electronic configurations of the elements and ions. **[7]**

Chemical Bonding: Valence bond theory and its limitations, directional and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH_3, H_3O^+, SF_4, ClF_3, ICl_2 and H_2O, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenteric bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference. Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond, free electron, valence bond and band theories. **[7]**

Chemistry of *s*- Block Elements: Electronic configurations, diagonal relationships, solvation and complexation tendencies including their functions in biosystems. **[4]**

Periodicity of p-block elements: Periodicity in properties of p-block elements, Some Important Compounds of p-Block Elements : Hydrides of boron, diborane and higher boranes, fullerenes, carbides, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides. **[4]**

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds (XeF2, XeF4, XeF6, XeOF4, XeO2F2, XeO3). Weak Interactions: Hydrogen bonding, Vander Waals forces. **[4]**

Suggested Readings:

Text Books:

1. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part I, 2008, RBD.

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd Edition, 1995, Wiley Interscience.
2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd

CH 20.103 **Organic Chemistry-I** **3-0-0-3**

Fundamentals of Organic Chemistry: Hybridization, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance, Hyperconjugation, charge-transfer compounds and field effects. **[7]**

Cleavage of Bonds: Homolysis and Heterolysis, Nucleophiles and electrophiles, shape and stability order of reactive Intermediates: Carbocations, Carbanions and free radicals.Strength of organic acids and bases: Comparative study with emphasis on factors affectingpK values.

Stereochemistry: Conformations with respect to ethane, n-butane and cyclohexane. Interconversion of WedgeFormula, Newmann, Sawhorse and Fischer representations. Concept of chirality and Elements of symmetry. Configuration: Geometrical and Optical isomerism; Enantiomerism,Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S and E / Z nomenclature . **[8]**

Chemistry of Alkanes and Alkenes: Preparation,Physical properties and chemical reaction of alkanes. Mechanism of free radical halogenations of alkanes. Alkenes: Preparation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff's rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes- mechanisms involved in hydrogenation, electrophilic and free radical additions. Markownikoff's rule, hydroboration- oxidation, oxymercuration- reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. **[8]**

Chemistry of dienes and alkynes: Isolated, conjugated and cumulated dienes, Structure of allenes and butadiene, methods of formation, polymerization, Chemical reactions-1, 2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes, methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reduction, oxidation and polymerization. **[8]**

Arenes and Aromaticity: Structure of benzene: molecular formula and Kekule structure. Stability and carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: Huckel's rule, aromatic ions. Aromatic electrophilic substitution: General pattern of the mechanism, role of sigma and pi complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives and Birch reduction. **[8]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.
3.McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.

CH20.102 **Inorganic Chemistry-II** **2-0-0-2**

Chemistry of Elements of First Transition series: Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation states, coordination number and geometry.	**[5]**
Chemistry of Elements of Second and Third Transition Series:General characteristics, comparative treatment with their 3d- analogues in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.	**[4]**
Coordination Compounds: Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.	**[7]**
Chemistry of Lanthanide and Actinide Elements: Electronic configuration, oxidation states and ionic, atomic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. Preparation of transuranic elements, Chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.	**[10]**

Suggested Readings:

Text Books:

1. P.L. Soni, Text Book of Inorganic Chemistry, 1999, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

1. F.A. Cotton. G. Wilkinson and P.L. Gaus, Basic Inorganic Chemistry 5rd Ed. 2005, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 18th Ed. 2009, S. Chand & Co. Ltd.
3. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.

CH20.104	**Physical Chemistry-I**	**3-0-0-3**
Gaseous States: Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of Vander Waals equation, relationship between critical constants and Vander Waals constants, the law of corresponding states, reduced equation of state. Molecular velocities: Root mean square, average and most probable velocities. Qualitative discussions of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases (based on Joule- Thomson effect).		**[9]**
Liquid State: Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. Liquid crystals. Difference between liquid crystals, solid and liquid. Classification, structure of nematic and cholestric phases.		**[6]**
Solid State: Definition of space lattice, unit cell. Laws of crystallography, Law of constancy of interfacial angles, Law of rationality of indices, Law of symmetry. Symmetry elements in crystals. X-ray diffraction by crystals. Derivation of Bragg's equation. Determination of crystal structure of NaCl, KC1 and CsCl (Laue's method and Powder method).		**[7]**
Surface tension and Viscosity: Introduction, measurement, applications in chemical constitution, effect of temperature on surface tension and viscosity and parachore.		**[4]**

Nuclear & Radio Chemistry: Elementary idea of nucleus, nuclear forces, mass defect, binding energy, fission and fusion. Liquid drop and shell model of nucleus, theory of radioactivity, GM counters, Wilson cloud chamber, isotopes, group displacement laws and radioactive steady state. **[3]**

Spectroscopy: Electromagnetic radiation of the spectrum, basic features of different spectrometers, Rotational Spectrum -Diatomic molecules, idea of vibrational frequencies of different functional groups. Raman Spectrum concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules. **[4]**

Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus- Drapper law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples). **[6]**

Suggested Readings:

Text Books:

1. P. D. Sharma, A. P. Bhargava, Physical Chemistry B.Sc. Part I, , 2011, RBD.
2. R L Madan, Physical Chemistry, McGraw Hill Education

Reference Books:

1. P.W. Atkins, The elements of Physical Chemistry, 4thEdition, 1998, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 5th Ed. 2003, Vishal Publishing Co.
3.Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4.Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

CH 20.201 Organic Chemistry-II 3-0-0-3

Ultraviolet absorption spectroscopy: Introduction of absorption spectrum. Absorption laws (Beer Lambert Law), Molar absorbance, presentation and analysis of UV spectra, types of electronic transitions, effect of solvents on π-π* and n-π* transitions, effect of conjugation, Concept of chromophore and auxochrome. Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated dienes and enones. **[6]**

Infrared absorption spectroscopy: Molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, Fermi resonance, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds. **[5]**

Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution SN^1 and SN^2. **[5]**

Polyhalogen compounds: Synthesis and uses of chloroform, carbon tetrachloride, iodoform, dichloromethane, freons, DDT and BHC. **[5]**

Alcohols: Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and Pinacol-Pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol. **[5]**

Phenols: Nomenclature, structure and bonding, Preparation of Phenols, Physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction. **[5]**

Ethers and Epoxides: Nomenclature of ethers and methods of their formation, Physical properties, Chemical reactions-cleavage and auto oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides. **[4]**

Synthetic Polymers: Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step growth polymerization. Polyesters, polyamides, phenol-formaldehyde resins, urea-formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubbers. **[4]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.

CH20.203 **Physical Chemistry-II** **2-0-0-2**

Thermodynamics: Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work. Definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature, calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition. **[7]**

Thermochemistry: Hess's Law and its applications, Heat of reaction at constant pressure and volume. Enthalpy of neutralization. Bond dissociation energy and its calculation, temperature dependence of enthalpy, Kirchoff's equation. Carnot cycle and its efficiency. Thermodynamic scale of temperature. Concept of entropy: Entropy- as a state function, as a function of V & T, as a function of P & T, as a criteria of spontaneity and equilibrium, entropy change in physical change, Clausius inequality, Entropy change in ideal gases and mixing of gases. Nernst heat theorem, concept of residual entropy, evaluation of absolute entropy from heat capacity data, Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T. **[8]**

Chemical Kinetics: Scope, Rate of a reaction and factors influencing it. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero, first, second; pseudo order, half-life and mean-life. Determination of the order of reaction-differential method, method of integration, method of half-life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods of chemical kinetics: conductometric, potentiometric, optical, polarimetry and spectrophotometry. Theories

of chemical kinetics. Arrhenius equation, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory. Expression for the rate constant based on equilibrium constant and thermodynamic aspects. **[11]**

Suggested Readings:

Text Books:

1. P. D. Sharma and A.P. Bhargava, Physical Chemistry B. Sc. Part II, 2011, RBD.
2. K.R. Genwa, Physical Chemistry B.Sc. Part II, 2004, RBD.

Reference Books:

1. P. W. Atkins, The elements of Physical Chemistry, 3rd Ed. 1993, Oxford.
2. Puri, Sharma, Pathania, Principles of Physical Chemistry, 6th Ed. 2009, Vishal Publishing Co.
3. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd

CH20.202 Inorganic Chemistry-III 2-0-0-2

Acids and Bases: Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases. **[4]**

Hard and Soft Acids and Bases (HSAB): Classification of acids and bases as hard and soft. Pearson's HSAB concept, acid-base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness. **[8]**

Oxidation and Reduction: Oxidation and reduction potential, applications of electrochemical series. Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements. **[9]**

Non-aqueous Solvents: Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2. **[5]**

Suggested Readings:

Text Books:

1. P. L.Soni, Text Book of Inorganic Chemistry, 2005, S. Chand & Co. Ltd.
2. Shivahare and Lavania, Inorganic Chemistry B.Sc. Part III, 2004, RBD.

Reference Books:

1. F. A. Cotton. G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 4th Ed. 2005, Wiley Interscience.
2. Wahid U. Malik, G.D. Tuli, R.D. Madan, Selected Topics in Inorganic Chemistry, 17th Ed. 2006, S. Chand & Co. Ltd.
3. R.L. Madan,G.D. Tuli, Inorganic Chemistry, reprint 2003, S. Chand & Co. Ltd.
4. Practical Chemistry: Giri, Bajpai and Pandey, reprint 2009, S. Chand & Co.Ltd.

CH20.204 Organic Chemistry-III 3-0-0-3

Nuclear magnetic resonance (NMR) spectroscopy: Proton magnetic resonance (^{1}H-NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of PMR spectra of simple **[9]**

organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1, 2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.

Aldehydes and Ketones: Structure of the carbonyl group. Synthesis of aldehydes and ketones from acid chlorides, 1,3-dithianes, nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel condensations, condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. **[10]**

Carboxylic Acids: Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Carboxylic acids- Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids. Mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids. Methods of preparation and chemical reactions of three unsaturated monocarboxylic acids. Dicarboxylic acids: methods of preparation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids). **[10]**

Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation and chemical reactions of carboxylic acid derivatives. Mechanisms of esterification and hydrolysis (acidic and basic). **[6]**

Organic Synthesis via Enolates: Acidity of α-hydrogens, alkylation of diethyl malonate and ethyl acetoacetate. Synthesis of ethyl acetoacetate; the Claisen condensation. Keto-enol tautomerism of ethyl acetoacetate. Alkylation of 1, 3-dithianes. Alkylation and acylation of enamines. **[4]**

Suggested Readings:

Text Books:

1. P. L. Soni and H. M. Chawla, Text Book of Organic Chemistry, 28th Ed. 1999, S. Chand & Co Ltd.
2. A. K. Srivastava, Organic Chemistry, 1st Ed. 2002, New Age International.
3. P. Singh, Organic Chemistry B.Sc. Part I, 2006, RBD.

Reference Books:

1. Morrison & Boyd, Organic Chemistry, 6th Ed. 1998, Prentice Hall.
2. Bahl and Arun Bahl, Advanced Organic Chemistry, 19th Ed. 2005.

CH 20.111	Inorganic and Organic Chemistry Laboratory-I	0-0-2-1

Perform any EIGHT experiments from the below list.

1-4.To analyze the given mixture containing four radicals (two acidic and two basic) including interfering acid radicals- fluoride, borate, oxalate, phosphate and excluding insoluble. (Four mixture)

1. Preparation of standard solutions of different Molarity/Normality of titrants.
2. Purification of a given organic sample solid/liquid through crystallization or distillation and ascertaining their purity through melting point or boiling point.
3. To study the process of sublimation of camphor and phthalic acid.
4. Systematic identification-I (detection of extra elements, functional groups: To determine the functional group of the given organic compound through element detection and functional group analysis: Carboxylic Acid, alcoholic, phenolic, ester, aldehydic, ketonic, carbohydrate, amide, anilide, nitro and hydrocarbon.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
2. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
3. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.

Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

CH20.112	Inorganic and Physical Chemistry Laboratory-I	0-0-2-1

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
3. Determination of Hardness of water by EDTA method.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
6. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
7. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi – and trivalent anions.
8. To determine the surface tension of a given liquid by drop number method.
9. To determine the viscosity of a given liquid.
10. To determine the specific refractivity of a given liquid.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

3. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
6. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
7. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.

CH 20.211	Organic and Physical Chemistry Laboratory-I	0-0-2-1

1. Systematic identification-II: To identify the given organic compound through element detection, functional group analysis and confirmative test and preparation of at least one pure solid derivative.Any six organic compounds may be identified, like Naphthalene, m-dinitrobenzene, resorcinol, α-naphthol, β-naphthol, benzophenone, benzaldehyde, benzoic acid, salicyclic acid, cinnamic acid, benzamide, urea, acetanilide, benzanilide, aniline, glucose.
2. To determine the CST of phenol – water system.
3. To determine the solubility of benzoic acid at various temperatures and to determine the pH of the dissolution process.
4. To determine the enthalpy of neutralization of a weak acid/weak base vs. strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
5. To determine the enthalpy of solution of solid calcium chloride.
6. To study the distribution of iodine between water and CCl_4.

Suggested Readings:
Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
2. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
3. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

CH20.212	Inorganic and Organic Chemistry Laboratory-II	0-0-2-1

1. Estimation of Ni(II) using dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN.
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
4. Quantitative estimation of copper-Zinc of the following mixture by volumetric and gravimetric methods
5. Quantitative estimation of Zinc-nickel of the following mixture by volumetric and gravimetric methods
6. Steam distillation (non evaluative) Naphthalene from its suspension in water Separation of o- and p-nitrophenols
7. Column chromatography (non evaluative) Separation of fluorescein and methylene blue. Separation of leaf pigments from spinach leaves.
8. Determination of Rf values and identification of organic compounds.
9. Separation of green leaf pigments (spinach leaves may be used) by paper chromatographic method (b) Separation of a mixture of coloured organic compounds using common organic solventsby TLC.

Suggested Readings:

Text Book:

1. Practical Chemistry: Giri, Bajpai and Pandey, Reprint 2009, S. Chand & Co. Ltd.
2. R.L. Madan, G.D. Tuli, Physical Chemistry, 2nd revised Ed. 2005, S. Chand & Co. Ltd.

Reference Books:

1. Experimental Inorganic/Physical Chemistry, 1st Edition, An Investigative, Integrated Approach to Practical Project Work, M A Malati, Woodhead Publishing, 1999.
4. Laboratory Manual Of Practical Inorganic Chemistry, Yogyakarta State University.
5. A.O. Thomas, Practical Chemistry, 8th Ed. Geethanjali Offset Prints, Calicut.
6. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

Mody University of Science & Technology

Master's of Science (Microbiology)

(Effective from Academic Year 2020-21)

M.Sc. (Microbiology)

Vision:

To provide quality education in Microbiology contributing to make student's career bright as well as making them competent.

Mission

To provide an environment to foster continuous improvement, innovation and become vanguard in the field of Microbiology.

Programme Educational Objectives (PEO's)

PEO1: Graduates are grounded with practical knowledge and hands-on microbiological techniques and project experience to meet the industrial needs.

PEO2: Graduates are well indoctrinated to be employed in the field of education, research, food and pharma industries.

PEO3: Graduates are prepared and motivated to adapt themselves for life-long learning through professional activities to become universal figurehead.

Program Outcomes (POs)

At the end of the M.Sc. Microbiology Programme, graduates will be able to

PO1: Acquire knowledge of various domains including Bacteriology, Phycology, Virology, Mycology, Physiology, Food/Medical/Industrial and Environmental Microbiology and many others.

PO2: Gain expertise in handling and working of microbiological tools, equipment and instruments.

PO3: Prepare for NET/SET examinations.

PO4: Gain insight into research and research methodologies.

Programme Specific Outcome (PSOs)

At the end of the M.Sc Programme, Post-graduates will be able to

PSO1: Can implement their knowledge and skills in a wide range of careers in industry (marketing, technical support and regulatory affairs) education (teaching, museums and science centres), business (patent attorney or accountant) and communications (public relations, journalism and publishing).

PSO2: Student will demonstrate high level proficiency in emerging research areas.

PSO3: Devise and fabricate new inventions and share their work through publications.

Session 2020-2021 onwards

The proposed programme shall be governed by the Department of - Biosciences, SLAS, MUST, Laxshmangarh.

Programme Level: Post Graduate **Duration:** Two Years (Four Semesters)

No. of Seats: 10

Introduction:

Master of Science is a graduate level degree course in the field of science for 2 years (four semesters). This course contains a deeper insight into microbiology which includes the study of all living organisms that are too small to be visible to the naked eye such as bacteria and fungi which are collectively known as microbes. The subject of microbiology is a vast subject, including numerous sub-disciplines like virology, parasitology, mycology and bacteriology. These microscopic organisms are known as microbes which play crucial roles in nutrient cycling, biodegradation/biodeterioration, climate change, food spoilage, the cause and control of disease, and biotechnology. Microbes are also useful in making life-saving drugs, manufacturing of biofuels, cleaning up pollution and producing/processing food and drink. The job opportunities for a graduate of M.Sc course are plenty in the public and private sectors.

Input Qualification:

Candidate should have passed bachelor's degree from a recognized university with Microbiology/ Biotechnology/ Botany/ Zoology as a subject for three years or six semesters.

Programmed and Teaching Methodology

The teaching methods include lectures, practical's, field visits, workshops, seminars, field visits, guest lectures etc.

Evaluation Procedure

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [4] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation: Year up-gradation of the student will be as per the University ordinance.

Name of the Programme: M.Sc. Microbiology								Year: First			
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)			
			L	T	P			CW[$]	MTE	ETE	
	Core Courses										
Autumn Semester	MB20.501	Microbial Physiology and Metabolism	4	-	-	4	3	25	25	50	
	MB20.503	Bacteriology and Phycology	3	-	-	3	3	25	25	50	
	MB20.505	Microbial Physiology and Instrumentation Laboratory	-	-	6	3	8	25	25	50	
	MB20.507	Microbiology Laboratory-I	-	-	6	3	8	25	25	50	
	BT20.507	Cell and Molecular Biology	3	-	-	3	3	25	25	50	
	MS20.501	Math and Statistics for Biology	2	-	-	2	3	25	25	50	
	RM20.501	Research Methodology and Scientific Communication Skills	2	-	-	2	3	25	25	50	
	BT20.513	IPR and Biosafety and Bioethics	2	-	-	2	3	25	25	50	
	FL-I	Foreign Language-I	3	-	-	3	3	25	25	50	
		Sub Total	**19**		**12**	**25**					
	SF 101 (Non credit)	Personal Grooming, Fine Dining				1					

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester	**Core Courses**									
	MB20.502	Virology and Mycology	3	-	-	3	3	25	25	50
	MB20.504	Microbial Genetics	3	-	-	3	3	25	25	50
	MB20.506	Microbiology Laboratory-II	-	-	6	3	6	25	25	50
	BT20.512	Elective Course: Food Technology	3	-	-	3	3	25	25	50
	BT20.502	Bioinformatics	3	-	-	3	3	25	25	50
	BT20.504	Immunology	3	-	-	3	3	25	25	50
	BT20.506	Genetics Engineering	3	-	-	3	3	25	25	50
	BT20.516	Bioinformatics and Immunology Laboratory	-	-	6	3	6	25	25	50
	FL-II	Foreign Language-I	3	-	-	3	3	25	25	50
		Sub Total	**21**		**12**	**27**				
	SF 102 (Non credit)	Social Grooming, Home & Decor and Business Communication				1				

$CW (Course work) includes teacher assessment, assignments, class /quiz test.

Elective paper	BT20.512 Food Technology FS20.510 Introduction to Forensic Biotechnology

Session 2020-2021 onwards										
Name of the Programme: M.Sc. Microbiology							**Year: Second**			
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$^{\$}$	MTE	ETE
Autumn Semester										
	MB20.601	Environmental and Agricultural Microbiology	3	-	-	3	3	25	25	50
	MB20.603	Industrial Microbiology	3	-	-	3	3	25	25	50
	MB20.605	Medical Microbiology	3	-	-	3	3	25	25	50
	MB20.607	Critical Analysis of Classical Papers	2	-	-	2	-	-	-	100
	BT20.603	Emerging Technologies	2	-	-	2	3	25	25	50
	MB20.609	Project Proposal	2	-	-	2	-	-	-	100
	MB20.611	Research Seminar	1	-	-	1	-	-	-	100
	MB20.613	Elective Course: Plant pathogen interaction	3	-	-	3	3	25	25	50
	MB20.615	Microbiology Laboratory –III	-	-	6	3	6	25	25	50
		Sub Total	**20**	**-**	**6**	**22**				
	SF 201 (Non-credit)	Personal Grooming, Fine Dining				1				
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$^{\$}$	MTE	ETE
Spring Semester										
	MB20.602	Dissertation	-	-	40	20	-	25	-	75
		Sub Total				**20**				
	SF 202 (Non-credit)	Personal Grooming, Fine Dining				1				
Total			94							

Elective paper	MB20.613 Plant pathogen interaction BT20.615-- Biocatalysis and Biotransformation BT20.617. Molecular Diagnostics

MB20.501 Microbial Physiology and Metabolism 4-0-0-4

Course Objective: To develop understanding of variable aspects of microbial physiology along with diverse metabolic pathways existing in bacteria.

Transport Mechanisms: Basic features of transport- Role of cell membrane in transport, Thermodynamics of transport, Types of transport- passive diffusion, facilitated diffusion, active transport, group translocation, uniport, symport and antiport, Transport of siderophores, Catabolite repression, inducer exclusion and expulsion.	[10]
Microbial Respiration and Fermentation: Oxidative and Substrate level phosphorylation, Aerobic and Anaerobic pathways: Glucose Metabolism- Reactions and control of Glycolysis, Pentose Phosphate Pathway, Gluconeogenesis, Citric acid cycle, Amphibolic and Anaplerotic reaction, , Glyoxylate cycle, Homo and heterolactic fermentation, Pasteur effect, Fermentation pathways in specific group of microorganisms: Lactic acid, propionic acid, butyric acid producing fermentation	[14]
Photosynthesis: Brief account of photosynthetic and accessory pigments- Chlorophyll, Bacteriochlorophyll, Carotenoids and Phycobiliproteins, Details of Oxygenic and Anoxygenic photosynthesis, Major groups of photosynthetic bacteria and their pathways: Fixation of CO_2- Calvin cycle, C_3 and C_4 pathway.	[13]
Nitrogen and Lipid Metabolism: Nitrogen cycle, Assimilation of nitrogen, Biosynthesis of amino acids, Nitrogen fixation- basic concepts, nitrogenase enzyme, Fatty acid oxidation, Fatty acid biosynthesis, Degradation of cellulose. Disorders of amino acid metabolism (phenylketonuria, alkaptonuria)	[10]
Sporulation and Morphogenesis: Endospore formation- structure, properties and germination; Dormancy in selected microbes	[5]

Course Outcome: student will be acquainted with methods of measuring microbial growth, calculating growth kinetic parameters, in-depth knowledge of transport systems existing in bacteria, central metabolic pathways for carbon metabolism and various other biochemical properties of bacteria.

Suggested Readings:

Text Books:

1. Microbial Physiology by A.G. Moat, J. W. Foster, M. P. Spector. 3rd Edition. John Wiley & Sons. 2002
2. Lehninger Principles of Biochemistry by D. L. Nelson, M. M. Cox. 6th Edition. W. H. Freeman. 2012
3. Biochemical Calculations: by Irwin H. Segel. 2nd Edition. Wiley. 2004.

4. Understanding Enzymes by T. Palmer, E.Horwood. 3rd Edition. Wiley. 1991.

Reference Books:

1. Biochemistry by Geoffrey L. Zubay. 4th Edition. Brown Co, USA. 1999.
2. The Physiology and Biochemistry of Prokaryotes by D. White, J. Drummond, C. Fuqua. 4th Edition. Oxford University Press. 2011.
3. Microbial Biochemistry by G. N. Cohen. 2nd Edition. Springer. 2014.
4. Lippincott's Illustrated Reviews: Biochemistry edited by D. R. Ferrier. 6th Edition. Lippincott Williams & Wilkins. 2013

MB20.503 Bacteriology and Phycology **3-0-0-3**

Course Objective: To gain knowledge in the area of bacterial cell structure, division, survival and propagation.

General Concepts of Microbiology: History and development of Microbiology as a discipline of science, spontaneous generation vs biogenesis, Koch's postulates Basic features of microscopy-Compound, fluorescence, dark field, phase contrast, SEM and TEM, Staining methods-simple, differential and sample preparation for electron microscopy. [5]

Origin and Classification of Microorganisms: Origin and evolution of microbial world, concept of Hackle's three kingdom system, Whittaker's five kingdom system, Eight kingdom system by Thomas Cavalier-Smith and three domain concept of Carl Woese; Tools for Systematics: Numerical taxonomy, Phylogenetic analysis, Polyphasic approach; Bacterial Classification by Bergeys manual of Systematic Bacteriology; General characteristics of various groups of prokaryotic bacteria, significance of Gram-positive and Gram negative bacteria. Modern methods of studying microbial diversity; Microbial culture collections. Phyla of Archaea, Significance of Archaea, Evolutionary developments of Archaea (Detailed account of some model archaeal organisms: Methanococcus, Halobacterium, Pyrococcus and Sulfolobus) [15]

Morphology and Ultrastructure of Bacteria: Basic ultrastructure, morphological types, cell wall of gram positive, gram negative and archeobacteria and comparison with eubacteria, cell wall biosynthesis, cytoplasmic membrane-structure, composition and functions, function of various cell structure appendages: flagella- structure, assembly and [8]

mechanism of movement; pili and fimbriae- types, structure and their role. External cell surface structures and functions: capsule, glycocalyx, slime layer S-layer and L-form.

Cultivation of Bacteria: Aerobic and anaerobic cultivation, Nutrient media- selective and differential, Nutrient types of bacteria, Growth curve and kinetics of growth, Batch culture, fed-batch culture and continuous culture, synchronous growth, Factors affecting growth, Control of bacteria-physical and chemical agents. [6]

Algae: General Characteristics, Classification, Nutrition, Reproduction, Algal ecology, Economic importance of Diatoms, Rhodophyta and Green algae. [5]

Course Outcome: Will be able to attain in-dept knowledge about the bacterial morphological features, cell arrangement, cell structure, its division and the process of sporulation and apply it to practical work.

Suggested Readings:

Text Books:

1. Prescott's Microbiology by J. Willey, L. Sherwood, C. J. Woolverton. 10th edition. McGraw Hill Education. 2017.
2. Brock Biology of Microorganisms by M. Madigan, K. Bender, D. Buckley, W. Sattley, D. Stahl. 15th Edition. Pearson Education. 2018.

Reference Books:

1. Alcamo's Fundamentals of Microbiology by J. C. Pommerville. 10th Edition. Jones and Bartlett Learning. 2013.
2. Archaea Molecular and Cellular Biology by Ricardo Cavicchioli. American Society of Microbiology. 2007.
3. The Physiology and Biochemistry of Prokaryotes by D. White, J. Drummond, C. Fuqua. 4th Edition. Oxford University Press. 2011.

MB20.505 Microbial Physiology and Instrumentation Laboratory 0-0-6-3

Course Objective: The objective of this laboratory is to teach a variety of techniques used in physiology research and principles of instruments used in a microbiology laboratory.

- To learn the working and principle of the basic instruments used in the microbiological laboratory (like Microscope, LAF, Spectrophotometer, Autoclave, Centrifuge, Colony counter etc.)
- Demonstration of PCR
- Determination of growth curve of bacteria.
- Bacterial population count by turbidity method.
- Estimation of fungal growth by gravimetric estimation.
- Effect of pH, Oxygen, temperature on bacterial growth.
- Biochemical characterization of bacterial cultures: catalase, urease, cytochrome oxidase and sugar fermentation, citrate utilization, gelatin liquefaction, sulfide indole motility test.
- Nitrification and denitrification by bacteria.
- Preparing various stock solutions and working solutions that will be needed for the course.
- To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.
- To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert‟s Law.
- Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by thin layer chromatography.

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Course Outcome: On completion of this course, the student will be able to apply the learnt knowledge in various practical streams.

MB20.507 Microbiology Laboratory-I 0-0-6-3

Course Objective: To provide understanding towards the basic concepts of microbiological techniques.

1. General instructions, Microbiology laboratory and its discipline
2. Handling of microscopes
3. Methods of sterilization
4. Preparation of culture media plates, agar slants and agar deep tubes for microbes.

5. Demonstration of techniques for isolation of pure culture of microorganisms.
6. Aseptic transfer of pure culture of microorganisms.
7. Isolation and culturing of fungi (yeasts and molds) and algae
8. Culturing methods of microbes – slant and stab cultures, tube culture, flask cultures, shake flask cultures.
9. Concept ofAnaerobic culturing methods – anaerobic jar and its use, pyrogallol method, thioglycollate media culturing, anaerobic glove box and its application.
10. Microbial growth experiments – Viable count of growing cultures
11. Staining techniques for bacteria: simple, differential (Gram staining etc.), special staining (spore staining etc.)
12. Identification and cultivation of algae
13. Identification of an unknown sample as DNA, RNA or protein using available laboratory tools. (Optional Experiments)
14. Protein characterization using different gel-based proteomic tools
15. Agarose gel electrophoresis

Course Outcome: On completion of this course, the student will be able to apply the learnt knowledge in various practical streams.

BT20.507	**Cell and Molecular Biology**	**3-0-0-3**
Course Objective	The objectives of this course are to sensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules, the understanding of various biological processes becomes deeper and inclusive.	
	Dynamic Organization of Cell: Universal features of cells; cell chemistry and biosynthesis: chemical organization of cells; internal organization of the cell - cell membranes: structure of cell membranes and concepts related to compartmentalization in eukaryotic cells; intracellular organelles: endoplasmic reticulum and Golgi apparatus, lysosomes and peroxisomes, ribosomes, cellular cytoskeleton, mitochondria, chloroplasts and cell energetics; nuclear compartment: nucleus, nucleolus and chromosomes.	6
	Chromatin Structure and Dynamics: Chromatin organization - histone and DNA interactome: structure and assembly of eukaryotic and prokaryotic DNA polymerases, DNA-replication, repair and recombination; chromatin control: gene transcription and silencing by chromatin-Writers,-Readers and –Erasers; Transcriptional	12

	control: Structure and assembly of eukaryotic and prokaryotic RNA Polymerases, promoters and enhancers, transcription factors as activators and repressors, trancriptional initiation, elongation and termination; post-transcriptional control: splicing and addition of cap and tail, mRNA flow through nuclear envelope into cytoplasm, breakdown of selective and specific mRNAs through interference by small non-coding RNAs (miRNAs and siRNAs), protein translation machinery, ribosomes-composition and assembly; universal genetic codes, degeneracy of codons, Wobble hypothesis; Iso-accepting tRNA; mechanism of initiation, elongation and termination; co- and post-translational modifications, mitochondrial genetic code translation product cleavage, modification and activation.	
	Cellular Signalling: Transport and Trafficking Molecular mechanisms of membrane transport, nuclear transport, transport across mitochondria and chloroplasts; intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior. Manipulating and Studying Cells, Isolation of cells and basics of cell culture; observing cells under a microscope, different types of microscopy; analyzing and manipulating DNA, RNA and proteins.	6
	Cellular Processes: Cell cycle and its regulation; cell division: mitosis, meiosis and cytokinesis; cell differentiation: stem cells, their differentiation into different cell types and organization into specialized tissues; cell-ECM and cell-cell interactions; cell receptors and trans-membrane signalling; cell motility and migration; cell death: different modes of cell death and their regulation.	8
	Genome Instability and Cell Transformation: Mutations, proto-oncogenes, oncogenes and tumour suppressor genes, physical, chemical and biological mutagens; types of mutations; intra-genic and inter-genic suppression; transpositions- transposable genetic elements in prokaryotes and eukaryotes, role of transposons in genome; viral and cellular oncogenes; tumor suppressor genes; structure, function and mechanism of action; oncogenes as transcriptional activators.	7
Course Outcome	Student should be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek; c) why to seek?	
Suggested Readings	**Text Book:** Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular biology of the cell. New York: Garland Science. Lodish, H. F. (2000). Molecular cell biology. New York: W.H. Freeman.	

References:

Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's genes XI. Burlington, MA: Jones & Bartlett Learning.

Cooper, G. M., & Hausman, R. E. (2009). The cell: A molecular approach. Washington: ASM ; Sunderland.

Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). Becker's world of the cell. Boston: Benjamin Cummings.

Watson, J. D. (1987). Molecular biology of the gene (7th ed.). Menlo Park, CA: Benjamin/Cummings.

MS20.501 **Math and Statistics for Biology** **2-0-0-2**

Objective: To acquire fundamental knowledge of bio statistics.

Introduction: Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean, median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean	**05**
Measures of Dispersion: Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures	**05**
Correlation and Regression Analysis: Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis	**05**
Tests of Significance: Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples	**05**
Probability and Probability Distributions: Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve	**06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of bio statistics in sciences and applied sciences with solve curriculum problems.

Text Books:

1. Fundamental of Mathematical Statistics by Gupta and Kapoor, SCS Publisher, 2002.
2. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

Reference Books:

1. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
2. Probability, Random Variables and Stochastic Processes by Papoulis, TMH.

RM20.501 **Research Methodology and Scientific Communication Skills** **2-0-0-2**

Course Objectives

- To give a background on the history of science, emphasizing the methodologies used to do research
- To use the framework of these methodologies for understanding effective lab practices and scientific communication
- To use the framework of these methodologies to understand and appreciate scientific ethics

History of Science and Science Methodologies **5**

Empirical science; The scientific method; Interrogative perturbation experiments and controls; Deductive and inductive reasoning; Descriptive science; Reductionist vs holistic biology. Preparation for Research

Choosing a mentor, lab and research question; Maintaining a lab notebook with date-wise entry.

Sampling, Scale and Analysis: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale **10**

Scientific Communication **11**

Technical Writing Skills - Types of reports; Layout of a formal report; Scientific writing skills - Importance of communicating science; Problems while writing a scientific document; Plagiarism; Scientific publication writing: Elements of a scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts; Publishing scientific papers - the peer review process and problems, recent developments such as open access and non-blind review; Plagiarism; Characteristics of effective technical communication; Scientific presentations; Ethical issues; Scientific misconduct.

Student Learning Outcomes

- Understanding of the history and methodologies of scientific research, applying these to recent published papers
- Understanding and practicing scientific reading, writing, presentations
- Appreciating scientific ethics through case studies.

Suggested Readings:

1. Valiela, I. (2001). Doing science: Design, analysis, and communication of scientific research. Oxford: Oxford University Press.
2. On being a scientist: A guide to responsible conduct in research. (2009). Washington, D.C.: National Academies Press.
3. Gopen, G. D., & Smith, J. A. (n.d.). The Science of Scientific Writing.

American Scientist, 78(Nov-Dec 1990), 550-558.
4. Mohan, K., & Singh, N. P. (2010). Speaking English effectively. Delhi: Macmillan India.
5. Movie: Naturally Obsessed, The Making of a Scientist.

BT20.513 **IPR , Biosafety and Bioethics** **2-0-0-2**

Course Objective

- To provide basic knowledge on intellectual property rights and their implications in biological research and product development.
- To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products.
- To understand ethical issues in biological research.

Introduction to IPR Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; introduction to history of GATT, WTO, WIPO and TRIPS; plant variety protection and farmers rights act; concept of „prior art": invention in context of "prior art"; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.	5
Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for patenting-introduction to existing schemes; publication of patents- gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing – outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and non-commercial incentives.	5
Biosafety and Biosecurity - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs &	5

	LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools.	
	National and International Regulations: International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies; Draft bill of Biotechnology Regulatory authority of India - containments – biosafety levels and category of rDNA experiments; field trails – biosafety research trials – standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI).	5
	Bioethics Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – biopiracy.	6
Course Outcome	Students will be able to – • Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents. • Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations • Understand ethical aspects related to biological, biomedical, health care and biotechnology research.	
Suggested Readings	**Text Book:** • Ganguli, P. (2001). Intellectual property rights: Unleashing the knowledge economy. New Delhi: Tata McGraw-Hill Pub. • Complete Reference to Intellectual Property Rights Laws.	

(2007). Snow White Publication Oct.

References:

- Kuhse, H. (2010). Bioethics: An anthology. Malden, MA: Blackwell.
- Office of the Controler General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. http://www.ipindia.nic.in/
- World Trade Organisation. http://www.wto.org
- World Intellectual Property Organisation. http://www.wipo.int
- International Union for the Protection of New Varieties of Plants. http://www.upov.int
- National Portal of India. http://www.archive.india.gov.in
- National Biodiversity Authority. http://www.nbaindia.org
- Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf
- Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F. (2009). Problem formulation in the environmental risk assessment for genetically modified plants. Transgenic Research, 19(3), 425-436. doi:10.1007/s11248-009-9321-9

MB20.502 Virology and Mycology **3-0-0-3**

Course Objective: The course will facilitate in understanding of molecular virology and Mycological aspects in detail.

General Concepts of Viruses: Discovery of viruses, Distinctive features, Morphology and Ultrastructure, Envelope and its properties, Structural proteins – envelope proteins, matrix proteins and lipoproteins, Virus related agents (Viroids and Prions). Classification-General properties, Nomenclature, Viral genomic organization, structure and replication – types of nucleic acid DNA (double stranded and single-stranded), RNA (double stranded, single stranded – positive sense and negative sense). [5]

General Methods of Diagnosis of Viruses: Methods of Isolation, Identification and Cultivation methods-embryonated eggs, experimental animals, cell cultures (Primary and secondary), Methods of detection- Direct using microscopes and Serological methods- heamagglutination, complement fixation, [10]

18athogenicity18ence, ELISA and RIA, infectivity assay (end point method), Western Bloting, Nucleic acid based diagnosis: Nucleic acid hybridization, polymerase chain reaction, microarray and nucleotide sequencing, Infectivity assay for animal and bacterial viruses – plaque method, LD_{50}.	
Bacterial and Plant Viruses: Classification of bacterial and plant viruses. Bacteriophage structure- general characteristics, Life cycle- Lytic and Lysogeny, One step growth curve, Regulation of lytic cycle, brief details of M13, Mu, Lambda and T4, Effect of viruses on plant appearance, histology, cytology, Transmission of plant viruses- Vector (insects, nematodes) and without vector, Common diseases of Paddy, Cotton, Tomato and Sugarcane, Life cycles- TMV, CMV and Potato Virus X. Control and prevention of plants and animal viral (Phage Therapy) diseases.	[9]
Animal Viruses: Classification of animal viruses Life cycle and 18athogenicity of RNA viruses- Picorna, Orthomyxo, Paramyxo, Rhabdo, Rota and HIV, Oncogenic viruses, DNA viruses- Pox, Herpes, Adeno, SV 40, Hepatitis viruses	[9]
Emerging Viruses and Prevention: Theories/Drivers on origin of virus, evolution of new viruses, emerging new viruses, Factors that drive viral emergence, genetic shift and drift. Basic concept of an effective vaccine	
General Concepts of Mycology: General features of fungi, Classification of fungi, Life cycles of *Aspergillus*, *Saccharomyces, Deuteromycetes*, Mycorrhiza: Ecto, endo and VAM, Lichens- general features, Fungal diseases- Systemic and Sub cutaneous Mycoses, Candidiasis, Dermatomycosis.	[6]

Course Outcome: On completion of the course, the student will be able to describe, classify and learn various processes associated to viruses and fungi.

Suggested Readings:

Text Books:

1. Basic Virology by Edward K. Wanger, M. Hewiett, D. Bloom, D. Camerini. 3rd edition. Blackwell Publishing. 2007.
2. Principles of Molecular Virology by A.J. Cann. 6th edition. Elsevier Academic Press. 2015.

Reference Books:

1. Principles of Virology: Molecular Biology, Pathogenesis and Control of Animal Viruses by S.J. Flint, L.W. Enquist, V.R. Racaniello, A.M. Skalka. 4th edition. ASM Press. 2015.
2. Introduction to Modern Virology by N. Dimmock, A.

Easton, K. Leppard. 7th edition. Blackwell Publishing. 2016.

MB20.504 Microbial Genetics **3-0-0-3**

Course Objective: The objective of this course is to understand how microorganisms can be used as tools to understand various biological phenomena.

Mutations: Basic concepts of mutation, Molecular nature of mutations, Spontaneous mutation, Reverse mutation, Frameshift mutation, Site directed mutagenesis- deletions, insertions, localized point mutation, Mutations by synthetic oligonucleotides, Evolutionary role of mutation. [4]

Gene transfer and mapping by conjugation: Basis of fertility in bacteria. Self-transmissible and mobilizable plasmids. Hfr strains. Mapping bacterial genomes using Hfr strains. Chromosomal DNA transfer by plasmids – by integrated plasmids, by chromosome mobilization and by creation of prime factors. Transfer systems in gram positive bacteria. Ti plasmid transfer system and its application in creating transgenics [10]

Lytic bacteriophages and gene transfer by transduction and transformation: Lytic cycle using phages T4 and T7 as models. Regulation of expression of genes in phage T4 and phage T7. Replication of T4 versus T7 phages. Replication and packaging of filamentous phages M13 and f1. Genetic analysis of phages – complementation and recombination tests with phages. [11]

Natural transformation and competence. Molecular basis of natural transformation – DNA uptake competence systems in gram positive and gram negative bacteria. Regulation of competence in *B. subtilis*. Importance of natural transformation. Artificially induced competence. Generalized versus specialized transduction: T4, lambda phage. Mapping bacterial genes by transduction.

Lysogenic phages: Lambda phage – gene and promoter organization. Lambda lytic cyle – regulation of gene expression – very early, early and late gene expression. Establishment and maintenance of lysogeny. Regulation of gene expression in lysogenic phase – role of cI, cII and cIII proteins. Lambda immunity region and immunity to superinfection. Events leading to induction – role of cI and cro repressors in regulating the events. Other lysogenic phages – P2 and P4. Lysogenic phages and bacterial pathogenesis. [9]

Transposons: Discovery of transposition. Classes of bacterial transposons. Regulation of transposition activity. Effects of transposition in bacteria. Assays to 19nalyse transposition events – suicide vectors and mating out assays. Molecular mechanisms of transposition – genetic evidence supporting the mechanisms.

Vectors: Plasmids, Colicins and col factors, Plasmids as vectors for gene cloning, Transposons and their use in genetic analysis, Mechanisms of antibiotic resistance by transposons. [5]

Gene expression and regulation: Control of gene expression. Positive gene regulation, negative gene regulation and attenuation, using the lac, gal, trp, ara, tol operons.

Course Outcome: Upon successful completion of the course, the student: will be able to discuss the importance of mutations, describe the processes of transformation, transduction and conjugation, lytic and lysogeny and regulation of these processes.

Suggested Readings:

Text Books:

1. Modern Microbial Genetics edited by U.N. Streips, R.E. Yasbin. 2nd edition. Wiley-Liss Publishers. 2002.
2. Microbial Genetics by S.R. Maloy, J.E. Cronan, Jr., D. Freifelder. 2nd edition. Jones and Bartlett Publishers. 1994.

Reference Books:

1. Molecular Genetics of Bacteria by L. Snyder, J. Peters, T. Henkin, W. Champness. 4th edition. ASM Press. 2013.
2. Fundamental Bacterial Genetics by N. Trun, J. Trempy. 1st edition. Wiley-Blackwell Publishing. 2004.

MB20.506 Microbiology Laboratory-II 0-0-6-3

Course Objective: To provide understanding of techniques associated with microbial genetics and virology.

- Isolation of genomic DNA from E.coli and Yeast.
- Estimation of DNA and RNA (colorimetry)
- Determination of molecular weight of DNA, resolved on agarose gel electrophoresis.
- Effect of UV radiations to study the survival pattern of E. coli/yeast.
- Replica plating technique
- Transformation in bacteria
- Conjugation in bacteria
- Isolation of phage from different soil samples using laboratory bacterial cultures (*Staphylococcus*, *Bacillus*)
- Isolation of phage from sewage using *Pseudomonas* and *E. coli* as host.
- Cultivation and preservation of phages.
- Quantification of phages
- One step growth curve for determination of virus titre.
- Study of fungal morphology and their identification by cotton blue staining

- Study of fungal diseases in plants and viruses

Course Outcome: On completion of this course, the student will be able to apply the learnt knowledge in various practical streams and join the path labs.

BT20.512 Food Technology 3-0-0-3

Course Objective: To impart knowledge of various areas related to Food Science and Technology, To enable the students to understand food composition and its physicochemical, nutritional, and microbiological aspects

Food and Fermentation Technology: Origin, Scope and development of fermented food products, Microbial starters for food fermentations. 10

Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.

Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,

Single cell protein, Mushroom cultivation

Spoilage and Preservation: 9

Factors affecting microbial growth in foods- extrinsic and intrinsic,

Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,

Spoilage detection and characterization.

Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).

Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli*O157:H7, *Listeria monocytogens, Campylobacter jejuni, Helicobacter pylori* 9

Packaging and Quality Control: 5

Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging,

Tetra pack, Nano capsule, Nano membrane.

Detection of food pathogens- Culture methods, Rapid detection using PCR 6

Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,

Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)

Disposal and treatment of food industry waste

Course Outcome: The students will have knowledge about different processing and preservation methods and principals involved. Students will have learnt about packaging materials, methods and their applications in food industry.

Suggested Readings

Text Book

- Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company, Ltd, New Delhi
- Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New, Delhi

References

Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT20.502	**Bioinformatics**	**3-0-0-3**
Course Objective	The objectives of this course are to provide students with the theory and practical experience of the use of common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts.	
	Bioinformatics basics: Computers in biology and medicine; Importance of Unix and Linux systems and its basic commands; Database concepts; Protein and nucleic acid databases; Structural databases; databases and search tools: biological background for sequence analysis; Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; resources at EBI; resources on the web; database mining tools.	7
	DNA sequence analysis: gene bank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; motif discovery and gene prediction; local structural variants of DNA, their relevance in molecular level processes, and their identification; assembly of data from genome sequencing.	7
	Multiple sequence analysis; multiple sequence alignment; flexible sequence similarity searching with the FASTA3 program package; use of CLUSTAL W and CLUSTAL X for multiple sequence alignment; submitting DNA protein sequence to databases: where and how to submit, SEQUIN, genome centres; submitting aligned set of sequences, updates and internet resources; methods of phylogenetic analysis.	7
	Protein modelling: introduction; force field methods; energy, buried and exposed residues; side chains and neighbours; fixed regions; hydrogen bonds; mapping properties onto surfaces; fitting monomers; RMS fit of conformers; assigning secondary structures	8
	Protein structure prediction: protein folding and model generation; secondary structure prediction; analyzing secondary structures; protein loop searching; loop generating methods; loop analysis; homology modelling: potential applications, description, methodology, homologous sequence identification; align structures, align model sequence; construction of variable and conserved regions; threading techniques; topology fingerprint approach for prediction; evaluation of alternate models; structure prediction on a mystery sequence; structure aided sequence techniques of structure prediction; structural profiles, alignment algorithms, mutation tables, prediction, validation, sequence based methods of structure prediction, prediction using inverse folding, fold prediction; significance analysis, scoring techniques, sequence-sequence scoring; protein function prediction; elements of insilico drug design.	10

Course Outcome

Student should be able to –

- Develop an understanding of the basic theory of these computational tools.
- Gain working knowledge of these computational tools and methods.
- Appreciate their relevance for investigating specific contemporary biological questions.
- Critically analyse and interpret the results of their study.

Suggested Readings

Text Book:

- Lesk, A. M. (2002). Introduction to bioinformatics. Oxford: Oxford University Press.
- Mount, D. W. (2001). Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

References:

- Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: A practical guide to the analysis of genes and proteins. New York: Wiley-Interscience.
- Pevsner, J. (2015). Bioinformatics and functional genomics. Hoboken, NJ.: Wiley- Blackwell.
- Bourne, P. E., & Gu, J. (2009). Structural bioinformatics. Hoboken, NJ: Wiley-Liss.
- Lesk, A. M. (2004). Introduction to protein science: Architecture, function, and genomics. Oxford: Oxford University Press.

BT20.504 **Immunology** **3-0-0-3**

Course Objective

The objectives of this course are to make students learn about the structural features of the components of the immune system as well as their function. The major emphasis of this course will be on the development of the immune system and mechanisms by which our body elicit the immune response. This will be imperative for the students as it will help them to think like an immunologist and predict about the nature of immune response that develops against bacterial, viral or parasitic infection, and prove it by designing new experiments.

Immunology fundamental concepts and anatomy of the immune system Components of innate and acquired immunity; phagocytosis; complement and inflammatory responses; pathogen recognition receptors (PRR) and pathogen associated molecular 6

pattern (PAMP); innate immune response; mucosal immunity; antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility.	
Immune responses generated by B and T lymphocytes Immunoglobulins - basic structure, classes & subclasses of immunoglobulins, antigenic determinants; multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; principles of cell signaling; basis of self & non-self discrimination; kinetics of immune response, memory; B cell maturation, activation and differentiation; generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; functional T Cell subsets; cell-mediated immune responses, ADCC; cytokines-properties, receptors and therapeutic uses; antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; cell-cell co-operation, Hapten-carrier system.	9
Antigen-antibody interactions Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; surface plasmon resonance, biosenor assays for assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock outs.	7
Vaccinology Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology- role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; antibody genes and antibody engineering- chimeric, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries, idiotypic vaccines and marker vaccines, viral-like particles (VLPs), dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, edible vaccine and therapeutic vaccine.	8
Clinical Immunology Immunity to infection : bacteria, viral, fungal and parasitic infections (with examples from each group); hypersensitivity – Type I-IV; autoimmunity; types of autoimmune diseases; mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; treatment of autoimmune diseases; transplantation – immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; tumor immunology – tumor antigens; immune response to tumors and tumor evasion of the immune system, cancer immunotherapy; immunodeficiency - primary immunodeficiencies, acquired or secondary immunodeficiencies,	9

autoimmune disorder, anaphylactic shock, immunesenescence, immune exhaustion in chronic viral infection, immune tolerance, NK cells in chronic viral infection and malignancy.

Course Outcome

Students should be able to –

- Evaluate the usefulness of immunology in different pharmaceutical companies.
- Identify the proper research lab working in the area of their own interests.
- Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.

Suggested Readings

Text Book:

- Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2006). Kuby immunology. New York: W.H. Freeman.
- Brostoff, J., Seaddin, J. K., Male, D., & Roitt, I. M. (2002). Clinical immunology. London: Gower Medical Pub.

References:

- Murphy, K., Travers, P., Walport, M., & Janeway, C. (2012). Janeway's immunobiology. New York: Garland Science.
- Paul, W. E. (1993). Fundamental immunology. New York: Raven Press.
- Goding, J. W. (1986). Monoclonal antibodies: Principles and practice: Production and application of monoclonal antibodies in cell biology, biochemistry, and immunology. London: Academic Press.
- Parham, P. (2005). The Immune System. New York: Garland Science.

BT20.506	**Genetic Engineering**	**3-0-0-3**
Course Objective	The objectives of this course are to teach students with various approaches to conducting genetic engineering that they can apply to their future career in biological research as well as in biotechnology industries. Genetic engineering is a technology that has been developed based on our fundamental understanding of the principles of molecular biology and this is reflected in the contents of this course. This technology has revolutionized the way modern biological research is done and has impacted mankind with a number of biological products and processes.	
	Impact of genetic engineering in modern society; general requirements for performing a genetic engineering experiment; restriction endonucleases and methylases; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; labelling of DNA: nick translation, random priming, radioactive and non-radioactive probes, hybridization techniques: northern, southern, south-western and far-western and colony hybridization, fluorescence in situ hybridization.	6
	Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, hagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Principles for maximizing gene expression expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; methodologies to reduce formation of inclusion bodies; mammalian expression and replicating vectors; Baculovirus and pichia vectors system, plant based vectors, Ti and Ri as vectors, yeast vectors, shuttle vectors.	7
	Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR – multiplex, nested; real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; proof reading enzymes; PCR based site specific mutagenesis; PCR in molecular diagnostics; viral and bacterial detection; sequencing methods; enzymatic DNA sequencing; chemical sequencing of DNA; automated DNA sequencing; RNA sequencing; chemical synthesis of oligonucleotides; mutation detection: SSCP, DGGE, RFLP.	7
	Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; isolation of mRNA and total RNA; reverse transcriptase and cDNA synthesis; cDNA and genomic libraries; construction of microarrays – genomic arrays, cDNA arrays and oligo arrays; study of protein-DNA interactions: electrophoretic mobility shift assay; DNaseI footprinting; methyl interference assay, chromatin	7

	immunoprecipitation; protein-protein interactions using yeast two-hybrid system; phage display. Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; gene knockouts and gene therapy; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems e.g. fruit flies (drosophila), worms (C. elegans), frogs (xenopus), fish (zebra fish) and chick; Transgenics - gene replacement; gene targeting; creation of transgenic and knock-out mice; disease model; introduction to genome editing by CRISPR- CAS with specific emphasis on Chinese and American clinical trials.	12

Course Outcome

Given the impact of genetic engineering in modern society, the students should be endowed with strong theoretical knowledge of this technology. In conjunction with the practicals in molecular biology & genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry.

Suggested Readings

Text Book:

- Old, R. W., Primrose, S. B., & Twyman, R. M. (2001). Principles of gene manipulation: An introduction to genetic engineering. Oxford: Blackwell Scientific Publications.
- Green, M. R., & Sambrook, J. (2012). Molecular cloning: A laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

References:

- Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.
- Selected papers from scientific journals, particularly Nature & Science.
- Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.

BT20.516 **Bioinformatics and Immunology Laboratory** **0-0-6-3**

Course Objective

The objectives of this laboratory course are to make students develop an understanding about practical aspects of the components of the immune system as well as their function. Basic as well as advanced methods will be taught to detect different antigen and antibody interactions, isolation of different lymphocyte cells etc. and how they can be used in respective research work.

- Selection of animals, Preparation of antigens, Immunization and methods of bleeding, serum separation and storage.
- Antibody titre by ELISA method.
- Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
- Complement fixation test.
- SDS-PAGE, Immunoblotting, Dot blot assays.
- Biological Databases: Sequence databases, Structure databases
- ORF Finder
- Pairwise sequence alignment using BLAST
- MSA using Clustal Omega and MEGA
- Phylogenetic analysis using MEGA software
- Primer Design
- 3-D structure Prediction

Course Outcome

Students should be able to –

- Evaluate the usefulness of immunology and Bioinformatics in different pharmaceutical companies.
- Identify proper research lab working in the area of their own interests.
- Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.
- Apply the bioinformatics tools for evolutionary analysis and drug designing

MB20.601 Environmental and Agricultural Mirobiology 3-0-0-3

Course Objective: The objective of this course is to understand various environmental and agricultural aspects of microbiology.

Aerobiology: Droplet nuclei, aerosols, Assessment of air quality- solid, liquid impingment, Air borne transmission of microbes	[3]
Soil and water microbiology: Types of Soils- physical and chemical characteristics, microflora, Rhizosphere and Phyllosphere.	[12]
Water Microbiology: Fresh water and marine habitats- general characteristics, Types of microbes, Microbial activity, Eutrophication and its effects, Assessment of water quality- water purification, Potability standards.	
Importance of soil microorganisms, nutrient transformation processes, plant-microbe symbiosis, microbial antagonism, biofilms and their biotechnological applications, drinking water microbiology and quality control.	
Biomass waste management of plant's residues: Lignocellulolytic microorganisms, enzymes and their biotechnological applications in: (i) biopulping, (ii) biobleaching, (iii) textiles (iv) biofuels, (v) animal feed production.	[8]
Biogeochemical Cycling: Carbon, Nitrogen and Sulphur cycle- role of microbes, Biodegradation- recalcitrant and xenobiotics, Degradation of pesticide, Wood and Textiles; Role of microbes in biodeterioration- Metal corrosion, Paper; Metal detoxification, Biopesticides.	[10]
Nitrogen Fixation: Biological nitrogen fixation- Symbiotic (Rhizobium, Frankia), Asymbiotic (Azotobacter, Azospirillum), Nitrogenase and nif genes, Biofertilizers, VAM- brief account and applications.	
Microbes in Waste Treatment: Types of wastes- Solid and Liquid waste, Waste treatments- Physical, Chemical and Biological (Primary, Secondary and Tertiary treatment), Trickling filter, Biocontactor, Activated sludge, Oxidation pond, Solid waste treatment- composting, biogas production.	6

Course Outcome: Upon successful completion of the course, the student: will be able to understand the cology od air, water and soil, biogeochemical cycles and processes like nitrogen fixation and waste treatment.

Suggested Readings:

Text Books:

1. Biotechnology-A textbook of Industrial Microbiology. II edition.Wulf Crueger and Anneliese Crueger.
2. Industrial Microbiology, A.H.Patel

3. Industrial microbiology, Casida

Reference Books:

1. Industrial Microbiology by L.E Casida, John Wiley and sons INC.
2. Industrial microbiology by A.H.Patel, Macillan India Ltd.
3. Principles of fermentation technology by P.Stanbury & Allan Whitekar, Pergamon.
4. Manual of Industrial Microbiology and Biotechnology,II edition. Arnold L.Demain and Juilan E.Davies.

MB20.603 Industrial Microbiology 3-0-0-3

Course Objective: The objective of this course is to learn and understanding the microbiological concepts applied in industries.

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feed-back repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods. [5]

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its applications. [10]

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment.

Applications of industrial microbiology-I: production aspects: Development of heterologous expression platforms like bacteria, yeast, mammalian and insect cells, process optimization of recombinant biopharmaceuticals; industrial enzymes (cellulases, laccase, amylases, biosurfactants, thaumatin, food additives etc.), therapeutic proteins (hormones and recombinant vaccines), antibodies (chimeric and humanized antibodies, antibody fragments) [9]

Applications of industrial microbiology-II: microbial transformation process, cell surface display technology, development of biosimilars, good manufacturing practices, intellectual property rights and technology transfer, different phases of clinical trials of therapeutic biomolecules. Basic objective for successful economically viable fermentation process, cost breakdown for well-established fermentation processes, market potential of the products, cost aspects of various stages in the processes development including effluent treatment [8]

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (β-lactam, aminoglycosides). 7

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids in brief.

Course Outcome: On completion of the course, the student will be competent enough to be an Industrial Microbiologists, who can progress in its diverse fields.

Suggested Readings:

Text Books:

1. Nduka Okafor, Benedict C. Okeke (2017). *Modern Industrial Microbiology and Biotechnology*. 2nd Edition: CRC Press Publishers.
2. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. (2002). *Industrial Microbiology: An Introduction.* Blackwell Science Publishers.

Reference Books:

1. W. Crueger & A. Crueger (2017). Cruegers Biotechnology: A Text Book of Industrial Microbiology. Edited by K.R. Aneja. Panima Publishing Corporation.
2. Reed. G. (1999). Prescott and Dunn's Industrial Microbiology. CBS Publishers.
3. Demain, A. L. (2001). Industrial Microbiology and Biotechnology IInd Edition. ASM Press, Washington.
4. P.F. Stanbury, W. Whitaker & S.J. Hall (2016). Principles of Fermentation Technology. 3rd edition. Elsevier publication.

MB20.605 Medical Microbiology **3-0-0-3**

Course Objective: This course deals with importance of the microorganisms in human health.

Normal Flora of Human Body: Skin, Oral cavity, Gastrointestinal tract, Respiratory tract, Urinogenital tract, Concept of opportunistic pathogens. [6]

Infection: Sources of infection for man, Vehicles or reservoirs of infection, Vertical and horizontal transmission of infection, Pathogenesis of infecting microorganisms-Virulence factors (adhesions, enzymes-coagulases, fibrinolysins, mucinases, lipase, proteases, nucleases, collagenase, neuraminidase). Toxins-endotoxins and exotoxins as agents of disease.

Microbial Strategies for Evading Immune Response: Evading phagocytosis, Survival in phagocytes, Immunosuppression, [10]

Induction of ineffective antibodies, Antigenic variation, Avoiding induction of immune response.

Bacterial Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of bacterial diseases caused by- *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacterium, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Vibrio, Yersinia, Mycobacterium, Treponema, Mycoplasma, Campylobacter, Helicobacter, Rickettsiae and Chlamydiae.* [8]

Viral Diseases: Pathogenesis, epidemiology, laboratory diagnosis, treatment and vaccination of viral diseases- Pox viruses (Small pox), Herpes viruses (HSV, Epstein-barr virus), Adenoviruses, Picorna viruses (Polio, Rhinoviruses), Orthomyxoviruses (Influenza), Paramyxoviruses (Mumps, Measles, RSV), Arboviruses (Dengue, Yellow fever,), Rhabdoviruses (Rabies), Hepatitis viruses, Rubella, Reovirus, Rotavirus, Viral Haemorrhagic Fevers, HIV, Oncogenic Viruses. [8]

Fungal and Protozoan Diseases: Pathogenesis, laboratory diagnosis and treatment of fungal and protozoan (Malaria, Kala Azar) diseases. 7

Antimicrobial Agents: Mode of action of important antibacterial, antifungal, antiviral and antiprotozoan agents.

Course Outcome: Students will have clear understanding of microbial diseases, host-pathogen dynamics and challenges involved in keeping drug resistant microbes under control.

Suggested Readings:

Text Books:

1. Brooks, G.F., Carroll, K. C., Butel, J. S. and Morse, S. A. (2007) Jawetz, Melnick, & Adelberg's Medical Microbiology, Twenty-Fourth Edition. McGraw-Hill Companies, UK
2. Murray P.R., Pfaller M.A., Tenover F.C., and Yolken R.H. (2007). Medical Microbiology 6th Edn., ASM Press, U.S.A.
3. Bauman, R.W. (2005). 4th Edition. Microbiology: with diseases by body system; Pearson Education, Inc., U.S.A.
4. Ryan K. J. and Ryan C.G. (2004) Sherris Medical Microbiology: an Introduction to infectious diseases. 2nd edition. McGraw-Hill, U.S.A.

Reference Books:

1. Nester E. W., Anderson D. G. and Nester M. T. 2006. Microbiology: A Human Perspective, McGraw-Hill, U.S.A.
2. Brogden, K. A., Minion, C., Roth, J.A., Bolin, C.A. and Stanton, T. B. (2000) Virulence Mechanisms of Bacterial

Pathogens 2nd Edition. ASM Press, U.S.A.
3. Salyers, A. A. and Whitt, D.D. (2002) Bacterial Pathogenesis: A molecular Approach –2nd Edn. ASM Press, U.S.A.

MB20.609 Critical Analysis of Classical Papers 2-0-0-2

Course Objective The objectives of this course are to familiarize the students with classic literature to make them appreciate how ground-breaking discoveries were made without, necessarily, use of high-end technologies.

Execution: There are sixteen classical papers. Each students will be taking one paper for analysis. Each week there may be a 1.5-hour presentation cum discussion for each of the papers. At the end of the semester each student will be asked to write a mini-review (2-3 pages long) on any of the sixteen papers, other than the one he/she presented/discussed.

Course Outcome Students should be able to train in the exercise of hypothesis building and methods of addressing the hypothesis with readily available technology.

Molecular Biology

1 Studies on the chemical nature of the substance inducing transformation of Pneumococcal types: Induction of transformation by a desoxyribonucleic acid fraction isolated from Pneumococcus type III.
Avery OT, Macleod CM, McCarty M.; J Exp Med. 1944 Feb 1;79(2):137-58.
Note: This paper demonstrates that DNA is the transforming Principle originally described by Fredrick Griffith.

2 Independent functions of viral protein and nucleic acid in growth of bacteriophage
Hershey AD and Chase M.; J Gen Physiol. 1952 May;36(1):39-56.
Note: This paper demonstrates that DNA, and not protein, component of phages enter bacterial cells.

3 Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid
Watson JD and Crick FH; Nature. 1953 Apr 25;171(4356):737-8
Note: In this one page paper Watson and Crick first described the structure of DNA double helix
Study help - Watson_Crick_Nature_1953_annotated

4 Transposable mating type genes in Saccharomyces cerevisiae
James Hicks, Jeffrey N. Strathern & Amar J.S. Klar; Nature 282, 478-483,1979
Note: This paper provided evidence for „cassette hypothesis" of yeast mating type switches i.e. interconversion of mating types in yeast (S. cerevisiae) occurs by DNA rearrangement.

5 Messelson and Stahl experiment demonstrating semi-conservative replication of DNA

Meselson M and Stahl FW.; Proc Natl Acad Sci U S A. 1958 Jul 15;44(7):671-82

Note: The experiment demonstrating semi-conservative mode of DNA replication is referred to as "the most beautiful experiment in biology"

6 In vivo alteration of telomere sequences and senescence caused by mutated Tetrahymena telomerase RNAs

Guo-Liang Yu, John D. Bradley, Laura D. Attardi & Elizabeth H. Blackburn; Nature 344, 126-132, 1990

Note: This paper demonstrates that the telomerase contains the template for telomere synthesis

Cell Biology

1 A protein-conducting channel in the endoplasmic reticulum

Simon SM AND Blobel G.; Cell. 1991 May 3;65(3):371-80

Note: This paper demonstrates the existence of a protein conducting channel

Study help - A brief history of Signal Hypothesis

2 Identification of 23 complementation groups required for post-translational events in the yeast secretory pathway

Novick P, Field C, Schekman R.; Cell. 1980 Aug;21(1):205-15

Note: In this groundbreaking paper Randy Schekman's group used a mutagenesis screen for fast sedimenting yeast mutants to identify genes involved in cell secretion

3 A yeast mutant defective at an early stage in import of secretory protein precursors into the endoplasmic reticulum

Deshaies RJ and Schekman R.; J Cell Biol. 1987 Aug;105(2):633-45

Note: Using another yeast mutation screen Schekman lab identifies Sec61, a component of ER protein Conducting Channel (PCC)

Suggested reference paper - A biochemical assay for identification of PCC.

4 Reconstitution of the Transport of Protein between Successive Compartments of the Golgi

Balch WE, Dunphy WG, Braell WA, Rothman JE.; Cell. 1984 Dec;39(2 Pt 1):405-16

Note: This paper describes setting up of an in vitro reconstituted system for transport between golgi stacks which eventually paved the way for identification of most of the molecular players involved in these steps including NSF, SNAP etc.

5 A complete immunoglobulin gene is created by somatic recombination

Brack C, Hirama M, Lenhard-Schuller R, Tonegawa S.; Cell. 1978 Sep;15(1):1-14

Note: This study demonstrates DNA level molecular details of somatic rearrangement of immunoglobulin gene sequences leading to the generation of functionally competent antibody generating gene following recombination.

6 A novel multigene family may encode odorant receptors: a molecular basis for odor recognition

Buck L and Axel R; Cell. 1991 Apr 5;65(1):175-87

Note: This paper suggests that different chemical odorants associate with

different cell-specific expression of a transmembrane receptor in Drosophila olfactory epithelium where a large family of odorat receptors is expressed.

7 Kinesin walks hand-over-hand

Yildiz A, Tomishige M, Vale RD, Selvin PR.; Science. 2004 Jan 30;303(5658):676-8

Note: This paper shows that kinesin motor works as a two-headed dimeric motor walking hand-over-hand rather than like an inchworm on microtubule tract using the energy of ATP hydrolysis.

Developmental Biology/ Genetics

1 Mutations affecting segment number and polarity in Drosophila

Christiane Nusslein-Volhard and Eric Weischaus; Nature 287, 795-801, 1980

Note: This single mutagenesis screen identified majority of the developmentally important genes not only in flies but in other metazoans as well.

2 Information for the dorsal--ventral pattern of the Drosophila embryo is stored as maternal mRNA

Anderson KV and Nüsslein-Volhard C; Nature. 1984 Sep 20-26;311(5983):223-7

Note: This landmark paper demonstrated that early dorsal-ventral pattern information is stored as maternal mRNA in flies and devised the method of identifying genes encoding such genes

3 Hedgehog signalling in the mouse requires intraflagellar transport proteins

Huangfu D, Liu A, Rakeman AS, Murcia NS, Niswander L, Anderson KV.; Nature. 2003 Nov 6;426(6962):83-7

Note: One of the architects of original fly mutagenesis screens conducted a mouse mutagenes screen which identified a gene Kif3a as a major component of hedgehog signaling pathway. Eventually this discovery revolutionizes our understanding of mechanisms of action of signaling pathways by demonstrating central role of cillia in it

Suggested Reference paper - Design and execution of a embryonic lethal mutation screen in mouse

BT20.603	**Emerging Technologies**	**2-0-0-2**
Course Objective	This course is broad-based in nature encompassing several new technologies that current experimental researchers are employing to probe complex system biology questions in life- sciences. The objectives of this course are to teach the basic principles of the new principles to the students and make them appreciate the current-day research tool-kit better.	
	Optical Microscopy Methods The Light Microscopy: lenses and microscopes, resolution: Rayleigh‟s Approach, Darkfield; Phase Contrast; Differential Interference Contrast; fluorescence and fluorescence microscopy: confocal microscope: scanning optical microscope, advanced fluorescence techniques: FLIM, FRET, and FCS, Fluorescence Lifetime, Fluorescence Resonant Energy	8

	Transfer (FRET), Fluorescence Correlation Spectroscopy (FCS), Evanescent Wave Microscopy; Near-Field and Evanescent Waves, Total Internal Reflection Microscopy; Near-Field Microscopy; Beyond the Diffraction Limit: Stimulated Emission Depletion (STED), Super-Resolution Summary, Super-Resolution Imaging with Stochastic Optical Reconstruction Microscopy (STORM) and Photoactivated Localization Microscopy (PALM).	
	Mass Spectroscopy Ionization techniques; mass analyzers/overview MS; FT-ICR and Orbitrap, fragmentation of peptides; proteomics, nano LC-MS; Phospho proteomics; interaction proteomics, mass spectroscopy in structural biology; imaging mass spectrometry.	4
	Systems Biology and Structural Biology: High throughput screens in cellular systems, target identification, validation of experimental methods to generate the omics data, bioinformatics analyses, mathematical modeling and designing testable predictions. X-ray diffraction methods, solution & solid-state NMR.	6
	CRISPR-CAS History of its discovery, elucidation of the mechanism including introduction to all the molecular players, development of applications for in vivo genome engineering for genetic studies, promise of the technology as a next generation therapeutic method.	4
	Nanobodies Introduction to Nanobodies, combining nanobody with phage-display method for development of antibody against native proteins, nanobody as a tool for protein structure-function studies, use of nanobodies for molecular imaging, catabolic antibodies using nanobodies.	4
Course Outcome	Students should be to learn the history, theoretical basis and basic understanding of some of the latest technologies in the area of biotechnology. They should also be able to learn about various applications of these technologies. They may learn one application in depth through an assignment and/or seminar.	
Suggested Readings	**Text Book:** • Campbell, I. D. (2012). Biophysical techniques. Oxford: Oxford University Press. • Serdyuk, I. N., Zaccai, N. R., & Zaccai, G. (2007). Methods in molecular biophysics: Structure, dynamics, function. Cambridge: Cambridge University Press. **References:** • Phillips, R., Kondev, J., & Theriot, J. (2009). Physical	

biology of the cell. New York: Garland Science.
- Biological physics: Energy, information, life. New York: W.H. Freeman.
- Huang, B., Bates, M., & Zhuang, X. (2009). Super-Resolution Fluorescence Microscopy. Annu. Rev. Biochem. Annual Review of Biochemistry, 78(1), 993-1016. doi:10.1146/annurev.biochem.77.061906.092014.
- Mohanraju, P., Makarova, K. S., Zetsche, B., Zhang, F., Koonin, E. V., & Oost, J. V. (2016). Diverse evolutionary roots and mechanistic variations of the CRISPR-Cas systems. Science, 353(6299). doi:10.1126/science.aad5147.

MB20.609 **Project Proposal** **2-0-0-2**

Course Objective

The objectives of this course are to prepare the students to present their topic of research and explain its importance to their fellow classmates and teachers.
Poster Presentation: Students will have to present the topic of their project proposal after few months of their selection of the topic. They should be able to explain the novelty and importance of their research topic.

Oral Presentation: At the end of their project, presentation will have to be given by the students to explain in detail the work done by them. Along with summarizing their findings they should also be able to discuss the future outcomes of their work.

Course Outcome

Students should be able to learn how to present and explain their research findings to the audience affectively.

MB20.611 **Research Seminar** **1-0-0-1**

The objectives of this course are to train the students to evaluate research papers, to assess quality of the papers and how the papers are refereed and published as well as learn how to get the papers published.
Student presentations: Each student will need to present one paper during the term. They should select research papers, which deal with upcoming or most recent scientific findings/breakthrough and technologies developed.

Class evaluations and discussions: Every week, each student will be

asked to write a short review and evaluations of the paper presented in the class and then indulge in discussion with flaws of the paper, important questions and impact of the overall paper. Recent technologies, can be discussed, where it can be applied.
Students should be able to –

- Critically analyse the research papers from different upcoming topics.
- Understand the weaknesses and strengths of the paper and what additional experiments could have been done to strengthen the research study.
- Understand the context of the paper and identify important questions.
- Acquire the skills in paper writing and getting it published.

MB20.602 **Dissertation** **0-0-40-20**

Course Objective The objectives of this course are to prepare the students to adapt to the research environment and understand how projects are executed in a research laboratory. It will also enable students to learn practical aspects of research and train students in the art of analysis and thesis writing.

Planning & performing of experiments: Based on the project proposal submitted in earlier semester, students should be able to plan, and engage in, an independent and sustained critical investigation and evaluate a chosen research topic relevant to biological sciences and society. They should be able to systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions. Senior researchers should be able to train the students such that they can work independently and are able to understand the aim of each experiment performed by them. They should also be able to understand the possible outcomes of each experiment. Thesis writing: At the end of their project, thesis has to be written giving all the details such as aim, methodology, results, discussion and future work related to their project. Students may aim to get their research findings published in a peer-reviewed journal. If the research findings have application-oriented outcomes, the students may file patent application.

Course Outcome Students should be able to learn how to select and defend a topic of their research, how to effectively plan, execute, evaluate and discuss their experiments. Students should be able to demonstration

considerable improvement in the following areas:

- In-depth knowledge of the chosen area of research.
- Capability to critically and systematically integrate knowledge to identify the issues that must be addressed within the framework of the specific thesis.
- Competence in research design and planning.
- Capability to create, analyse and critically evaluate different technical solutions.
- Ability to conduct research independently.
- Ability to perform analytical techniques/experimental methods.
- Project management skills.
- Report writing skills.
- Problem solving skills.
- Communication and interpersonal skills.

MB20.613 Plant Microbe Interaction **3-0-0-3**

Introduction: Plant and microbe interaction, Plants as a host environment, The effects of microbes on plant physiology such as effects on photosynthesis, respiration, and the translocation of water and nutrients. Plants defense including structural defenses, biochemical defenses, and the hypersensitive response, Biotechnological perspectives of plant-microbe interaction

Plant-Bacteria Interaction: Introduction, Abundance and distribution of bacteria in plants, Epiphytic/Endophytic bacteria, Rhizobacteria, Plant growth-promoting rhizobacteria/bacteria (PGPR/PGPB), Pseudomonads *Bacillus* and as PGPR, Bacteria and plant health, Root nodule formation on legumes by *Rhizobium*spp for nitrogen fixation; other nitrogen fixing systems such as in alder/ *Frankia* and *Azolla*/*Anabaena*, Molecular mechanism of plant growth-promotion and biocontrol by bacteria, Microbial response to plants under habitat-imposed stresses (abiotic and biotic), Pathogenic interactions of bacteria with plants

Plant-fungal Interaction: Introduction to fungal biology, Abundance and distribution of fungus in plants (Epiphytic/Endophytic), Mycorrhiza: Ecto, endo and VAM, Survey of fungal diseases important in plant pathology, Diagnostics and preventive measures

Plant-virus Interaction: Diversity of plant viruses, Plant diseases caused by

virus, Life cycles of plant viruses, Diagnostics and preventive measures

Plant-nematode Interaction: Root-knot nematode, role of *Meloidogyne*, Plant health and nematode, Diagnostics and preventive measures

Suggested Readings:

1. Burns and Slater. Experimental Microbial Ecology, Blackwell Scientific Publications, Oxford
2. Alexander M. Microbial Ecology, John Wiley and Sons

Atlas RM and Bartha R. Microbial Ecology: Fundamentals and Principles, Benjamin Cummins, USA

MB20.615 Microbiology Laboratory-III 0-0-6-3

Course Objective: To provide understanding towards the basic concepts of microbiological techniques related to agriculture, environment and medical aspects.

1. Culturing bacteria in laboratory and study its characteristics.
2. Estimation of microbial flora on seeds.
3. To determine the food quality and its deterioration by measuring the microbial population.
4. To prepare the selective and differential (EMB) medium.
5. Isolation of *E. coli* from sewage water samples with the help of EMB agar medium.
6. Isolation of symbiotic *Rhizobium* from plant root nodules.
7. To learn the technique of Immobilization of microbial cells
8. To study the flora of skin and determining its morphological characteristics.
9. To study the flora of human blood sample and determining its morphological characteristics.
10. To study the flora and its morphological characteristics using human urine sample.
11. Antibiotic sensitivity test disc preparation.
12. To determine the MIC of given antibiotic (streptomycin) by observing its effect on bacterial culture.
13. Widal test.
14. Blood film preparation and identification of cells
15. Detection of bacteria in milk
16. Reductase test for milk – Methylene Blue / Resazurin.
17. Isolation of Lactobacilli and Streptococci from curd.
18. Collection of fungal samples and study using KOH and Lactophenol cotton blue.
19. Enumeration of microbial population from soil: Bacteria,

Fungi, Actinomycetes.

20. Bacterial examination of water (qualitative) and Standard plate count (quantitative test)
21. Estimation of BOD and COD.
22. Enumeration of microorganism from air.

Course Outcome: On completion of this course, the student will be able to apply the learnt knowledge in various practical streams and enhance their placement opportuities in pathological labs, industries or run its private ventures.

FS20.510	**Introduction to Forensic Biotechnology**	**3-0-0-3**
Course Objective:	To give insight of biotechnology applicable in forensic area	

Serology and Immunology **6**

Cell structure and functions. Structure and function of carbohydrates, fats and proteins, serum proteins, haemoglobin and its variants, haptoglobins, HLA, polymorphic enzymes, blood groups-history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from fresh blood and biological stains, body fluids, determination of secretor status, polymorphic enzyme typing, serogenetic markers, determination of origin of species, immunology, immune response, antigens, haptens and antibodies, function and rising of antisera, lectins.Bloodstains investigations: Blood pattern analysis, ageing of bloodstains, difference between human and animal bloodstains, spectroscopic analysis.

Forensic Biology **8**

General plant classification schemes. Sub specialisation of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology.Wood and timber analysis.Diatoms and their forensic importance.Study and identification of various diatoms.Paper and pulp identification.

Hair examination **8**

Collection and preservation of hair samples.Morphological and microscopic examination of human and animal hair. Hair growth and development, determination of origin, race, sex, site from hair. Comparison between human and non-human hair.Macroscopic and microscopic features of hair.

Wildlife Forensics **8**

Introduction and importance of wild life. Protected and endangered species of animals and plants.Sanctuaries and their importance.Introduction to Wildlife (Protection) Act 1972 and

CITES, Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife animals

DNA Profiling **9**

Double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA.Nature and structure of human genome and its diversity.mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans, Forensic DNA profiling and its application in criminal and civil investigations.

Text Books

Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.

Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.

Reference Books

Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.

Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwellpublishing, London, 2006

BT20.617 **Molecular Diagnostics**

Course Objective

The objectives of this course are to sensitize the students about the recent advances in molecular biology and various facets of molecular medicine which has the potential to profoundly alter many aspects of modern medicine including the pre- or post-natal analysis of genetic diseases and identification of individuals predisposed to disease ranging from common cold to cancer.

Genome Biology in Health & Disease DNA, RNA, Protein: An overview; chromosomal structure & mutations; DNA polymorphism: human identity; clinical variability and genetically determined adverse reactions to drugs.

Genome: Resolution, Detection & Analysis PCR: Real-time; ARMS; Multiplex; ISH; FISH; ISA; RFLP; DHPLC; DGGE; CSCE; SSCP; Nucleic acid sequencing: new generations of automated sequencers; Microarray

chips; EST; SAGE; microarray data normalization & analysis; molecular markers: 16S rRNA typing; Diagnostic proteomics: SELDI-TOF MS; Bioinformatics data acquisition & analysis.

Diagnostic Metabolomics Metabolite profile for biomarker detection in the body fluids/tissues under various metabolic disorders by making use of LCMS & NMR technological platforms.

Detection & Identity of Microbial Diseases Direct detection & identification of pathogenic-organisms that are slow growing or currently lacking a system of invitro cultivation as well as genotypic markers of microbial resistance to specific antibiotics.

Detection of Inherited Diseases Exemplified by two inherited diseases for which molecular diagnosis has provided a dramatic improvement of quality of medical care: - Fragile X Syndrome: Paradigm of the new mutational mechanism of the unstable triplet repeats, von-Hippel Lindau disease: recent acquisition in the growing number of familial cancer syndromes.

Molecular Oncology Detection of recognized genetic aberrations in clinical samples from cancer patients; types of cancer-causing alterations revealed by next-generation sequencing of clinical isolates; predictive biomarkers for personalized onco-therapy of human diseases such as chronic myeloid leukemia, colon, breast, lung cancer and melanoma as well as matching targeted therapies with patients and preventing toxicity of standard systemic therapies.

Course Outcome

Students should be able to understand the various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in the early diagnosis and prognosis of human diseases.

Suggested Readings

Text Book:

- Campbell, A. M., & Heyer, L. J. (2006). Discovering genomics, proteomics, and bioinformatics. San Francisco: Benjamin Cummings.

References

- Brooker, R. J. (2009). Genetics: Analysis & principles. New York, NY: McGraw-Hill.
- Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). Molecular biotechnology: Principles and applications of recombinant DNA.

Washington, DC: ASM Press.

- Coleman, W. B., & Tsongalis, G. J. (1997). Molecular diagnostics: For the clinical laboratorian. Totowa, NJ: Humana Press.

BT20.615	**Biocatalysis and Biotransformation**	**3-0-0-3**
Course Objective	To introduce the students about importance of biocatalysts in industry and role of biotransformation for product developments	
	Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes	8
	Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system	8
	Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds	8
	Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc.	8
	Stresses related defense enzymes in plants and animals, Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc.	8
Course Outcome	After successful completion of this course, students will be able to reflect a broad knowledge about enzymes and their applications in academia and industry and have an overview of relevant bio-transformations	
Suggested Readings	**Text Book:** • Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press • Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press **References:** • Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford	

- Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.

FS20.510	**Introduction to Forensic Biotechnology**	**3-0-0-3**
Course Objective:	To give insight of biotechnology applicable in forensic area	

Serology and Immunology **6**

Cell structure and functions. Structure and function of carbohydrates, fats and proteins, serum proteins, haemoglobin and its variants, haptoglobins, HLA, polymorphic enzymes, blood groups-history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from fresh blood and biological stains, body fluids, determination of secretor status, polymorphic enzyme typing, serogenetic markers, determination of origin of species, immunology, immune response, antigens, haptens and antibodies, function and rising of antisera, lectins.Bloodstains investigations: Blood pattern analysis, ageing of bloodstains, difference between human and animal bloodstains, spectroscopic analysis.

Forensic Biology **8**

General plant classification schemes. Sub specialisation of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology.Wood and timber analysis.Diatoms and their forensic importance.Study and identification of various diatoms.Paper and pulp identification.

Hair examination **8**

Collection and preservation of hair samples.Morphological and microscopic examination of human and animal hair. Hair growth and development, determination of origin, race, sex, site from hair. Comparison between human and non-human hair.Macroscopic and microscopic features of hair.

Wildlife Forensics **8**

Introduction and importance of wild life. Protected and endangered species of animals and plants.Sanctuaries and their importance.Introduction to Wildlife (Protection) Act 1972 and CITES, Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife

animals

DNA Profiling **9**

Double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA.Nature and structure of human genome and its diversity.mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans, Forensic DNA profiling and its application in criminal and civil investigations.

Text Books

Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.

Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.

Reference Books

Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.

Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwellpublishing, London, 2006

Mody University of Science & Technology

MSc Maths

Session 2020-2021

Curriculum Structure

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M. Sc. Mathematics

(Session 2016-2017 Onwards)

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20

Objectives: The proposed PG programme in Mathematics is a highly interesting and promising with broader opportunity for absorption in teaching, research and industry for students. The M.Sc. Mathematics programme offers core fundamental skills in Mathematics which incorporate the ideas of applied mathematical knowledge as well as provide platform to the student's regarding research oriented programmes in various interdisciplinary areas of mathematics.

Scope: The programme will generate interest of students towards fundamental mathematical research and will be able to qualify eligibility test for various fellowships.. Student will be able to select various options for higher studies like doctoral programmes in Computational numerical analysis, Advanced graph and pebbling theory, Algebraic and numerical topology, Approximation theory, Optimization techniques , Economics Fluid dynamics, Financial mathematics, Theory of computation and artificial intelligence, Mathematical modeling and simulation etc. Further, they have scope for absorption in research Labs in India like BARC, IISc, TIFR, IITs, ISRO, DRDO etc. as well as may get opportunity for doctoral or post doctoral research in India and abroad.

Input Qualification:

Bachelor's Degree in Science from any recognized university with Mathematics as a core subject for three years/six semesters, with 50% of aggregate marks and adequate proficiency in English.

Evaluation Procedure: All the Rules and Regulations as a provided in the Ordinance and regulations of the Undergraduate/postgraduate programmes of Mody University shall be followed. The first batch of this programme is proposed to be admitted in the session 2016-2017.

	M.Sc. Mathematics									
	Two-Year Programme									
	Academic Curriculum(Session 2016-2017 onwards)									
	First Year									
Autumn Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 511	Computer Based Advanced Numerical Analysis	3	1	-	4	3	25	25	50
	MS 521	Discrete Mathematics	3	1	-	4	3	25	25	50
	MS 531	General Topology	3	1	-	4	3	25	25	50
	MS 541	Operations Research	3	1	-	4	3	25	25	50
	MS 551	Statistics and Probability -I	3	1	-	4	3	25	25	50
	MS 561	Ordinary Differential Equations	3	1	-	4	3	25	25	50
		Sub Total	**18**	**6**	**-**	**24**				
		Foreign Language-I** (Non-Credit)	3	-	-	3	3	25	25	50
Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
			L	T	P		Hours	CW*	MTE	ETE
	MS 512	Advanced Abstract Algebra	3	1	-	4	3	25	25	50
	MS 522	Complex Analysis and Integral Transform	3	1	-	4	3	25	25	50
	MS 532	Mathematical Modeling and Simulation	3	1	-	4	3	25	25	50
	MS 542	Partial Differential Equations	3	1	-	4	3	25	25	50
	MS 552	Statistics and Probability - II	3	1	-	4	3	25	25	50
	MS 562	Modeling and Simulation Laboratory	-	-	4	2	4	100		
		Sub Total	**15**	**5**	**4**	**22**				
		Foreign Language-II **(Non-Credit)	3	-	-	3	3	25	25	50

** Refer to Foreign Language Section.

M.Sc.(Mathematics)

Two-Year Programme (2016- 17 and onwards)

Second Year

Autumn Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 611	Advanced Linear Algebra	3	1	-	4	3	25	25	50
MS 621	Advanced Graph Theory and Combinatorics	3	1	-	4	3	25	25	50
MS 631	Real Analysis and Measure Theory	3	1	-	4	3	25	25	50
MS 641	Special Functions and Integral Equations	3	1	-	4	3	25	25	50
	Elective-I	3	1	-	4	3	25	25	50
	Sub Total	**15**	**5**	**-**	**20**				

Spring Semester

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE	ETE
MS 612	Functional Analysis	3	1	-	4	3	25	25	50
MS 622	Inequality and Continued Fractions	3	1	-	4	3	25	25	50
MS 632	Basics of MATLAB	-	-	4	2	4	100		
	Elective-II	3	1	-	4	3	25	25	50
MS 642	Dissertation	-	-	-	8		100		
	Sub Total	**9**	**3**	**4**	**22**				

Total Credits: 88 (I Year +II year)

Elective- I	**Elective- II**
MS 651 Magneto Hydrodynamics	MS 652 Viscous Fluid Dynamics
MS 661 Sequence and Series	MS 662 Summability and Approximation Theory
MS 671 Tensor Analysis	MS 672 Mechanics and Calculus of Variations
MS 681 Reliability Theories	MS 682 Fourier Analysis
MS 691 Advanced Number Theory	MS 692 Differential Geometry

* CW (Course work): It would include attendance, assignments, class /quiz test.

Note: Combinations of electives are: MS 651 & MS 652; MS 661 & MS 662; MS 671 & MS 672; MS 681 & MS 682; MS 691 & MS 692.

(Above II year is taken from AC 30, syllabus in AC 30 minutes)

MS 511 Computer Based Advanced Numerical Analysis 3-1-0-4

1. Algebraic and Transcendental Equations: General iterative methods, Newton-Raphson method for finding multiple roots, system of non linear equations, convergence of Newton-Raphson method, Graeffe's root squaring method, Muller's method , Bairstow iterative method. **[08]**

2. System of Linear Equations: Existence of solution, ill-conditioned system, Gauss elimination with pivoting, Gauss-Jordan method, triangular factorization method, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. **[08]**

3. Boundary Value and Eigen Value Problems: Solution of Eigen values problems by power method, Jacobi method, finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method. **[08]**

4. Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations. **[09]**

5. Difference Equations and Curve Fitting: Homogeneous difference equations with constant coefficients, particular solutions of a difference equations, curve fitting and regression, least square method, fitting of straight line and second order polynomials. **[06]**

Text Books:

1. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
2. Collatz L. (2013), Numerical Solution of Differential Equations, 6th ed., Springer.
3. Jain M.K. and Iyenger S.R.K.(2003), Numerical Methods for Scientists & Engineering Computations, 4th ed., Wiley Eastern Ltd.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.

MS 521 **Discrete Mathematics** **3-1-0-4**

1. Relation and Function: Definition of set, different forms, properties and operations, principle of inclusion and exclusion, partition of a set, definition and types of a relation, composition, properties, graphical representation, equivalence classes, closure of a relation, Warshall's algorithm, Hasse diagrams, definition of lattice, different forms, properties, definition and kinds of a function, composition and properties of functions, recursively defined functions. **[10]**

2. Logics and Proofs: Propositional logic, propositional equivalences, predicates and quantifiers, nested quantifiers, rules of inference, notion of a proof and methods for constructing proofs, normal forms (disjunctive and conjunctive), proof methods and strategy, statements of Fermat's last theorem, the $(3x + 1)$ conjecture and Godel's incompleteness theorem, program correctness. **[10]**

3. Induction and Counting: Mathematical induction, strong induction and well-ordering, recursive definitions and structural induction, recursive algorithms, basics of counting, pigeonhole principle, permutations and combinations, binomial coefficients, generalized permutations and combinations, generating permutations and combinations. **[09]**

4. Graphs and Finite Automata: Graph and digraphs,, Konigsberg bridge problem, finite and infinite graphs, incidence and degree, isolated vertex, pendant vertex, and null graph, isomorphism, sub graphs, walk, path and circuits, connected graphs, disconnected graphs and components, Euler graphs, operation on graphs, Hamiltonian paths and circuits, traveling salesman problem, types and properties of tree, matrix representation of graphs; deterministic and non-deterministic finite automata, transition table and transition diagram, Mealy and Moore machines, minimization of finite automation. **[10]**

Text Books:

1. Kenneth H. Rosen (2008), Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7th ed., TMH Education.
2. Kolman, Busby and Ross (2009), Discrete Mathematical Structure, 6th ed., Pearson.
3. K.D. Joshi (1989), Foundations of Discrete Mathematics, 2003 reprint, New Age International.

Reference Books:

1. Tremblay(1997), Discrete Mathematical Structures with Application to Computer Science, 35th reprint 2008,Mc Graw Hill Education,
2. Liu and Mohapatra (2000) , Elements of Discrete Mathematics , 2nd ed., Mc Graw Hill Education, New Delhi.
3. Narsingh Deo (2004), Graph Theory with Applications to Engineering and Computer Science, reprint ed.,PHI.

MS 531 **General Topology** **3-1-0-4**

1. Metric and Topological Spaces: Definition and examples of metric spaces, open sets, closed sets, convergence, completeness and Baire's theorem, continuous mappings, spaces of continuous functions, Euclidean and unitary spaces, definition and examples of topological spaces, elementary concepts, open bases and open subbases, weak topologies, function algebras. **[08]**

2. Compactness: Compact spaces, products of spaces, Tychonoff's theorem and locally compact spaces, compactness for metric spaces, Ascoli's theorem. **[08]**

3. Separation: T_1 – spaces and Hausdorff spaces, completely regular spaces and normal spaces, Urysohn's lemma and the Tietze extension theorem, Urysohn's imbedding theorem, Stone – Cech compactification. **[08]**

4. Connectedness: Connected spaces, the component of spaces, totally disconnected spaces, locally connected spaces. **[08]**

5. Approximation: Weierstrass approximation theorem, Stone-Weierstrass theorems locally compact Hausdrorff spaces, extended Stone-Weierstrass theorems. **[07]**

Text Books:

1. George F. Simmons (2015), Topology and Modern Analysis, reprint ed., McGraw Hill Education, New Delhi
2. Sharma J. N. and Vashistha A. R.(2010), Topology, 37th ed., Krishna Prakashan Media, Meerut.
3. Adams (2008), Introduction to Topology: Pure and Applied, 3rd reprint ed., Pearson.

Reference Books:

1. Cain L.(2012), Introduction to General Topology,1st impression. Pearson.
2. Armstrong (2014), Basic Topology, reprint ed., CBS Publication.
3. Seymour Lipschutz(1965), Schaum's Outline of Theory and Problems of General Topology, 1st ed.,McGraw Hill Education.

MS 541 **Operations Research**

3-1-0-4

1. Linear Programming: Dual simplex method, parametric linear programming, game theory, two person zero sum game, game with mixed strategies, graphical solution, solution by linear programming. **[10]**

2. Inventory and Replacement Models: Deterministic models purchase and manufacturing models, probabilistic models, replacement of items that deteriorate and whose maintenance and repair costs increases with time. **[10]**

3. Job Sequencing and Queuing Theory: N jobs two machines, N jobs three machines, two jobs N machines; elements of a queuing system, Kendall's notation, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞) models. **[10]**

4. Dynamic Programming and PERT-CPM: Bellman's principal, employment smoothing problem, cargo loading problem; project planning and scheduling using PERT-CPM. **[09]**

Text Books:

1. Gupta Prem Kumar and Hira D.S.(2007), Operations Research,4th ed., S. Chand & Company Ltd., New Delhi.
2. Kanti Swarup, Gupta P.K. and Man Mohan (2006), Operations Research, 3rd ed., Sultan Chand & Sons, New Delhi.
3. Hillier F.S. and Lieberman G.J. (2005), Introduction to Operations Research, 8th ed., McGraw Hill, New Delhi.

Reference Books:

1. Taha H.A. (2010),Operations Research-An Introduction, 9th ed., Macmillan Publishing Co., Inc., New York.
2. Hadly G.(1964), Nonlinear and Dynamic Programming , 2nd ed., Addison-Wesley, Reading Mass.

MS 551 **Statistics and Probability - I** **3-1-0-4**

1. Introductory Ideas: Recapitulation of basic probability theory, law of addition and multiplication, conditional probability, total probability, Bayes' theorem and its applications. **[06]**

2. Random Variables: Theorems on random variables, distribution function, properties of distribution, discrete random variable, probability mass function (pmf), discrete distribution function, continuous random variable, probability density function (pdf), cumulative distribution function(cdf), moments, covariance, moments generating function, two-dimensional random variables (discrete and continuous), transformation of random variables. **[12]**

3. Distributions: Discrete-binomial, Poisson, geometric, uniform distributions, continuous-uniform, exponential, gamma, weibull, normal distributions. **[12]**

4. Correlation and Regression: Simple and partial correlations, linear and non-linear regressions, regression coefficients, properties, angle between two lines of regression, standard error of estimate rank, regression curve correlation. **[09]**

Text Books:

1. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
2. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
3. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
4. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

1. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
2. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
3. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
4. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

1. Second Order Differential Equations: Review of the general solution of the second order homogeneous differential equations, use of a known solution to find another solution, homogeneous equations with constant coefficients, method of undetermined coefficient and method of variation of parameters. **[08]**

2. Non-Linear Ordinary Differential Equations: Two dimensional autonomous systems and phase space analysis- critical points, proper and improper nodes, spiral points and saddle points, definition of stability, Lyapunov function, stable, unstable and center subspaces, Riccati's equation-general solution and the solution when one, two or three particular solutions are known. **[10]**

3. Total Differential Equations: Different forms and solutions, necessary and sufficient condition, geometrical meaning of equation containing three and four variables, total differential equations of second degree. **[07]**

4. Power Series Solutions: Review of power series, series solutions of first order equations (Taylor series method), second order linear equations, solution near a regular singular point (method of Forbenius) for different cases, particular integral and the point at infinity. **[08]**

5. Existence and Uniqueness of Initial Value Problems: The existence and uniqueness of solutions, method of successive approximations, Picard's theorem, solution of initial-value problems by Picard method. **[06]**

Text Books:

1. Deo S. C., Lakshmikantham and Raghvendra V.(2000), Text book of Ordinary Differential Equations, 2nd ed.,Tata Mc-Graw Hill.
2. Dennis G. Zill, Michael R Cullen (2009), Differential Equations with Boundary-Value Problems, 7th ed., Brooks/Cole.
3. M. Rama Mohana Rao (1980), Ordinary Differential Equations: Theory and Applications, 2nd ed., Affiliated East-West Press Pvt. Ltd., New Delhi.

Reference Books:

1. Birkhoff and Rota G., G.C. (1978) , Ordinary Differential Equations , 4th ed., John Wiley and Sons Inc., NY.
2. Boyce, W.E. and Diprima, R.C.(1986), Elementary Differential Equations and Boundary Value Problems ,4th ed., John Wiley and Sons Inc., NY.
3. Raisinghaniya M.D. (2008), Ordinary and Partial Differential Equations , 18th ed.,S. Chand Limited.

MS 512 **Advanced Abstract Algebra** **3-1-0-4**

1. Groups: Introduction and preliminaries (equivalence relation, integers modulo n), group definition and basic axioms, examples (dihedral, symmetric, matrix, quaternion groups), subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups and quotient groups, centralizers and normalizers, nilpotent groups, direct products. **[10]**

2. Homomorphism and Group Actions: Definition and examples, isomorphism theorems, groups acting on themselves by left multiplication (Cayley's theorem), groups acting on themselves by conjugation (the class equation), automorphisms, Sylow p-groups and Sylow theorem. **[10]**

3. Ring: Basic definitions, examples (polynomial rings, matrix rings, group rings), ideals, ring homomorphism, integral domains and fields, maximal and prime ideals, Euclidean domain, principal ideal domains, unique factorization domains, polynomial rings over fields, introduction to modules (vector space as a special case). **[10]**

4. Field: Basic theory of field extensions, algebraic extensions, splitting fields and algebraic closures, separable and inseparable extensions, finite fields, field automorphisms, fundamental theorem of Galois theory, Galois groups of polynomials, cyclotomic extension. **[09]**

Text Books:

1. Fraleigh J. B. (2003), Abstract Algebra, 7th Edition, Pearson.
2. Dummit and Foote(1991), Abstract Algebra,3rd ed., John Wiley & Sons, Inc.
3. Khanna and Bhambri (2009), A Course in Abstract Algebra , 3rd ed., Vikas Publishing.
4. Herstein I. N.(1996), Topics in Algebra, 3rd Edition, Wiley India.

Reference Books:

1. Thomas W. Hungerford (2012), AbstractAlgebra, 4th Edition, Springer.
2. Vashistha, Modern Algebra(2011), 4th ed., Krishna Prakashan Mandir, Meerut.
3. Artin(2012), Algebra, 7th Edition, PHI.

MS 522 **Complex Analysis and Integral Transform** **3-1-0-4**

1. Basics of Complex Analysis: Complex numbers, complex function and its derivative, basic transcendental functions, power series of functions, integration in the complex plane, residues and their use in integration. **[10]**

2. Laplace Transforms and Stability of Systems: Laplace transform and their inversion, introduction of stability, Nyquist stability criterion, generalized functions, Laplace transforms and stability. **[10]**

3. Mellin Transform: Definition and properties of Mellin transform, evaluation of Mellin transform complex variable method and applications. **[09]**

4. Hankel Transform: Elementary properties, inversion theorem, transform of derivatives of functions, transform of elementary functions, Parseval's relation, relation between Fourier and Hankel transforms, use of Hankel transform in the solution of partial differential equations, dual integral equations and mixed boundary value problems. **[10]**

Text Books:

1. David Wunsch A.(2009), Complex Variables with Applications, 3rd Edition, Pearson.
2. H.K. Pathak(2004), Complex Analysis , 3rd ed., Shiksha Sahitya Prakashan, Meerut.
3. Gupta and Vashistha(2010), Integral Transform,4th ed., Krishna publication Media, Meerut.
4. Ian N. Sneddon(1972), The Use of Integral transforms by, 2nd Printing Edition, McGraw Hill.

Reference Books:

1. Ahlfors(1987), Complex Analysis,3rd ed., McGraw Hill Education.
2. Rudin(2006), Real and Complex Analysis,2nd reprint , McGraw Hill Education.
3. Andrews & Shivamoggi(2007) , Integral Transforms for Engineers,3rd ed., PHI Learning.

MS 532 **Mathematical Modeling and Simulation** **3-1-0-4**

1. Introduction to Simulation and Modeling: System concepts and theories, attributes and types of systems, discrete and continuous, deterministic and stochastic, open and closed, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, developing system dynamic equations - first order (+ve, -ve) systems, pure second order (+ve, -ve) systems and general feedback systems, simulation of equations for different systems. **[14]**

2. Random Numbers and Random Variates: Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods. **[10]**

3. Discrete Event Simulation: Concepts, event scheduling versus time advance scheduling, list processing. **[05]**

4. Verification and Validation of Simulation Models: Introduction, input modeling, identifying the distribution of data, parameter estimation, goodness of fit tests, model building, , verification calibration and validation of models, output analysis- measures of performance and their estimation. **[10]**

Text Books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2013), Discrete- Event System Simulation , 5th ed.,, Pearson, 2013.
2. Averill M. Law(2006), Simulation Modeling and Analysis, 4th ed., McGraw Hill Education.
3. V.P. Singh (2009), System Modeling and Simulation, 3rd ed., New Age International Publishers.
4. Frank L. Severance (2009) System Modeling and Simulation: An Introduction , 4th ed., Wiley.

Reference Books:

1. Taha(2012), Operations Research: An Introduction, 15th Indian reprint, PHI.
2. Geoffrey Gordon (2012), System Simulation, 2nd ed.,, PHI.
3. J.N. Kapoor (1994), Mathematical Modeling, 2nd ed.,Wiley Eastern Limited, Fourth reprint.

MS 542 **Partial Differential Equations** **3-1-0-4**

1. Second Order Partial Differential Equations: Preliminaries of partial differential equations, review of the classification of second order partial differential equations to hyperbolic, elliptic and parabolic forms, reduction of linear and quasi-linear equations in two independent variables to their canonical forms, characteristic curves. **[06]**

2. Laplace equation: Solution by method of separation of variables, mean value property, weak and strong maximum principle, Poisson's formula, Dirichlet's principle, solution of Laplace equation in cylindrical and spherical polar coordinates. **[06]**

3. Heat Equation: Solution by method of separation of variables, initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results. **[06]**

4. Wave Equation: Solution by method of separation of variables, uniqueness, D'Alembert's method, solution by spherical means and Riemann method of solution. **[06]**

5. Green's Functions: Introduction, Green's function for Laplace equation, method of images, eigenfunction method, Green's function for the wave and diffusion equations, Helmholtz theorem. **[08]**

6. Laplace and Fourier Transforms: Basics of Laplace transform solutions of diffusion and wave equations, basics of Fourier transform solution of diffusion, wave and Laplace equations. **[07]**

Text Books:

1. Sankara Rao K. (2003), Introduction to Partial Differential Equations , 4th ed., PHI Pvt. Ltd.
2. Asmar(2010), Partial Differential Equations and Boundary Value Problems with Fourier series, 2nd ed., Pearson.
3. Sundarapandian(2012), Ordinary and Partial Differential Equations, 3rd ed.,McGraw Hill Education, New Delhi.
4. Bhamra (2013), Partial Differential Equations: An Introductory Treatment with Applications ,4th ed., PHI Learning.

Reference Books:

1. Raisinghaniya M.D. (2008) , Ordinary and Partial Differential Equations , 3rd ed.,S. Chand Limited.
2. Zauderer(E. 1989), Partial Differential Equations of Applied Mathematics , 2nd ed., John Wiley and Sons, New York.
3. L Debnath(2007), Nonlinear PDE's for Scientists and Engineers , Birkhauser, Boston.
4. Sneddon I.N. (1957) , Elements of Partial Differential Equations, 2nd ed., McGraw Hill Book Company.

MS 552 **Statistics and Probability -II** **3-1-0-4**

1. Tests of Hypotheses: Simple hypothesis versus simple alternative, composite hypotheses, sampling from the normal distribution, tests on the mean and variance, tests on several means and variances, Chi-square tests, tests of hypotheses and confidence intervals, sequential tests of hypotheses. **[10]**

2. **Sampling and Sampling Distributions:** Sampling-inductive inference, populations and samples, distribution of samples, statistics and sample moments, sample mean and variance, law of large numbers, central limit theorem and its applications, sampling from the normal distributions, role of the normal distribution in statistics, sample mean, Chi-square distribution, F distribution, student's t distribution. **[10]**

3. Random Processes: Basics of random process, random process concept, continuous and discrete, statistics of random process, classification of random process, stationary and evolutionary random processes, cross-correlation, Markov process and Markov chain, binomial, Poisson, normal, Ergodic, random telegraph , sine wave random processes. **[11]**

4. Time Series Analysis: Introduction, characteristics movements in a time series, time series models, measurement of trends, secular trend, seasonal movements, cyclical movement, irregular movements, long cycles and applications. **[08]**

Text Books:

5. Baisnab A.P. and Manoranjan Jas (2003), Elements of Probability and Statistics, 2nd ed., TMH .
6. Pugalararasu(2011) , Probability and Queuing Theory , 1st ed., TMH.
7. Gupta and Kapoor (2002), Fundamental of Mathematical Statistics , 3rd ed., SCS Publisher.
8. J. Susan Milton and Jesse C. Arnold (2016), Introduction to Probability and Statistics, 4th ed.,, Mc Graw Hill Education.

Reference Books:

5. Papoulis(2002), Probability, Random Variables and Stochastic Processes,4th ed., TMH.
6. Palaniammal(2012), Probability and Random Processes , 3rd ed., PHI.
7. Probability and Statistics (Schaum's outline Series) by Spiegel (2009), 3rd ed., TMH.
8. Miller and Freund's (2007), Mathematical Statistics with Applications, 7th Edition, Pearson.

MS 562 **Modeling and Simulation Laboratory** **0-0-4-2**

Modeling and Simulation Laboratory related to Course Code MS 532 (Mathematical Modeling and Simulation).

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MS 611 **Advanced Linear Algebra** **3-1-0-4**

1. Vector Spaces and Linear Equations: Fields, vector spaces, subspaces, bases, dimension, span, coordinates, row reduced echelon matrices, invertible matrices, row and column space, system of linear equations, direct sum, determinants. **[08]**

2. Linear Transformations: Definition of linear transformations, kernel, range, rank-nullity theorem, algebra of linear transformations, representation of transformations by matrices, eigenvalues, eigenvectors, diagonalization, invariant subspaces, invertibility and isomorphisms, linear functional, transpose of a linear transformation, dual spaces. **[08]**

3. Inner Product Space and Norms: Definition of an inner product and its properties, (including the Cauchy Schwartz inequality), orthogonality, Gram-Schmidt orthogonalization process, orthogonal projections, minimization problem (least squares), adjoints. **[08]**

4. Operators on Inner Product Spaces: Unitary and orthogonal operators and their matrices, normal and self-adjoint operators, bilinear and quadratic forms on inner product spaces, spectral theory. **[08]**

5. Rational and Jordan Forms: Cyclic subspaces and annihiliators, Jordon canonical form, minimal polynomial, block matrices and matrix factorization, SVD and pseudoinverse. **[07]**

Text Books:

1. Friedbeg, Insel, Spence (2011) Linear Algebra, 4th Edition, PHI.
2. David C. L. (2002) Linear Algebra and its Applications, 3rd Edition, Pearson.

Reference Books:

1. Kumaresan S. (2000) Linear Algebra: A Geometric Approach, PHI.

2. Charles. W. C. (2012) Linear Algebra: An Introductory Approach, 3rd Edition, Springer.
3. RomanS. (2008) Advanced Linear Algebra, 3rd Edition, Springer.
4. Cheney, Kincaid (2012) Linear Algebra: Theory and Applications, 2nd Edition, Jones and Bartlet.

MA 621 Advanced Graph Theory and Combinatorics 3-1-0-4

1.Preliminaries: Graphs(undirected and directed), sub graphs, degree-sum formula, graphic sequences, matrix representations of a graph, path and circuits, bipartite graphs, graph isomorphism, decomposition,Euler graph and its properties,operations on graphs, Hamiltonian paths and circuits, traveling –salesman problem. **[08]**

2. Trees, Cut-Sets and Cut-Vertices: Definition and properties of trees, distance and centers in a tree, rooted and binary trees, on counting trees, spanning trees, rank, nullity and cyclomatic number, Kruskal's and Prim's algorithms, cut sets and their properties, all cut sets, connectivity and separability, 1-Isomorphism and 2-Isomorphism. **[08]**

3. Planarity, Matching, Coloring and Covering: Combinatorial versus geometric graphs, geometric and combinatorial duals of a graph, planar embeddings, Euler's formula, triangulation, Kuratowski's theorem, dual graphs, factors and matching (in bipartite and non-bipartite graphs), Hall's matching theorem, chromatic number, chromating partitioning, chromatic polynomial, matching, coverings, the four color problem. **[08]**

4.Pebbling on Graph: Pebbling on undirected graph with properties, pebbling number, cover pebbling, the staching theorem, pebbling on directed graph with properties, pebbling on isomorphic graphs, pebbling of cyclic graph, alternating wheel graph, alternating fan graph and alternating complete graph with their properties, extension of graph pebbling. **[08]**

5. Advance Counting Techniques: Recurrence relations, solving linear recurrence relations, divide-and-conquer algorithms and recurrence relations, generating function, inclusion-exclusion with applications. **[07]**

Text Books:

1. Deo N.(2001)Graph Theory with Applications to Engineering and Computer Science,

PHI.
2. Chartland G., Zhang P. (2006)Introduction to Graph Theory, Fourth reprint, Mc Graw Hill Education.

Reference Books:

1. Wilson R. J. (2010) Introduction to Graph Theory, 4th Edition, Pearson.
2. Jonathan L.G. Yellen J. (2004) Handbook of Graph Theory, CRC Press.
3. Yerger C.R.(2005) Extensions of Graph Pebbling, Thesis.
4. Ore O. (1991) Theory of Graphs, Volume 38, American Mathematical Society, Colloquium Publications.
5. West D. B. (2001) Introduction to Graph theory, 2nd Edition, PHI Learning.
6. Kenneth H R. (2007) Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, 7thEdition, Mc Graw Hill Education.

MS 631 **Real Analysis and Measure Theory** **3-1-0-4**

1. Metric Spaces: Review of the real number system (supremum, infimum, field, order and completeness axioms, extended real number system, basic notions of sets, relation and functions), finite, countable and uncountable sets, open and closed sets, adherent and accumulation points, Bolzano-Weistrass theorem, Heine-Borel covering theorem, compactness in R^n and in general metric spaces, connectedness. **[08]**

2. Limits and Continuity: Convergent sequences, Cauchy sequences, complete metric spaces, limit of a function, continuous functions, uniform continuity, convergence of series, rearrangements, Abel's and Dirichlet's theorem, sequence of functions, point wise and uniform convergence, sequential compactness, Ascoli-Arzela theorem, real power series, Weistrass theorem. **[08]**

3. Differentiation and Riemann Integration: Algebra of derivatives, the chain rule, differentiation of monotone functions (leading to the mean value theorem and intermediate value theorem), upper and lower integrals, oscillations, integrality of continuous functions, fundamental theorem of calculus, interchange of limit and integration operations, vector valued differentiation and integration. **[08]**

4. Measure Theory: Indicator functions, fields and σ-fields, definition and fundamental properties of a non-negative measure, measurable sets, measure zero sets, positive Borel measures,Lebesgue measure,algebra of measurable functions, almost everywhere convergence, convergence in measure. **[08]**

5. Integration Theory on General Measure Spaces: The Lebesgue integral, Fatou's Lemma, the monotone and dominated convergence theorems, continuous functions with compact support, Tonelli and Fubini's theorems, comparison of proper and improper Lebesgue and Riemann integrals. **[07]**

Text Books:

1. Rudin W.(1976)Principles of Mathematical Analysis, 3rd Edition, TMH.
2. Bartle R. G., Donald R. S. (2011)Introduction to Analysis, 2nd Edition, Wiley and Sons.

Reference Books:

1. Royden H.L. (2017)Real Analysis , 2nd Edition, PHI
2. Apostle (1997)Mathematical Analysis , 2nd Edition, Narosa Publishing House,
3. Carothers N. L. (2000) Real Analysis, 2nd Edition, Cambridge University Press.
4. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.

MS 641 **Special Functions and Integral Equations** **3-1-0-4**

1. Hypergeometric Functions: Definition, convergence, gamma and beta functions, Gauss hypergeometric function and its properties, series solution of Gauss hypergeometric equation, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, Kummer's confluent hyper geometric function and its properties, integral representation. **[10]**

2.Bessel and Legendre Functions: Definition, connection with hypergeometric function, differential and pure recurrence relations, generating function, integral representation, orthogonal properties. **[10]**

3.Linear Integral Equations: Definition and classification, conversion of initial and boundary value problems to an integral equation, Eigen values and Eigen functions, solution of homogeneous and general Fredholm integral equations of second kind with separable kernels. **[10]**

4.Solution of Integral Equations: Solution of Fredholm and Volterra integral equations of second kind by methods of successive substitutions and successive approximations, Resolvent kernel and its results, conditions of uniform convergence and uniqueness of series solution, solution of Volterra integral equations of second kind with convolution type kernels by Laplace transform. **[09]**

Text Books:

1. Kanwal R.P. (1971)Linear Integral Equations: Theory and Techniques,Academic Press, New York.
2. Miller LieW. Jr. (1968)Theory and Special Functions,Academic Press, New York and London.

Reference Books:

1. Rainville E.D. (1960) Special Functions, Macmillan Company, New York.
2. Wazwaz A. M. (2011)Linear and Non Linear Integral Equations: Methods and Applications,Higher Education Press, Springer.
3. Banerjee P.K., Goyal M.C. (2003) Special Functions and Calculus of Variations, Ramesh Book Depot. Jaipur, India.
4. Swarup S., Singh S. J. (2014) Integral Equation, 22nd Edition, Krishna Prakashan Meerut.

MS 612 **Functional Analysis** **3-1-0-4**

1. General Theory: Introduction of topological vector spaces, separation properties, linear mappings, finite-dimensional spaces, metrization, boundedness and continuity, seminorms and local convexity, quotient spaces, completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

2. Completeness and Compactness: Completeness, Baire category, Banach-Steinhaus theorem, open mapping theorem, closed graph theorem, bilinear mappings, convexity, Hahn-Banach theorems, weak topologies, compact convex sets, vector-valued integration, holomorphic functions. **[10]**

3.Duality in Banach Spaces and Applications I: The normed dual of a normal space, adjoints, compact operators, continuity theorem, closed subspaces of Lp-spaces, the range of a vector-valued measure, **[10]**

4.Duality in Banach Spaces and Applications II: Generalized Stone-Weierstrass theorem, two interpolation theorems, Kakutani's fixed point theorem, Haar measure on compact groups, uncomplemented subspaces, sum of Poisson kernels, two more fixed point theorems. **[09]**

Text Books:

1. Rudin W. (2006) Functional Analysis, McGraw Hill Education (India).
2. Limaye B.V.(2013)Functional Analysis, 3rd Edition, New Age International.

Reference Books:

3. Somasundaram D. (2014) First Course in Functional Analysis, 1 Edition, Narosa Book Distribution Pvt. Ltd.
4. Corlson, Robert (2006) Concrete Introduction to Real Analysis, Vikas publishing House Pvt. Ltd.
5. Kreyszig E. (2007) Introductory Functional Analysis with Applications John Wiley & Sons.

MS 622 **Inequality and Continued Fractions** **3-1-0-4**

1. Inequalities: Definition and important properties**,** maximum and minimum values of algebraic functions and expressions with and without constraints, some important inequalities, Weirstrass inequality, Schwarz's or Cauchy's inequality,Tchebychef's inequality, important proofs and theorems. **[10]**

2. Continued Fractions I: Definition and different form of continued fractions, simple, infinite or non terminating and terminating continued fractions, continued fractions with positive quotients, conversion of fraction into continued fraction, successive convergent, law of formation of successive convergent of simple continued fraction. **[10]**

3. Continued Fractions II: Difference between the fraction and its convergent, equivalent numbers and periodic continued fractions, some special quadratic surds, recurring continued fraction. **[10]**

4. Continued Fractions III: Different theorems based on odd and even convergent, limits to error in convergent for the continued fraction, series of fractions and approximation. **[09]**

Text Books:

1. Hardy G. H., Littlewood J. E., Polya G. (1952) Inequalities, Cambridge University Press.
2. Hardy G. H., Wrihgt E.M. (1979) An Introduction to Theory of Numbers, 5th Edition, Oxford, University Press.

Reference Books:

1. Niven, Zuckerman H. S., Montgomery H. L. (2004) An Introduction to the Theory of Numbers, 5th Edition, John Wiley and Sons, Inc., New York.
2. Bruce C. B. (2005)Ramanujan's Note Books Volume-1 to 5, Springer.
3. ApostolT. M. (2013)Introduction to Analytic Number Theory, Narosa Publishing House, New Delhi.

MS 632 **Basics of MATLAB** **0-0-4-2**

1. Introduction: MATLAB interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. **[08]**

2. Functions and Files: Elementary mathematical functions, user defined functions, additional functions, working with data files. **[06]**

3. Decision-Making Programs: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[06]**

4. Advanced Plotting and Model Building: *xy* Plotting functions, additional commands and plot types, interactive plotting, function discovery, regression, basic fitting interface, three dimensional plots. **[06]**

Text Books:

1. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.
2. William J. Palm III (2012), A Concise Introduction to MATLAB, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.
2. Stormy A. (Edition 4), MATLAB: A Practical Introduction to Programming and Problem Solving, BH Publication.

MS 651 **Magneto Hydrodynamics** **3-1-0-4**

1. Fundamental Equations of MFD: Electromagnetic field equations(charge conservation equation, constitutive equations, Maxwell's equations, generalized Ohm's law),fluid dynamics field equations(equation of state, equation of motion, equation of energy), MFD approximation, magnetic field equation, magnetic Reynolds number, Alfven's theorem, magnetic energy, electromagnetic stresses, force free magnetic fields. **[10]**

2. Basic Equations of MHD Flow: Boundary conditions, flow between parallel plates, Hartmann flow, Couette flow with velocity and temperature distributions, flowin a tube of rectangular cross section, pipe flow, flow in a annular channel, flow between two rotating coaxial cylinder. **[10]**

3. Boundary Layer Approximation: Two dimensional boundary layer equations for flow over a plane surface for fluids of large electrical conductivity, flow past a semi infinite rigid flate plate in an aligned and transverse magnetic field, two dimensional thermal boundary layer equations for flow over a plane surface, heat transfer in MHD boundary layer flow past a flate plate in an aligned magnetic field. **[10]**

4. Magneto Hydrodynamics Waves: Waves in an infinite fluid of infinite electrical conductivity, Alfven waves, waves in a compressible fluid, waves in the presence of dissipative effects, stationary plane shock waves in absence of magnetic field. **[09]**

Text Books:

1. Cramer R.K., Pai S.I.(1973) Magnetofluid Dynamics for Engineers and Physicists, Scripta Publishing Company, Washington D. C.
2. Charlton P.(1985) Text Book on Fluid Dynamics, CBS Publications, Delhi.

Reference Books:

1. Shereliff J.A. (1965) Magneto Hhydrodynamics, Pergamon Press, London.
2. Rathy R.K. (1976)an Introduction to Fluid Dynamics Oxford and IBH Publishing Company, New Delhi.

MS 652 **Viscous Fluid Dynamics** **3-1-0-4**

1. Fluid Motion: Introduction and continuum hypothesis, constitutive equations for Newtonian fluids, viscosity, Navier Stoke's equation for viscous compressible flow, vorticity and circulation, equation of energy, flow between two concentric rotating cylinders, stagnation point it two dimensional flow, flow due to plane wall suddenly set in motion(Stoke's first problem). **[10]**

2. Temperature Distribution: Physical importance of non-dimensional parameters. Renold's number, Prandtl number, Mach number, Froude Number, Nusselt number , plane couette flow, plane poisseullecouette flow, plane poissuille flow, Haigen poissuille flow in a circular pipe, Stoke's equation of very slow motion, Stoke's stream function, flow past a sphere. **[10]**

3. Laminar Flow: Two dimensionalincompressible boundary layer equation, Blasuis Topfer solution of boundary layer on a flat plate, wedge flow, flow in a convergent channel, flow in the wake of flat plate, two dimensional plane jet flow. **[10]**

4. Boundary Layer Theory: Thermal boundary layer in two dimensional incompressible flows, Crocco's integrals, forced convection in laminar boundary layer on a flat plate, free convection from a heated vertical plate, Karman momentum and kinetic energy integral equations. **[09]**

Text Books:

1. Schliching H., Boundary Layer Theory, McGraw Hill.
2. Pai, S.I, Nostrand D.V. (1956) Viscous Flow Theory, Vol.I, Laminar Flow, Company, New York.

Reference Books:

1. BansalJ.L. (2004)Viscous Fluid Dynamics, Oxford and IBH.
2. Frank M. W. (1991)Viscous Fluid Flow,2nd edition, McGraw Hill.

MS 661 **Sequence and Series** **3-1-0-4**

1. **Real and Complex Numbers:**Introduction, field and order structures, bounded and unbounded sets with supremum and infimum, completeness, absolute value, limit points, closure, countable and uncountable sets,complex number system, triangle inequality, functions of single variable. **[12]**

2. Sequences: Sequences of real and complex numbers, limit points, limits, convergence and non-convergence, Cauchy's general principle of convergence, algebra of sequences, monotonic, point wise convergence, uniform convergence on an interval, tests for convergence, properties, Weierstrass approximation theorem. **[11]**

3.Infinite Series I: Introduction, series of real and complex numbers, positive term series, comparison, Cauchy's root, D'Alembert's ratio, Raabe's, Logarithmic, integral, Gauss's tests, series with arbitrary terms, rearrangement of terms. **[08]**

4.Infinite Series II: Properties of uniform convergent series, power series, properties of functions expressible as power series, Abel's theorem, Taylor's and Lauren's series with convergence. **[08]**

Text Books:

1. Mallik S.C., Arora S. (1992) Mathematical Analysis, 2nd Edition New Age International Ltd.
2. Rudin W.(1976) Principles of Mathematical Analysis, 3rd Edition, TMH.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trignometric Series, Vol. 1, Cambridge University Press.
3. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.
4. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
5. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 662 **Summability and Approximation Theory** **3-1-0-4**

1. Transformation and Summability Means: Matrix and linear transformation, definition of summability, Norlund means and its regularity condition, Cesaro means (C, 1) means, Cesaro and holders matrices, consistency of methods, examples and related theorems. **[15]**

2.Convergence of Fourier Series: Convergence of Fourier series, Dirichlet's integral, Riemann-Lebesgue theorem, (C, 1) summability of Fourier series, Fejer theorem, Fejer-Lebesgue theorem. **[08]**

3. L_p Space: Definition of L_2space, L_p space, Bessel's inequality, Holders inequality and Minkowski inequality. **[08]**

4.Approximation Theory: Best approximation in normed space, linear operators, Weierstrass's approximation theorem, Stone Weierstrass theorem, Chebyshev polynomials, trigonometric polynomials, error approximation function, Bernstein polynomial. **[08]**

Text Books:

1. Hardy G. H.(1967)Divergent Series, Clarendon Press, Oxford.
2. Lorentz G.G., Tinehart H., Winston (1966) Approximation of Functions.

Reference Books:

1. TitchmarchE. C. (1959) Theory of Functions, Oxford.
2. Zygmund A. (1959) Trigonometric Series, Vol. 1, Cambridge University Press.
3. PetersonG. M (1966) Regular Matrix Transformation, Mc-Graw Hill.
4. Boss J. (2000) Classical and Modern Methods in Summability, Oxford University Press.
5. Mursaleen M. (2014) Applied Summability Methods, Springer.
6. Hrushikesh N., Haskar M, Pai D.V. (2000) Fundamentals of Approximation Theory, Narosa Publishing House.
7. MaddoxI. J. (1970) Elements of Functional Analysis, Cambridge University Press.

MS 671 **Tensor Analysis** **3-1-0-4**

1. Vector Algebra: Vectors and scalars, operations on vectors, bases and transformations, product of vectors, reciprocal bases, variable vectors. **[10]**

2. The Tensor Concept: Zeroth-order tensors, first-order tensors, second-order tensors, higher-order tensors, transformation of tensors under rotation about a coordinate axis, invariance of tensor equations, curvilinear coordinates, tensors in generalized coordinate systems. **[10]**

3. Tensor Algebra: Addition of tensors, multiplication of tensors, contraction of tensors, symmetry properties of tensors, reduction of tensors to principal axes, invariants of tensors, pseudotensors. **[10]**

4. Vector and Tensor Analysis: Field concept, Gauss, Green And Stokes theorem, scalar fields, vector fields, second-order tensors fields, the operator ∇ and related differential operators. **[09]**

Text Books:

1. Vector and Tensor Analysis by A. I. Borisenko and I. E. Tarapov, Dover, 1979.
2. Introduction to Vector and Tensor Analysis by R. C. Wrede, Dover, 1972.

Reference Books:

1. DavisH. F., SniderA. D. (1995) Introduction to Vector Analysis, 7thEdition, Brown Publishers.
2. Schey H.M. (1997) Div, Grad, Curl and All That: An Informal Text on Vector Calculus, 2nd edition, W.W. Norton.
3. Bourne D.E., KendallP.C. (1977) Vector Analysis and Cartesian Tensors, Nelson.
4. Tensor Calculus by J. L. Synge and A. Schild, Dover, 1978.

MS 672 **Mechanics and Calculus of Variation** **3-1-0-4**

1. Generalized Coordinates: Holonomic and non holonomic systems, Scleronomic and Reonomic systems, generalized potential, Lagrange's equations of first kind, Lagrange's equations of second kind, uniqueness of solution, and energy equation of conservative fields. **[10]**

2. Hamilton's Variables: Donkin's theorem, Hamilton canonical equations, cyclic coordinates, Routh's equation, Poisson's bracket, Poisson's identity, Jacobi- Poisson theorem. **[10]**

3. Calculus of Variations: Motivating problems of calculus of variations, Brachistochrone problem, isoperimetric problem, geodesic, fundamentals lemma of calculus of variations, Euler's equation of one dependent function and its generalization to (i) 'n' dependent functions, (ii) higher order derivatives, conditional extremum under geometric constraints and integral constraints. **[10]**

4. Hamilton-Jacobi Theory: Hamilton's principal, principal of least action, Poincare Cartan integral invariant, Whittaker's equations, Jacobi's equations, statement of Lee Hwa Chung's theorem, Hamilton-Jacobi's equation, Jacobi's theorem, method of separation of variables. Lagrange's bracket and Poisson brackets, invariance of Lagrange's bracket and Poisson brackets under canonical transformations. **[09]**

Text Books

1. Ramsey A.S.(1941)Dynamics Part II, Cambridge University Press.
2. Goldstein H. (2002) Classical Mechanics, 3rd edition, Narosa Publishing House.

Reference Books:

1. Loney S.L. (2016) An Elementary Treatise on Statics, First paperback edition, Cambridge University Press.
2. Louis N. H., Janet D. F.(1999)Analytical Mechanics, Cambridge University Press.
3. Gelfand I M., Fomin S.V., Richard A. S. (2000) Calculus of Variations PHI.
4. Tiwari R.N., Takhur B.S. (2007) Classical Mechanics: Analytical Dynamics, PHI.

MS 681 **Reliability Theory** **3-1-0-4**

1. Basic Concepts of Reliability: Introduction, reliability and quality, failure and failure modes, causes of failures and unreliability, maintainability and availability, reliability analysis, mathematical models and numerical evaluation, designing for higher reliability, redundancy techniques, equipment hierarchy, reliability and cost. **[07]**

2. Reliability Mathematics: Random experiments and probability, random variables, discrete distribution (Binomial and Poisson) and Continuous distributions (uniform, exponential, Rayleigh, Weibull, gamma, normal, log normal, truncated normal, inverse Gaussian), numerical characteristics of random variables and Laplace transform. **[08]**

3. System Reliability and Hazard Models: Component reliability from test data, mean time to failure, time-dependent hazard models, stress-dependent hazard models, derivation of reliability function using Markov model, treatment of field data, system with components in series and parallel, k-out-of-m systems,non series-parallel systems, system with mixed-mode failures, fault-tree technique. **[08]**

4. System Design and Reliability Redundancy: Component versus unit redundancy, weakest-link technique, mixed redundancy, standby redundancy, redundancy optimization, double failures and redundancy, maintainability and availability concepts with two-unit parallel system with repair, preventive maintenance. **[08]**

5. Reliability Testing Demonstration and Acceptance: Problem of life testing, estimation of parameters and reliability using standard probability models using complete and censored samples, properties of these estimators, probability plotting and graphical procedures for estimating the parameter and testing validity of model by some standard statistical tests, life test acceptance sampling plans in exponential case, sequential life test in exponential case, accelerated life tests. **[08]**

Text Books:

1. Ebeling C. E. (2015), An Introduction to Reliability and Maintainability Engineering, Eighteenth reprint, McGraw Hill Education.

Reference Books:

1. Balagurusamy E. (2008) Reliability Engineering, Sixth reprint, TMH.
2. Srinath L.S., Reliability Engineering, Fourth Edition, EWP.

MS 682 **Fourier Analysis** **3-1-0-4**

1. Fourier Series: Recapitulation about piecewise continuous functions, odd and even functions, periodic and non-periodic functions, orthogonal and orthonormal functions, orthonormal sets, Dirichlet's conditions, Fourier series, change of interval, Fourier cosine series, Fourier sine series, complex form of Fourier series, convergence of Fourier series, generalized Fourier series, practical harmonic analysis,Fourier–Bessel series, Fourier – Legendre series. **[10]**

2. Fourier Integral and Applications: The Fourier integral formula, Dirichlet's integral, Fourier integral theorem, cosine and sine integrals, Eigen value problems on unbounded intervals, superposition of solutions, steady temperature in a semi-infinite strip, temperature in a semi-infinite solid, temperature in an unlimited medium. **[10]**

3.Fourier Transform and Applications I: Definition and properties of Fourier transform, Fourier cosine and sine transforms, complex Fourier transform, convolution theorem, Parseval's identities, finite Fourier transforms, solution of some partial differential equations. **[10]**

4. Fourier Transform and Applications II: Discrete Fourier Transform (DFT), approximation of Fourier coefficients of a periodic function, inverse DFT, properties of DFT, cyclical convolution and convolution theorem for DFT, Parseval's theorem for DFT, matrix form, N-point inverse DFT, fast Fourier transform(FFT). **[09]**

Text Books:

1. Ward Brown J., ChurchillR. V. (2015) Fourier Series and Boundary Value Problems, McGraw Hill Education.
2. Davis H.F. (1989) Fourier series and Orthogonal Functions, Dover Books on Mathematics.

Reference Books:

1. Spiegel (2015) Theory and Problems of Fourier Analysis with Applications to Boundary Value Problems (Schaum's Outline Series), McGraw Hill Education.
2. Jain R.K., Iyengar S.R.K. (2003) Advanced Engineering Mathematics, Narosa Publishing House.
3. Tolstov G.P. (1976) Fourier series, Dover Books on Mathematics.
4. JamesI.F. (2002) A Student's Guide to Fourier Transform with Applications in Physics and Engineering, 3rd edition, Cambridge.

MS 691 **Advanced Number Theory** **3-1-0-4**

1. Divisibility Theory and Factorization: Prime numbers and their distribution, greatest common divisor and the Euclidian algorithm, linear Diophantine equation, sieve of Eratosthenes, Mersenne primes and perfect numbers, sums of two squares. **[08]**

2. Theory of Congruences: Basic properties of congruences, linear congruences and the Chinese remainder theorem, Fermat's little theorem and pseudoprimes, $\varphi(n)$ (Euler's phi function), Euler generalization of Fermat's theorem, Wilson's theorem. **[08]**

3. Primitive Roots and Quadratic Reciprocity: Multiplicative orders of integers modulo$n$, primitive roots of primes and composites, Legendre and Jacobi symbols, quadratic reciprocity and quadratic congruences with multiple moduli. **[08]**

4. Special Functions and Recent Applications: Fermat numbers, amicable numbers, the Mobius inversion formula, sums of more than two squares, public key cryptosystems, primalty testing and factorization, Diffie-Helman key exchange, finite fields, cyclotomic polynomials, Gaussian integers, continued fractions, Pells equations, valuations, Deedkind domain, the Riemann zeta(ζ) function, modular (quadratic) forms, quadratic number fields. **[15]**

Text Books:

1. BurtonD.M. (2011) Elementary Number Theory, 2nd Edition, Tata Mc Graw Hills.
2. Telang S.G. (1996) Number Theory, 6th Edition, Tata Mc Graw Hills.

Reference Books:

1. Murty V. K. (1998) Contemporary Mathematics (Number Theory), Wald Schmidt AMS Society.
2. Lang S. (1994) Algebraic Number Theory, 2ndEdition, Springer Textbooks.
3. LandauE. (1966)Elementary Number Theory, 2nd Edition, AMS.
4. Frohlich, Taylor, Taylor (1991) Algebraic Number Theory, 2nd Edition, Cambridge University Press.
5. Niven I., Zuckerman (1991) Introduction to Theory of Numbers, 5th Edition Montgomery, Wiley.

MS 692 **Differential Geometry** **3-1-0-4**

1. Space Curves I: Definition of space curves, arc length, natural equation of a line, and intersection of curves, intersection of curve and surface, order of contact, tangent, normal, osculating plane. **[10]**

2. Space Curves II: Principal normal and binormal at a point of a curve, curvature, torsion, Frenet – Serret formulae, plane curves, osculating circle and osculating sphere, fundamental theorem for space curves, helices, evolutes and involutes. **[10]**

3. Surfaces I: Definition of a surface, tangent plane and normal at a point of a surface, surfaces of revolution, conicoids and helicoids, envelopes and developable surfaces, ruled surfaces. **[10]**

4. Surfaces II: First fundamental form(metric), metric potentials, direction coefficients and angle between two curves on a surface, second fundamental form, lines of curvatures, principal curvatures, Meusnier's theorem, Euler's theorem, Dupin's indicatrix, means curvature, Gaussian curvature. **[09]**

Text Books:

1. Hsiung C. C. (1997) A First Course in Differential Geometry, International Press, and Cambridge, MA.
2. Willmore T.J. (1964) An Introduction to Differential Geometry, Oxford University Press,

Reference Books:

1. Carmo M. P. D. (1976) Differential Geometry of Curves and Surfaces, Prentice-Hall, Englewood, NJ.
2. Abate M., Tovena F. (2012) Curves and Surfaces, Springer.
3. PetersA. K. (2010) Differential Geometry of Curves and Surfaces, Ltd., Natick, Mass.
4. Struik D.J. (1988) Lectures on Classical Differential Geometry, 2nd Edition, Addison-Wesley.

Mody University of Science & Technology

Master's of Science (Food & Nutrition)

(Effective from Academic Year 2020-21)

[M.Sc. (Food & Nutrition)]
(Session 2020-2021 onwards)

Programme Level:	**No. of Seats:**	**Duration: Two Years (Four Semesters)**
PostGraduation		

Affiliation: The proposed programme shall be governed by the Department of - Biosciences, SLAS, MUST, Laxshmangarh.

Programme Education Objectives:

The objectives of M.Sc. Food and Nutrition programme are:

PEO1 To impart the understanding of the concepts of biochemistry, food chemistry and food microbiology

PEO2 To enable the students to learn the methods of assessing human nutritional requirements, nutritional assessment and diet planning

PEO3 To apply theoretical concepts in laboratory setting as per standard methods in the above mentioned areas

PEO4 To understand the applications of nutritional sciences in clinical interventions, communication for health promotion, food service management, food science and processing

PEO5 To improve understanding and develop skills for planning, management and monitoring of public health nutrition programmes implemented by the government.

PEO6 To acquire skills to undertake systematic research in the area of food science, clinical nutrition and public health nutrition

Programme Outcomes:

The programme trains students to become professionals who can work as public health nutritionists, dieticians and food scientists. After completing this programme the student will be able to:

PO1 Assess nutritional status and plan appropriate diets.

PO2 Use the knowledge of nutritional sciences in clinical interventions and communication for health promotion

PO3 Work as program planners and managers in the field of public health nutrition

PO4 Work as food scientists, quality assurance managers and analysts

PO5 Manage a food service establishment

PO6 Apply theoretical concepts and practical training for research in the field of food science, clinical nutrition and public health nutrition

Scope:

The programme endeavors to train a cadre of professionals who can create nutrition awareness for promotion of healthy lifestyle among the population. The courses of this programme have been designed to enhance the core competency of students in the fields of public health nutrition, dietetics and food science. The curriculum provides a strong theoretical base and also includes experiential learning through field placements and practicals. The programme aims to strengthen the research acumen of students to enable them to develop into academicians and researchers in the field of food science and nutrition.

Input Qualification:

The minimum eligibility criteria needed to be met for admission to the course are:
Candidate should have passed B.Sc. with Food and Nutrition as a subject at under graduation for three years marks in Science stream from a recognized Board with proficiency in English.

Programmed and Teaching Methodology

The teaching methods include lectures, practical's, field visits, workshops, seminars, field visits, guest lectures etc.

Evaluation Procedure

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [4] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation: Year up-gradation of the student will be as per the University ordinance.

Session 2020-2021 onwards										
Name of the Programme: M.Sc. Food and Nutrition								**Year: First**		
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
Autumn Semester	FN20.501	Basic principles of ayurvedic diet	2	-	-	2	3	25	25	50
	FN20.503	Human Physiology	3	-	-	3	3	25	25	50
	FN20.505	Human Nutrition	3	-	-	3	3	25	25	50
	FN20.507	Nutrition for health and fitness	3	-	-	3	3	25	25	50
	BT20.501	Biochemistry	3	-	-	3	3	25	25	50
	MS20.501	Math and Statistics for Biology	2	-	-	2	3	25	25	50
	RM20.501	Research Methodology and Scientific Communication Skills	2	-	-	2	3	25	25	50
	BT20.509	Biochemistry and Instrumentation Laboratory	-	-	6	3	6	25	25	50
	FN20.509	Food and Nutrition Laboratory-I	-	-	4	2	3	25	25	50
	FL-I	Foreign Language-I	3	-	-	3	3	25	25	50
		Sub Total	**21**		**10**	**26**				
	SF 101 (Non credit)	Personal Grooming, Fine Dining				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
Spring Semester										
	Core Courses									
	FN20.502	Nutritional Biochemistry	3	-	-	3	3	25	25	50
	FN20.504	Food Packaging and Quality control	3	-	-	3	3	25	25	50
	FN20.506	Women Nutrition and Health	3	-	-	3	3	25	25	50
	BT20.508	Food Technology	3	-	-	3	3	25	25	50
	FN20.510	Nutraceutical and functional foods	3	-	-	3	3	25	25	50
	FN20.512	Advanced food Science	4	-	-	4	3	25	25	50
	FN.20.514	Food and nutrition laboratory- II	-	-	6	3	6	25	25	50
	FL-II	Foreign Language-II	3	-	-	3	3	25	25	50
		Sub Total	**22**		**6**	**25**				
	SF 102 (Non credit)	Social Grooming, Home & Decor and Business Communication				1				

$CW (Course work) includes teacher assessment, assignments, class /quiz test.

Session 2020-2021 onwards											
Name of the Programme: M.Sc. Food and Nutrition									**Year: Second**		
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)			
			L	T	P			CW[$]	MTE	ETE	
Autumn Semester											
	FN20.601	Public Health Nutrition	4	-	-	4	3	25	25	50	
	FN20.603	Clinical Therapeutic Nutrition	3	-	-	3	3	25	25	50	
	BT20.605	Bioentrepreneurship	2	-	-	2	3	25	25	50	
	MB20.603	Industrial Microbiology	3	-	-	3	3	25	25	50	
	FN20.605	Project Proposal	2	-	-	2		-	-	100	
	FN20.607	Research seminar	1	-	-	1	-	-	-	100	
	FN20.609	Food and nutrition laboratory- III	-	-	6	3	6	25	25	50	
		Sub Total	**15**	**-**	**6**	**18**					
	SF 201 (Non-credit)	Personal Grooming, Fine Dining				1					
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)			
			L	T	P			CW[$]	MTE	ETE	
Spring Semester											
	FN20.602	Dissertation	-	-	40	20	-	25	-	75	
		Sub Total				**20**					
	SF 202 (Non-credit)	Personal Grooming, Fine Dining				1					
Total			**89**								

FN20.501 Basic principles of ayurvedic diet 2-0-0-2

Course Objectives

The course will acquaint the students with properties and applications of ayurvedic principles for better lifestyles.

History of Ahara Nutrition- Vedic and Madhyayugin diet and its processing, Basic Principle: Ayurveda and Aharashastra, Ayurvedic components, Ritucharya (Seasonal regimen)	[10]
Ayurvedic Principles-Lokpurushasamya (Doctrine of Macrocosm and Microcosm), Karyakarana Siddhanta (Principles of Caouse and Effect), Samanya-Vishesh Siddhanta (Principles of Similarity and Dissimilarity	[05]
Panchamahabhoota Siddhanta- (Theory of Five Elements), Swabhavoparmvada Siddhanta (Theory of Healing)- in relation with diet and its importance	[03]
Fundamentals of Dosha-Dhatu-Mala- Doshavigyana Dhatuvigyana - Tissue/ Cell metabolism, Malavigyana – Excretary, Vigyana Strotovidyana – Systematic circulation,	[05]
Dhatusharta - Cell replenishing, Prakriti – Constitution, Dosha-Dhatu-Mala vigyana – The importance of diet in physiological process.	[03]

Course outcome

Student will be able to:

1. Understand the Ahara Nutrition
2. Have coherent and systematic knowledge on metabolic regulation

Text Book:

1. Tripathi B. (2007) (Ed.) Acharya Charaks' Charak Samhita, Chowkhamba Surbharati Prakashan Varanasi.
2. Panda S.K. (2006) Basic Principles of Kriya Sharira, Chaukhamba Orientalia, New Delhi.

Reference Book:

1. Lochan Kanjiv (2007). Astanga Hridayam, (Sutrasthana), Chowkhamba Sanskrit Bhawan Varanasi
2. Srikanthamurthy K.R. (2005). (Ed.) Acharya Vagbhatas' Ashtanga Samgraha, Chaukhamba Orientalia, Varanasi.
3. Lochan Kanjiv, Dietary Rules & Prohibitions in Different Diseases, Chowkhamba Sanskrit Bhawan Varanasi. 2004
4. Sushruta, Sushruta Samhita (1994) 5th Edition, Motilal Banarasidas , New Delhi.

5. Brahmavarchas (2005) Ayurved Darshan,Vedmata Gayatri Trust, Shantikunj, Haridwar.
6. Radhakrishnan Sarvapalli (1999) Indian Philosophy, Vol. Oxford University Press, London.

FN20.503 Human Physiology 3-0-0-3

Course Objective

The course will acquaint the students with properties and applications of enzymes, give the knowledge on carbohydrate and lipid metabolism, role of hormones in metabolism and impart knowledge on spectrophotometry.

Cell structure and function-Levels of cellular organisation and fucntion-organelles, tissues, organs and systems-Brief review. Cell membrane, transport across cell membrane and intercellular communication. Regulation of cell multiplication. [05]

Nervous system-review of structure and function of neuron, conduction of nerve impulse, synapses, role of neurotransmitters.

Organisation of central nervous system, structure and function of brain and spinal cord, afferent and efferent nerves, Blood brain barrier, CSF. Hypothalamus and its role in various body function-obesity, sleep, memory.

Endocrine system-structure, function, role of hormones, regulation of hormonal secertion. The neuroendcrime axis.Disorders of endocrine glands. Emphasis on physiology of diabetes and stress hormones. [04]

Sense organs-Review of structure and function. Role of skin, eye, ear, nose and tongue in preception of stimuli.

Digestive System-Review of structure and function. Secretory, Digestive and absorptive functions. Role of liver, pancreas and gall bladder and their dysfunction. Motility and hormones of GIT. [10]

Respiratory system

Review of structure and function. Role of lings in the exchange of gases. Trasport of oxygen and CO2. Role of haemoglobin and buffer sstems. Cardio-respiratory response to excercise and physiological effects of training. [10]

The circulatroy system

Structure and function of heat and blood vessel. Regulation of cardic output and blood pressure, heart failure, hypertension.

Blood formation, compsotion, blood clotting and haemostasis Formation and function of plasma proteins. Erythropoesis. Blood groups and histocompatibility. Blood indices. Use of blood for investigation and diagnosis of specific disorders. Anemia.

The excretory system

Structure and function of nephron. Urine formation. Role of kidney in [10]

maintaining ph of blood. Water, electrolytes and acid base balance, diuretics

The Musculo-skeletal system

Structure and function of bone, cartilage and connective tissue. Disorders of the skeletal system. Types of muscles, structure and function.

Immune System

Cell mediated and humoral immunity. Activation of WBC and production of anitbodies. Role in inflammation and defence.

Reproduction

Menstrual cycle, spermatogenesis, physiological changes in pregnancy

Course Outcome

Student will be able to:

3. Understand the enzymes, their types, enzyme activity and their diagnostic role
4. Have coherent and systematic knowledge on carbohydrate metabolic regulation
5. Understand the lipid metabolism and its regulation

Text Book:

1. Jain A.K. (2010) Textbook of Physiology, Vol. I and II, Avichal publishing co., New Delhi

References:

1. Applied Physiology, MFM 001 Course, Indira Gandhi National Open University
2. Vander A.J., Sherman J.H., Luciono D.S. (2000) Human Physiology. 7th edition, New York, McGraw Hill
3. Guyton A.C. and Hall J.B. (1996) Textbook of Medical Physiology. 9th edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore.

FN20.505 Human nutrition 3-0-0-3

Course Objective

The course will acquaint the students with properties and applications of energy content of foods, give the knowledge on carbohydrate and lipid metabolism, role of hormones in metabolism.

Energy: Energy content of foods. Physiological fuel value-review. Measurement of energy expenditure: BMR, RMR, Thermal effects of feeding and physical activity, methods of measurement. Estimating energy requirements of individuals and groups. Regulation of energy metabolism: control of food intake, digestion, absorption and body weight. [05]

Carbohydrates: Types, classification, digestion and transport-review, dietary fiber, fructo-oligosaccharides, resistant starch-chemical composition and physiological effects. Glycemic index of food. [04]

Proteins: Classification, digestion, absorption and transport – review. Metabolism of proteins: Role of muscle, liver, and gastro intestinal tract. Protein quality, methods of evaluating protein quality. Protein and amino acid requirements. Therapeutic applications of specific amino acids: Branched chain, glutamine arginine, homocysteine, cysteine, taurine. [10]

Lipids: Classification, digestion, absorption, transport-review. Functions of EFA. Role of n-3, n-6 fatty acids in health and disease. Requirements of total fat and fatty acids. Trans fatty acids. Prostaglandins.

Water: Regulation of intra and extra cellular volume. Osmolality, water balance and its regulation. [15]

Minerals: (Note: For each nutrient sources, bioavailability, metabolism, function, requirements, RDI/ESDDI, deficiency and toxicity, interactions with other nutrients are to be discussed).

Macro minerals: calcium, phosphorus, magnesium, sodium, potassium and chloride.

Micro minerals: Iron, copper, zinc, manganese, iodine, fluoride.

Trace minerals: selenium, cobalt, chromium, vanadium, silicon, boron, nickel.

Vitamins: Historical background, structure, food sources, absorption and transport, metabolism, biochemical function, assessment of status. Interactions with other nutrients. Physiological, pharmacological and therapeutic effects, toxicity and deficiency.

Non-nutritive food components with potential health effects: Polyphenols, tannins, phytate, phytoestrogens, cyanogenic compounds, lectins and saponins. [05]

Nutritional regulation of gene expression: Nutrition management in special conditions: Space travel, high altitudes, low temperatures, submarines.

Course outcome

Student will be able to:

1. Understand the enzymes, their types, enzyme activity and their diagnostic role
2. Have coherent and systematic knowledge on carbohydrate metabolic regulation
3. Understand the lipid metabolism and its regulation
4. Correlate the action of hormones with metabolic regulation

Text Book:

1. Bamji M.S., Rao N.P., Reddy V. Eds. (2009). Textbook of Human Nutrition. 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.

References:

1. ICMR (1990). Nutrient Requirements and Recommended Dietary Allowances for Indians.
2. FAO/WHO/UNU (2004). Human Energy Requirements. Report of a Joint Expert Consultation.

3. WHO (2007). Protein and Amino acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935.
4. Nutrition in Developmental Transition. (2006). NFI-WHO (SEARO) Symposium. NFI
5. ICMR. A Manual of Laboratory Techniques.
6. Gibney M.J., Margetts B.M., Kearney J.M., Arab L. (2004). Public Health Nutrition. The Nutrition Society. Blackwell Publishing, Oxford, UK.
7. Sundararaj P. and Siddhu A. (2006). Qualitative tests and quantitative procedures in Biochemistry- A Practical Manual. Third edition. Elite Publishers, New Delhi.
8. AOAC (1997). Official Methods of analysis. 16th edition. Association of official Analytical Chemists.

FN20.507 **Nutrition for health and fitness** **3-0-0-3**

Course Objectives

To understand the nutrition assessment, planning, implementation, monitoring and follow up in nutrition care process, the causative factors and metabolic changes in various diseases/disorders and acquire knowledge on the principles of diet therapy and comprehend principles of dietary Counselling and the rationale of prevention of various diseases/disorders.

Definition, components and assessment criteria of age: Specific fitness and health status. [05]

Holistic approach to the management of fitness and health: Energy input and output. Diet and exercise. Effect of specific nutrient on work performance and physical fitness. Nutrition, exercise, physical fitness and health inter- relationship.

Review of different energy system for endurance and power activity: Fuel and nutrients to support physical activity. Shifts in carbohydrates and fat metabolism. Mobilization of fat stores during exercise. [04]

Nutrition in sports: Sports specific requirements. Diet manipulation. Pre- game and post game meals. Assessment of different mutagenic aids and commercial supplements. Diets for persons with high energy requirements, stress, fractures and injury. [10]

Water and electrolytes balances: Losses and their replenishment during exercise and sports events, effects of dehydration, sports drink. [10]

Significance of physical fitness and nutrition in the prevention and management of weight control, obesity, diabetes mellitus, CV disorders, bone health and cancer.

Nutrition and exercise regimes for management of obesity: Critical review of various dietary regimes for weight and fat reduction. Prevention of weight cycling. [05]

Defining nutritional goals. Guidelines appropriate to health, fitness and prevention and management of the above chronic degenerative disorders.

Nutrition and exercise regimes for pre-post-natal fitness: Alternative systems for health and fitness like yogic diet, meditation, vegetarianism and traditional diets.

The student will be able to

1. Understand the importance of nutritional assessment in the care of patients.
2. Gain knowledge about causative factors and metabolic changes in various diseases/disorders and the associated principles of diet therapy.
3. Learn the principles of dietary Counselling.

Text Book:

1. Mahan L.K. & Ecott-Stump S. (2000): Krause's Food, Nutrition and Diet Therapy, 10th Edition, W.B. Saunders Ltd.

References:

1. Sizer F. & Whitney E. (2000): Nutrition-Concepts and controversies, 8th Edition, Wadsworth Thomson Learning.
2. Whitney E.N. & Rolfes .R. (1999): Understanding Nutrition, 8th Edition, West/Wadsworth, An International Thomson Publishing Co.
3. Parizkova J. Nutrition, Physical activity and health in early life, Ed. Wolinsky, I., CRC press.
4. Ira Wolinsky (Ed) (1998): Nutrition in Exercise and sports, 3rd Edition, CRC Press

FN.20.514 Biochemistry **3-0-0-3**

Course Objective The objectives of this course are to build upon post-graduate level knowledge of biochemical principles with specific emphasis on different metabolic pathways. The course shall make the students aware of various disease pathologies within the context of each topic.

Chemical basis of life- Miller-Urey experiment, abiotic formation of amino acid oligomers, composition of living matter; Water – properties of water, essential role of water for life on earth pH, buffer, maintenance of blood pH and pH of gastric juice, pH optima of different enzymes (pepsin, trypsin and alkaline phosphatase), ionization and hydrophobicity, emergent properties of biomolecules in water, biomolecular hierarchy, macromolecules, molecular assemblies; Structure-function relationships: amino acids – structure and functional group properties, peptides and covalent structure of proteins, elucidation of primary and higher order structures, Ramachandran plot, evolution of protein structure, protein degradation and introduction to molecular pathways controlling protein degradation, structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin etc.; basic principles of protein purification; tools to characterize [14]

expressed proteins;Protein folding: Anfinsen's Dogma, Levinthal paradox, cooperativity in protein folding, free energy landscape of protein folding and pathways of protein folding, molten globule state, chaperons, diseases associated with protein folding, introduction to molecular dynamics simulation.

Enzyme catalysis – general principles of catalysis; quantitation of enzyme activity and efficiency; enzyme characterization and Michaelis-Menten kinetics; relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification; single substrate enzymes; concept of catalytic antibodies; catalytic strategies with specific examples of proteases, carbonic anhydrases, restriction enzymes and nucleoside monophosphate kinase; regulatory strategies with specific example of hemoglobin; isozymes; role of covalent modification in enzymatic activity; zymogens. [07]

Sugars - mono, di, and polysaccharides with specific reference to glycogen, amylose and cellulose, glycosylation of other biomolecules - glycoproteins and glycolipids; lipids - structure and properties of important members of storage and membrane lipids; lipoproteins. Self-assembly of lipids, micelle, biomembrane organization - sidedness and function; membrane bound proteins - structure, properties and function; transport phenomena; nucleosides, nucleotides, nucleic acids - structure, a historical perspective leading up to the proposition of DNA double helical structure; difference in RNA and DNA structure and their importance in evolution of DNA as the genetic material. [07]

Bioenergetics-basic principles; equilibria and concept of free energy; coupled interconnecting reactions in metabolism; oxidation of carbon fuels; recurring motifs in metabolism; Introduction to GPCR, Inositol/DAG//PKC and Ca++ signaling pathways; glycolysis and gluconeogenesis; reciprocal regulations and non-carbohydrate sources of glucose; Citric acid cycle, entry to citric acid cycle, citric acid cycle as a source of biosynthetic precursors; Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F1-F0 ATP Synthase; shuttles across mitochondria; regulation of oxidative phosphorylation [07]

Photosynthesis – chloroplasts and two photosystems; proton gradient across thylakoid membrane; Calvin cycle and pentose phosphate pathway; glycogen metabolism, reciprocal control of glycogen synthesis and breakdown, roles of epinephrine and glucagon and insulin in glycogen metabolism; Fatty acid metabolism; protein turnover and amino acid catabolism; nucleotide biosynthesis; biosynthesis of membrane lipids and sterols with specific emphasis on cholesterol metabolism and mevalonate pathway; elucidation of metabolic pathways; logic and integration of central metabolism; entry/ exit of various biomolecules from [11]

central pathways; principles of metabolic regulation; steps for regulation.

Course Outcome

Students should be able to -

- Gain fundamental knowledge in biochemistry.
- Understand the molecular basis of various pathological conditions from the perspective of biochemical reactions.

Suggested Readings

Text Book:

1. Stryer, L. (1988). Biochemistry. New York: Freeman.
2. Lehninger, A. L. (1982). Principles of biochemistry (4th ed.). New York, NY: Worth.

References:

1. Voet, D., & Voet, J. G. (2004). Biochemistry (4th ed.). Hoboken, NJ: J. Wiley & Sons.
2. Dobson, C. M. (2003). Protein folding and misfolding. Nature, 426(6968), 884-890. doi:10.1038/nature02261.
3. Richards, F. M. (1991). The Protein Folding Problem. Scientific American, 264(1), 54-63. doi:10.1038/scientificamerican0191-54.

BT20.509 Biochemistry and Instrumentation Laboratory 0-0-6-3

Course Objective

The objective of this laboratory course is to introduce students to experiments in biochemistry. The course is designed to teach students the utility of set of experimental methods in biochemistry in a problem oriented manner.

- Preparing various stock solutions and working solutions that will be needed for the course.
- To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.
- To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert‟s Law.
- Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by thin layer chromatography.
- Purification and characterization of an enzyme from a recombinant source (such as Alkaline Phosphatase or Lactate Dehydrogenase or any enzyme).
- Experimental verification that absorption at OD_{260} is more

for denatured DNA as compared to native double stranded DNA.

- Identification of an unknown sample as DNA, RNA or protein using available laboratory tools. (Optional Experiments)
- Biophysical methods (Circular Dichroism Spectroscopy, Fluorescence Spectroscopy).
- Determination of mass of small molecules and fragmentation patterns by Mass Spectrometry.
- Protein characterization using different gel-based proteomic tools
- Agarose gel electrophoresis

Course Outcome Students would be able to -

- To elaborate concepts of biochemistry with easy to run experiments.
- To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.

FN.20.519 Food and nutrition lab I 0-0-4-2

Course Objective Understand the importance of nutritional assessment in the care of patients.

1. Finding the coagulation time of blood.
2. Determination of blood groups.
3. Counting of mammalian RBCs.
4. To plan diet chart for diabetes mellitus patient.
5. To plan diet chart for weight control of an obese person.
6. To plan a diet chart for bone health and cancer.
7. Planning of Diet for Athlete
8. Anthropometric techniques demionstration

Course Outcome Gain knowledge about causative factors and metabolic changes in various diseases/disorders and the associated principles of diet therapy.

FN20.502 Nutritional Biochemistry **3-0-0-3**

Course Objective The course will acquaint the students with properties and applications of enzymes, give the knowledge on carbohydrate and lipid metabolism, role of hormones in metabolism and impart knowledge on spectrophotometry.

Basic concepts – Function of nutrients. Measurement of the fuel values of foods. Direct and indirect calorimetry. Basal metabolic rate: factors affecting BMR, measurement and calculation of BMR. Measurement of energy requirements. Specific dynamic action of proteins. [05]

Elements of nutrition – Dietary requirement of carbohydrates, lipids and proteins. Biological value of proteins. Concept of protein quality. Protein sparing action of carbohydrates and fats. Essential amino acids, essential fatty acids and their physiological functions. [04]

Minerals – Nutritional significance of dietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper.
Vitamins – Dietary sources, biochemical functions, requirements and deficiency diseases associated with vitamin B complex, C and A, D, E & K vitamins [10]
Malnutrition – Prevention of malnutrition, improvement of diets. Recommended dietary allowances, nutritive value of common foods. Protein- calorie malnutrition. Requirement of proteins and calories under different physiological states- infancy, childhood, adolescence, pregnancy, lactation and ageing. [10]
Starvation – Techniques for the study of starvation. Protein metabolism in prolonged fasting. [05]
Obesity – Definition, Genetic and environmental factors leading to obesity

Course Outcome Student will be able to:

1. Understand the enzymes, their types, enzyme activity and their diagnostic role
2. Have coherent and systematic knowledge on carbohydrate metabolic regulation
3. Understand the lipid metabolism and itsregulation

FN20.504 Food Packaging and Quality control **3-0-0-3**

Course objective To acquaint with properties of foods and basic principle of Food Engineering and its processes, along with the unit operations.

Packaging- Concepts, Definition, Significance, Classification.
Packaging-development, Unit/Retail.
Packaging of food(s)- fresh and processed, general characteristics & food [05]

preservation.
Primary Packaging Media- Properties and applications
Paper boards, metals, plastics, wood & plywood, glass, flexible etc.
Labels, caps & closures & wads, adhesives, inks & lacquers,
cushioning materials, reinforcements etc.

Packaging – Laws & Regulations - FDA, PFA, Packaging commodity Rules, Weight & Measures Act etc [04]
Introduction to quality assurance and food safety assurance-Current concepts of quality control.
Quality assurance programme: Quality plan, documentation of records, product standards Product and purchase specifications, process control and HACCP hygiene and housekeeping, corrective action, quality and programme and total quality process.
Quality costs: Measurement and analysis.
Testing & evaluation of packing media – retail packs (including shelf life evaluation) and transport packages.
Packaging systems and methods for food products- vacuum packaging, gas flush. Packaging, CAP & MAP, Aseptic & retort packing, Bag-in Box etc. [10]
Food products- General classification and packing types, varieties and trends.
Storage, handling and distribution of packages (foods) – including palletisation & Containerization.
Food marketing and role of packaging. Packaging Aesthetic & graphic design.
Product Evaluation-Sampling for product evaluation and line control.
Statistical quality and process control, Specifications and food standards.
International, national-Mandatory, Voluntary, Sample Preparation. [10]
Reporting results and reliability of analysis.
Tests for specific raw food ingredients and processed. Foods including additives: Proximate principles, Nutrient analysis, Quality parameters and test of adulterants. Consumer protection. [05]

Course outcome

Student will be able to

1. Understand the basic concepts of properties of foods and basic food engineering concepts

2. Acquire the knowledge of various unit operations in food processing.

3. Gain the knowledge of food packaging and its interaction with food products.

Text Book

1. Joshi, V.K. and Pandey, A. Ed. (2009). Biotechnology. Food Fermentation, (2 Vol. set). Education Publ. New Delhi.

References

1. Bains W. 1993, Biotechnology from A to Z, Oxford Univ. Press, Oxford. Crueger, W. and Crueger A. 1984.
2. Knorr, D. 1982. Food Biotechnology. Marcel Dekker, New York.

3. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
4. Pomeranz, Y. and MeLoan, C.E. (1996): Food Analysis: Theory and Practice, CBS Publishers and Distributor, New Delhi.

FN20.506 Women Nutrition and Health **3-0-0-3**

Course Objective The purpose of this course is to enable the students to understand the concept and methods of nutritional status assessment of a female.

Role of women in National Development- Role of women in Family and Community, Demographic Changes, menarche, marriage, fertility, morbidity, mortality, life-expectancy, sex ratio, aging and widowhood, female- headed families. [10]

Women and Work-Environmental stress, production activities, nutrition, health and gender, living conditions, occupational health, health facilities. Women's nutritional requirements and food needs.

Women and Society-Women's role, their resources and contribution to family and community and effect on nutritional status, Impact of economic policies, industrialization, and globalization on women. [04]

Women and Health-Health facilities, Disease patterns and Reproductive health, Gender and health, Health seeking behavior, Women pregnancy and lactation. [10]

Detailed role of Safe motherhood, Care of at-risk mothers, Family planning.

Women and aging with Special concerns in developed and developing societies- Menopause, osteoporosis, chronic degenerative diseases, neurological problems. Women and AIDS Women and Nutrition, Situation of women in global, national and local context, Improving the nutritional and health status, Interventions throughout the life cycle. [10]

Policies and Legislations- CEDAW (Convention on elimination of all forms of Discrimination Against Women), Women's Right to Life and Health (WRLH). Empowerment of Women-Role of Education and various national schemes. [05]

On completion of the course, students are expected to be able to –

1. Understand the concept and purpose of nutritional status assessment of women in community setting.
2. Explain nutritional concerns among vulnerable sections like females of the community and strategies to combat them.
3. Gain knowledge with regard to standard methods and techniques for assessing nutritional status.

Text Book:

1. Gopalan, C. and Kaur, S (Eds) (1989): Women and Nutrition in India, Nutrition Foundation of India

Reference books:

1. Wallace, H.M. and Giri,K. (1990): Health care of women and children in developing countries, Third party Publishing Co., Oakland, California.
2. UNICEF: The Urban Poor and Household Food Security, UNICEF
3. NGO committee on UNICEF (1997): Women and children in Urban Poverty-What Way Out?
4. Census Reports, Government of India.
5. UNICEF-State of the world children.
6. International Nutrition Foundation-Micronutrient Initiative (2010): preventing Iron Deficiency in Women and Children; Technical Consensus on Key issues.

BT20.512 Food Technology **3-0-0-3**

Course Objective

To impart knowledge of various areas related to Food Science and Technology,
To enable the students to understand food composition and its physicochemical, nutritional, and microbiological aspects,

Food and Fermentation Technology: Origin, Scope and development of fermented food products, Microbial starters for food fermentations. [10]
Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.
Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,
Single cell protein, Mushroom cultivation

Spoilage and Preservation: [09]
Factors affecting microbial growth in foods- extrinsic and intrinsic, Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,
Spoilage detection and characterization.
Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).

Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia*, Diseases caused by Fungi, Emerging pathogens, *E.coli*O157:H7, *Listeria monocytogens*, *Campylobacter jejuni*, *Helicobacter pylori* [09]

Packaging and Quality Control: [05]
Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane.

Detection of food pathogens- Culture methods, Rapid detection using PCR [06]
Food standards- Standards for Milk, Poultry, Food control agencies-

BIS, Codex commission,
Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)
Disposal and treatment of food industry waste

Course Outcome

The students will have knowledge about different processing and preservation methods and principals involved.
Students will have learnt about packaging materials, methods and their applications in food industry.

Suggested Readings

Text Book

- Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company, Ltd, New Delhi
- Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New, Delhi

References

- Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

FN20.508 Nutraceuticals and functional foods **3-0-0-3**

Nutraceuticals- Use of nutraceuticals in traditional health sciences. Their role in preventing /controllingdiseases. [04]

Definition- Classification, food and non food sources, mechanism of action, Role of omega-3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compoundsas neutraceuticals. [10]

Prebiotics and probiotics- Usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. [10]

Functional foods- Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage; Development of biomarkers to indicate efficacy of functional ingredients; Research frontiers in functional foods. [10]

Development of nutraceutical and functional foods – Standards for health claims. Process of developing - preclinical & clinical studies, Marketing and Regulatory issues, Regulatory bodies in India [05]

Text Book:

1. Geoffrey P. Webb. (2006). Dietary supplements and functional foods. Blackwell Publishing.

References:

1. Losso, J.N. (2007). Angi-angiogenic functional and medicinal foods. Press.
2. Cupp, J and Tracy, TS. (2003). Dietary supplements: Toxicology and C Pharmacology. Humana Press.
3. Manson, P. (2001). Dietary supplements (2nd Ed) Pharmaceutical Press.
4. Campbell, JE and Summers, JL. (2004). Dietary Supplement Labeling Compliance.
5. Shi, J.(2007). Functional Food Ingredients and Nutraceuticals: Processing Technologies. Taylor & Francis Publ. CRC Press.
6. Goldberg, I (1994). Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall.
7. Robert E.C. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

FN20.510 Advanced food science **4-0-0-4**

Course Objectives To understand the etiology, physiological and metabolic anomalies and provide appropriate nutrition care for prevention and treatment of various disorders / diseases

Hepatobiliary and Pancreatic Disorders- Etiopathophysiology, metabolic & clinical aberrations, diagnosis, complications and recent advances in prevention, treatment, MNT and dietary Counselling in Nonalcoholic fatty liver disease (NAFLD), Cirrhosis, End stage liver disease (ESLD), Encephalopathy, Liver resection and transplant; Cholecystitis, Cholelithiasis, cholecystectomy, Pancreatitis. [10]

Diseases of Heart and Blood Vessels -Etiopathophysiology, metabolic & clinical aberrations, diagnosis, complications and recent advances in prevention, treatment, MNT and dietary counselling in Myocardial Infarction, Coronary artery bypass graft (CABG), angioplasty, cerebrovascular and peripheral vascular disease, heart transplant [10]

Renal Disorders-Etiopathophysiology, metabolic & clinical aberrations, diagnosis, complications and recent advances in prevention, treatment, MNT and dietary Counselling in Nephrotic Syndrome, Glomerulonephritis, Acute Renal Failure, Chronic Kidney Disease, End Stage Renal Disease (ESRD), Dialysis, Transplant, Renal Stones. [15]

Surgery and Critical Care-Metabolic & clinical aberrations, diagnosis, complications, treatment, MNT and dietary Counselling in [07]

Metabolic Stress -Surgery, Burns, Sepsis and Trauma, Critical care

Neurological disorders - Etiopathophysiology, metabolic & clinical aberrations, diagnosis, complications and recent advances in prevention, treatment, MNT and dietary Counselling in Alzheimer's disease, Parkinson disease, Epilepsy [10]

Course Outcome

Students will be able to-

1. Develop a detailed understanding of the etiology, physiological and metabolic anomalies of various acute and chronic disorders / diseases
2. Demonstrate competency in nutrition assessment and diet history interview skills
3. Develop understanding and expertise on the effect of various disorders on nutritional status, nutritional and dietary requirements
4. Use critical thinking and clinical reasoningto develop nutritional care plan for prevention and treatment of various disorders / diseases

Text Book-

1. Mahan, L. K. and Escott Stump. S. (2016) *Krause's Food & Nutrition Therapy 14th ed.* Saunders-Elsevier

Reference Books-

1. Joshi Y K.(2008) *Basics of Clinical Nutrition 2nd ed.* Jaypee Brothers Medical Publishers
2. Shils, M.E., Shike, M, Ross, A.C., Caballero B and Cousins RJ (2005) *Modern Nutrition in Health and Disease. 10thed*. Lipincott, William and Wilkins.
3. Gibney MJ, Elia M, Ljungqvist &Dowsett J. (2005) *Clinical Nutrition*. The Nutrition Society Textbook Series. Blackwell Publishing Company
4. Garrow, J.S., James, W.P.T. and Ralph, A. (2000) *Human Nutrition and Dietetics. 10th ed.*
5. Churchill Livingstone.
6. Marian M, Russel M, Shikora SA. (2008) *Clinical Nutrition for Surgical Patients*. Jones and Bartlett Publishers.
7. McClave, S.A., Taylor, B.E., Martindale, R.G., Warren, M.M., Johnson, D.R., Braunschweig, C., McCarthy, M.S., Davanos, E., Rice, T.W., Cresci, G.A. and Gervasio,
8. J.M. (2016). Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (ASPEN). *Journal of Parenteral and Enteral Nutrition*, 40(2), pp.159-211.

FN.20.528 Food and nutrition lab II **0-0-6-3**

Course Objectives

To enable students to develop skill in nutritional diagnosis, planning and providing suitable preventive/ therapeutic diets for various diseases / disorders

1. Water (Most Probable Number)
2. Milk (Methylene Blue Reduction Test)
3. Curd and probiotic count
4. Adulteration test for various food products.
5. Rapid detection test
6. Phenol co-efficient method
7. Zone of Inhibition technique
8. HACCP plan for a food process
9. Diet for Lactating mother
10. Diet plan for pregnant lady
11. Development of fermented food
12. Identification of probiotic and their health beneficial features in food

Course Outcome: Students will be able to-

1. Use critical thinking and clinical reasoning to develop nutritional care plan for prevention and treatment of various disorders / diseases
2. Apply the nutrition care process to the medical nutritional therapy of nutritionally vulnerable individuals using best evidence

FN20.601 Public Health Nutrition **4-0-0-4**

Course Objectives The course will familiarize the students with understanding of the concept of public health nutrition and the national health care delivery system, the current concerns in public health nutrition and the strategies for improving the nutritional status of the communities. The course will also orient students towards concept of food and nutrition security and critical appraisal of the current scenario.

Concept of public nutrition - Relationship between health and nutrition, role of public nutritionists in the health care delivery system. Population dynamics- Demographic transition, population structure, population policy, fertility behaviour, nutrition and quality of life interrelationship. Nutritional status -methods for assessing nutritional status – Indirect methods – demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR) - Direct – anthropometry, biochemical, clinical, dietary and functional methods of assessments. [10]

Nutrition during life span – pregnancy, lactation, infancy, preschool age, school going and adolescents, adults and old age [05]

Assessment and surveillance of nutritional status in emergency affected populations- Scope for malnutrition assessment, indicators and simple screening methods. Organization for nutritional surveillance. Nutritional relief and rehabilitation- Assessment of food needs, food distribution strategy, targeting food aid, mass and supplementary feeding, special foods/rations for nutritional relief, organization for mass feeding/food distribution, transportation and storage, feeding centers, sanitation and hygiene and public nutrition approach to tackle nutritional and health problems in emergencies, ethical considerations. [15]

Approaches and strategies for improving nutritional status and health - Programmatic options – their advantages and demerits. Intervention Programmes – Health based interventions, Food – based interventions including fortification and genetic improvement of foods, supplementary feeding. Malnutrition and Health economics - Its impact on productivity and national development. Cost management. [07]

Information Education Communication approaches to improve health and nutrition- Concepts – Scope- Elements- Models of communication - Communication Process - Approaches and Barriers to communication, Communication for Extension Education and Development - Introduction to IEC Aims and Objectives, Importance of IEC, relevance to programmes - Nutrition education for behaviour change – Rationale, Planning Execution and evaluation of Department of Food Science and Technology. [10]

Course Outcomes

Students will be able to:

1. Understand the concept and current concerns of Public Health Nutrition.
2. Comprehend the National Health Care Delivery System.
3. Get exposed to population dynamics and economics of malnutrition and how it impacts national development
4. Understand the causes and consequences of nutritional problems in the community.
5. Be familiar with the concept of food and nutrition security.

Text books

1. Part, K. (2000): Part's Textbook of Preventive and Social Medicine, 18th Edition, M/s. Banarasidas Bhanot, Jablpur.

Reference

1. Owen, A.Y. and Frackle, R.T., (2002): Nutrition in the Community. The Art of Delivering Services, 2nd Edition Times Mirror/Mosby.
2. Beaton, G.H. and Bengoa, J.M. (Eds) (2000): Textbook of Human Nutrition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Bamji, M.S., Rao, P.N., Reddy, V (Eds) (2003): Textbook of Human Nutrition,

FN20.603 Clinical Therapeutic Nutrition **3-0-0-3**

Course Objectives To understand the etiology, physiological and metabolic anomalies and provide appropriate nutrition care for prevention and treatment of various disorders / diseases

Nutritional screening and assessment of nutritional status of hospitalized and outdoor patients. Identification of high risk patients. Assessment of patient needs based interpretation of patient data-clinical, biochemical, biophysical, personal etc. Newer trends in delivery of nutritional care and dietary counseling. [10]

Diet nutrient and drug interaction. Effect of drugs on ingestion, digestion, absorption and metabolism of nutrients, effect of foods, nutrients and nutritional status on drug dosage and efficacy. [04]

Nutritional support-recent advances in techniques and feeding substrates Etiopathophysiology, metabolic and clinical aberrations, complications, prevention and recent advances in the medical nutritional management of: [10]
Weight imbalances
Cardio vascular
disorders

Diabetes mellitus and other metabolic
disorders GI tract disorders
Liver and gall bladder, pancreatic
disorders Renal disorder
Stress and trauma
Cancer
Neurological
disorders Musculo-
skeletal disorders
Immuno-deficiency
disorder Genetic
disorders
Infection and AIDS
Respiratory
problems [10]

Childhood problems/disorders including inborn errors of metabolism and their nutritional management. [05]

Course Outcomes Students will be able to-

1. Develop a detailed understanding of the etiology, physiological and metabolic anomalies of various acute and chronic disorders / diseases
2. Demonstrate competency in nutrition assessment and diet history

interview skills

3. Develop understanding and expertise on the effect of various disorders on nutritional status, nutritional and dietary requirements

Text Book

1. Mahan, L.K. and Escott-Stump, S. (2000): Krause's Food Nutrition and DietTherapy, 10th Edition, W-13 Saunders Ltd.
2. Shills, M.E., Olson, J.A, Shike, M and Ross, A.C. (2003): Modern Nutrition in Health and Disease, 9th Edition, A. Vaiiiams and Willdns.

Reference

3. Williams, S.R. (2003): Nutrition and Diet Therapy, 7th Edition, Times Mirror/Mosby Collage Publishing.
4. Chandra, R.K. (eds) (2002): Nutrition and Immunology, ARTS Biomedical. St. John's Newfoundland.
5. Sareen, S, James, J (2005). Advanced Nutrition in Human Metabolism, 4th Edition, Thomson Wordsworth Publication, USA.

BT20.605 **Bioentrepreneurship**

Course Objective The objectives of this course are to teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.

Basics of Bioentrepreneurship Importance of entrepreneurship; advantages of being entrepreneur - freedom to operate; introduction to bioentrepreneurship – biotechnology in a global scale; Scope in bioentrepreneurship; types of bio-industries – biopharma, bioagri, bioservices and bioindustrial; innovation – types, out of box thinking; skills for successful entrepreneur – creativity, leadership, managerial, team building, decision making; opportunities for bioentrepreneurship-entreprenuership development programs of public and private agencies (MSME, DBT, BIRAC, Startup & Make in India); patent landscape, IP protection & commercialization strategies.

Accounting and Finance Business plan preparation; business feasibility analysis by SWOT, socio-economic costs benefit analysis; funds/support from Government agencies like MSME/banks and private agencies like venture capitalists:/angel investors for bioentrepreneurship; business plan proposal for „virtual startup company"; statutory and legal requirements for starting a company/venture; basics in accounting practices: concepts of balance sheet, profit and loss statement, double entry bookkeeping; collaborations & partnerships; information technology for business administration and expansion.

Business Strategy Entry and exit strategy; pricing strategy; negotiations with financiers, bankers, government and law enforcement authorities;

dispute resolution skills; external environment/ changes; avoiding/managing crisis.

Marketing Market conditions, segments, prediction of market changes; identifying needs of customers; Market linkages, branding issues; developing distribution channels - franchising; policies, promotion, advertising; branding and market linkages for „virtual startup company".

Knowledge Centre and R&D Knowledge centres e.g., in universities, innovation centres, research institutions (public & private) and business incubators; R&D for technology development and upgradation; assessment of technology development; managing technology transfer; industry visits to successful bio-enterprises, regulations for transfer of foreign technologies; quality control.

Course Outcome Students should be able to gain entrepreneurial skills, understand the various operations involved in venture creation, identify scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies.

Suggested Readings

Text Book:

- Adams, D. J., & Sparrow, J. C. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion.
- Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.

References:

- Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge.
- Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
- Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.

MB20.603 Industrial Microbiology

Course Objective: The objective of this course is to learn and understanding the microbiological concepts applied in industries.

General Concepts: Isolation, Preservation and Improvement of Industrially important organisms, Enrichment culture technique, Storage at low temperature, Liquid nitrogen, Lyophilization, Strain improvement by mutation, Feed-back repression and inhibition, Modification in characteristics of inhibitors, Isolation of auxotrophic mutants, Use of recombinant methods.

Growth Kinetics: Microbial growth kinetics and product kinetics, Microbial biomass, Enzymes, metabolites, Batch and continuous culture- comparison, external and internal, Fed batch and its

applications.

Basic Concepts in Fermentation: Fermentation media, Sterilization, Batch and Continuous Sterilization, Filter sterilization, Fermenter design, Control of Fermenter, Mass and gas transfer, Product recovery and Effluent treatment.

Applications of industrial microbiology-I: production aspects: Development of heterologous expression platforms like bacteria, yeast, mammalian and insect cells, process optimization of recombinant biopharmaceuticals; industrial enzymes (cellulases, laccase, amylases, biosurfactants, thaumatin, food additives etc.), therapeutic proteins (hormones and recombinant vaccines), antibodies (chimeric and humanized antibodies, antibody fragments)

Applications of industrial microbiology-II: microbial transformation process, cell surface display technology, development of biosimilars, good manufacturing practices, intellectual property rights and technology transfer, different phases of clinical trials of therapeutic biomolecules. Basic objective for successful economically viable fermentation process, cost breakdown for well-established fermentation processes, market potential of the products, cost aspects of various stages in the processes development including effluent treatment

Industrial Production: Industrial production of Ethanol, Acetone, Butanol, Citric acid, Gluconic acid, Acetic acid, Lactic acid and Kojic acid, Glutamic acid, Lysine and Tryptophan, Amylases, Proteases and Lipases, Antibiotics (β-lactam, aminoglycosides).

Production of other Metabolites: Production of single cell proteins, Recombinant vaccines, Interferon and Steroids in brief.

Course Outcome: On completion of the course, the student will be competent enough to be an Industrial Microbiologists, who can progress in its diverse fields.

Suggested Readings:

Text Books:

1. Nduka Okafor, Benedict C. Okeke (2017). *Modern Industrial Microbiology and Biotechnology*. 2nd Edition: CRC Press Publishers.
2. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. (2002). *Industrial Microbiology: An Introduction.* Blackwell Science Publishers.

ference Books:

1. W. Crueger & A. Crueger (2017). Cruegers Biotechnology: A Text Book of Industrial Microbiology. Edited by K.R. Aneja. Panima Publishing Corporation.
2. Reed. G. (1999). Prescott and Dunn's Industrial Microbiology. CBS Publishers.
3. Demain, A. L. (2001). Industrial Microbiology and Biotechnology IInd Edition. ASM Press, Washington.
4. P.F. Stanbury, W. Whitaker & S.J. Hall (2016). Principles of Fermentation Technology. 3rd edition. Elsevier publication.

FN20.605 Project Proposal **2-0-0-2**

Course Objective

The objectives of this course are to prepare the students to present their topic of research and explain its importance to their fellow classmates and teachers.

Poster Presentation: Students will have to present the topic of their project proposal after few months of their selection of the topic. They should be able to explain the novelty and importance of their research topic.

Oral Presentation: At the end of their project, presentation will have to be given by the students to explain in detail the work done by them. Along with summarizing their findings they should also be able to discuss the future outcomes of their work.

Course Outcome

Students should be able to learn how to present and explain their research findings to the audience affectively.

FN20.607 Research seminar **1-0-0-1**

Course Objective

The objectives of this course are to train the students to evaluate research papers, to assess quality of the papers and how the papers are refereed and published as well as learn how to get the papers published.

Student presentations: Each student will need to present one paper during the term. They should select research papers, which deal with upcoming or most recent scientific findings/breakthrough and technologies developed.

Class evaluations and discussions: Every week, each student will be asked to write a short review and evaluations of the paper presented in the class and then indulge in discussion with flaws of the paper, important questions and impact of the overall paper. Recent technologies, can be discussed, where it can be applied.

Course Outcome

Students should be able to –

Critically analyze the research papers from different upcoming topics.

Understand the weaknesses and strengths of the paper and what additional experiments could have been done to strengthen the research study.

Understand the context of the paper and identify important questions.
Acquire the skills in paper writing and getting it published.

Suggested Readings

FN20.609 Food and nutrition laboratory- III **0-0-6-3**

Course Objective

The objective of this laboratory course is to introduce students to experiments in Food and nutrition. The course is designed to teach students the utility of set of experimental methods in Food and nutrition in a problem oriented manner.

Market Survey for commercial nutritional therapeutic products .

Planning & preparation of diets for the following conditions:

- Post burn
- Liver Cirrhosis
- Hepatic Encephalopathy
- Pancreatitis
- Myocardial infarction
- Congestive heart failure
- Nephritis
- Acute Renal Failure
- Chronic renal failure
- Patients on dialysis
- Culturing bacteria in laboratory and study its characteristics.
- Estimation of microbial flora on seeds.
- To determine the food quality and its deterioration by measuring the microbial population.
- To prepare the selective and differential (EMB) medium.
- Isolation of E. coli from sewage water samples with the help of EMB agar medium.
- To learn the technique of Immobilization of microbial cells

Course Outcome

Students would be able to -

- To elaborate concepts of Food and nutrition with easy to run experiments.
- To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in Food and nutrition.

FN20.602 Dissertation **0-0-40-20**

Course Objective

The objectives of this course are to prepare the students to adapt to the research environment and understand how projects are executed in a research laboratory. It will also enable students to learn practical aspects of research and train students in the art of analysis and thesis writing.

Planning & performing of experiments: Based on the project proposal submitted in earlier semester, students should be able to plan, and engage in, an independent and sustained critical investigation and evaluate a chosen research topic relevant to biological sciences and society. They should be able to systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions. Senior researchers should be able to train the students such that they can work independently and are able to understand the aim of each experiment performed by them. They should also be able to understand the possible outcomes of each experiment. Thesis writing: At the end of their project, thesis has to be written giving all the details such as aim, methodology, results, discussion and future work related to their project. Students may aim to get their research findings published in a peer-reviewed journal. If the research findings have application-oriented outcomes, the students may file patent application.

Mody University of Science & Technology

M.Sc. FORENSIC SCIENCE
Session 2020-2021

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc. FORENSIC SCIENCE
(Session 2020 – 2021 onwards)

Programme Level: Postgraduate **Duration:** 2 Years (Four Semesters)
No. of Seats: 20

Affiliation: Mody University of Science and technology

Objective: To impart world class teaching in Forensic Science at Postgraduate level

Scope: Employability in various Forensic Science Laboratories and Forensic Science research institutions across India

Input Qualification: Bachelor's Degree in Forensic Science/ Physics/ Chemistry/ Mathematics/ Botany/ Zoology/ Microbiology/ Biotechnology/ Biochemistry/ Engineering or Pharmacy with minimum 50% marks with adequate proficiency in English.

Evaluation Procedure:
All the Rules and Regulations as provided in the Ordinances and Regulations of the Postgraduate Programmes of Mody University shall be followed.

Vision:

- To develop professional, ethical graduates whose competence in problem-solving, legal analysis and application, quantitative reasoning, investigation and scientific laboratory procedures can be applied to immediate employment or advanced study
- To make the World a Better and Safer place to live.
- To strengthen the Criminal Justice Delivery System.

Mission:

- Education through Investigation
- To impart High Quality Education of International Standards.
- Enhancing academic excellence through a balanced emphasis on teaching and research.
- Adopting innovative teaching methods that promote learning, creativity and critical thinking skills.

Program Educational Objectives(PEOs):

The graduates will

PEO1	Pursue interdisciplinary research in Universities in India and abroad.
PEO2	Adapt themselves for life-long learning through professional activities on latest technology and trends needed for a successful career.

PEO3	Acquire and apply knowledge and understanding of the forensic principles.
PEO4	Develop the ability to present technical, scientific and forensic information and arguments clearly and correctly, in written and oral presentation.
Program Outcomes (POs)	
At the end of the MSc Forensic Science Program, graduates will be able to	
PO1	Develop high awareness of major issues and development of forensic casework and competent in initiating, developing, and pursuing a scientific research.
PO2	Develop a conceptual understanding of criminal justice system, rules of evidence, legal system.
PO3	Act with integrity and good ethics in their profession and their obligation to society.
PO4	Identify, invent, research activities to provide solutions for trace evidence analysis using fundamental concepts of science and technology.
PO5	Understand professional ethics and regulations and develop the youth with social commitments.
PO6	Identify and examine current and emerging concepts and practices within the forensic science field.
PO7	Compete for employment in a field that uses their degree.
Program Specific Outcomes (PSOs): *At the end of the programme, the student should be able to*	
PSO1	Understand the concepts and applications in the field of Forensic Sciences.
PSO2	Apply the learning from the courses and develop new methodologies for real time case works.
PSO3	Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of evidences.
PSO4	Understand the technological developments in the usage of modern crimes and development tools to analyze and design new technology for solve the mysteries.
PSO5	Communicate in both oral and written forms, demonstrating the practice of professional ethics and the concerns for social welfare.

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS20.501	Criminology, Criminal Law, Police Administration	3	-	-	3	3	25	25	50
	FS20.503	Introduction to Forensic Science & Crime Scene Investigation (CSI)	3	-	-	3	3	25	25	50
	FS20.505	Forensic Physics and Trace Evidences	3	-	-	3	3	25	25	50
	FS20.507	Fingerprinting and Forensic Photography	3	-	-	3	3	25	25	50
	FS20.509	Introduction to Digital Forensics	3	-	-	3	3	25	25	50
	FS20.511	Forensic Practical I	-	-	4	2	4	25	25	50
	FS20.513	Forensic Practical II	-	-	4	2	4	25	25	50
		Foreign Language I	3	-	-	3	3	25	25	50
		Sub Total	**18**	**-**	**8**	**22**				
		SEFS				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	FS20.502	Forensic Ballistics	3	-	-	3	3	25	25	50
	FS20.504	Forensic Anthropology	3	-	-	3	3	25	25	50
	FS20.506	Introduction to Questioned Document Examination	3	-	-	3	3	25	25	50
	FS20.508	Introduction to Forensic Chemistry, Toxicology & Pharmacology	3	-	-	3	3	25	25	50
	FS20.510	Introduction to Forensic Biotechnology	3	-	-	3	3	25	25	50
	FS20.512	Forensic Practical III	-	-	4	2	3	25	25	50
	FS20.514	Forensic Practical IV	-	-	4	2	3	25	25	50
		Foreign Language II	3	-	-	3	3	25	25	50
		Sub Total	**18**	**-**	**8**	**22**				

Second year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	FS20.601	Analytical Instruments & Techniques	3	-	-	3	3	25	25	50
	FS20.603	Elements of Forensic Medicine	3	-	-	3	3	25	25	50
	FS20.605	Forensic Psychology	3	-	-	3	3	25	25	50
	FS20.607	Statistics & Research Methodology	2	-	-	2	3	25	25	50
	FS20.609	Forensic Practical V			6	3	4	25	25	50
	Specialization A: FORENSIC CHEMISTRY AND TOXICOLOGY									
	FS20.611	Advanced Forensic Chemistry	2			2	3	25	25	50
	FS20.613	Advanced Forensic Pharmacology & Toxicology	2			2	3	25	25	50
	FS20.615	Forensic Practical VI-A(Chemistry, Pharmacology, Toxicology)			8	4	4	25	25	50
	Specialization B: FORENSIC BIOTECHNOLOGY and DNA PROFILING									
	FS20.617	Advanced Molecular Biology	2			2	3	25	25	50
	FS20.619	Advanced Forensic serology and Bioinformatics	2			2	3	25	25	50
	FS20.621	Forensic Practical VI- B (Forensic Biotechnology)			8	4	4	25	25	50
	Specialization C: QUESTIONED DOCUMENT EXAMINATION									
	FS20.623	Advanced Questioned Documents Examination I	2			2	3	25	25	50
	FS20.625	Advanced Questioned Documents Examination II	2			2	3	25	25	50
	FS20.627	Forensic Practical VI- C			8	4	4	25	25	50
		Sub Total	**15**		**14**	**22**				

Spring Semester	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours
			L	T	P		
	FS20.602	Dissertation	-	-	-	20	-
	FS20.604	Out House Trainings	-	-	-	6	-
		Sub Total				**26**	

Semester	**Number of papers**	**Credits**				**Total**
		Theory	**Practical**	**Dissertation/Training**	**Open Elective**	
Semester-I	**8**	**18**	**4**	**-**	**-**	**22**
Semester-II	**8**	**18**	**4**	**-**	**-**	**22**
Semester-III	**8**	**11**	**3**	**-**	**4(T)+4(P)**	**22**
Semester-IV	**-**	**-**	**-**	**20+6**	**-**	**26**
		Total Credits				**92**

FS20.501	**CRIMINOLOGY, CRIMINAL LAW & POLICE ADMINISTERATION**	**3-0-0-3**
Objective:	To learn various aspects of criminology, criminal law & police administration	
Unit 1	**Introduction to Criminology** Criminology: Definition, Nature and Scope. Criminal Action and Criminal Behavior, Introduction of Victimology, Causes of crime: Social, Economic, Psychological, Political, Culture, and Geographical and their prevention, Juvenile Delinquency, Role of the Correctional Institutions.	**7**
Unit 2	**Theories of Criminology** Criminology: Definition, Nature and Scope. Criminal Action and Criminal Behavior, Introduction of Victimology, Causes of crime: Social, Economic, Psychological, Political, Culture, and Geographical	**8**
Unit 3	**Type of Offences and Indian Courts structure** Criminal Offences, Nature and types, Framing of Charges, Terrorism, Sexual Offences, White collar crime, Courts: Structure and types- criminal courts, Juvenile Courts.	**10**
Unit 4	**Criminal Law** Indian Penal Code: sections-23, 24, 25, 39, 44, 52,76-79,84-86. Criminal Procedure Code: sections-2, 6-35, 41-60, 61-90,154-176, 293, 294. Charges: bailable/non-bailable offences, cognizable/ non-cognizable, summon case and warrant cases. Indian Evidence Act: sections- 3, 24-30, 45, 135-138, 141. Expert testimony. NDPS Act, Food and Adulteration Act, Drugs and Cosmetic Act, Arms Act, Explosives Act.	**8**
Unit 5	**Police Administration system** Police duties and responsibilities, Structure of Police in India,	**6**

	role of Police in society, Police Investigation, Interrogation and Interviewing of criminals, maintenance of Law and order, Custodial crimes and death, Police and human rights.	
Text Books		
1	Rama Ahuja: Social Problems in India	
2	Swansan, C.R, Terrbles, L &Taylor,R.W; Police Administration, Prentice Hall, USA,1998.	
Reference Books		
1	Gross.H; Criminal Investigation- A Practical Textbook for Magistrates, Police Officers, and Lawyers; Universal Law Publishing Co., New Delhi, 2000	
2	Lyman, M.D; Criminal Investigation – The Art &the Science, Prentice Hall, New Jersey, 2002.	
3	O'Hara CE &Osterburg, JW; An Introduction to Criminalistics., Indiana University. Press, London, 1972	

FS20.503	**Introduction to forensic science and crime scene investigation**	**3-0-0-3**
Objective:	To learn various aspects of forensic science and crime scene investigation	
Unit 1	**Crime Scene Management** Definition and causation of crime, Types of crime scene, Crime scene survey, protection of crime scene, searching of physical evidences, Recording, documentation and presentation in the court, processing and reconstruction of the crime scene.	**9**
Unit 2	**Introduction to Forensic Science and Quality Management (ISO/IEC 17025)** Introduction and History of Forensic Science, Basic principles and significance, Utilization of Forensic Science, Forensic Scientist at the scene of crime, Structure of Forensic Labs, General requirements for the competence of testing and	**8**

	calibration laboratories - Introduction, Scope, Management requirements: Organization, Quality System, Document Control, Service to the clients, Complaints, Corrective and preventive actions, Control of records, Internal Audits etc.	
Unit 3	**Investigation and Interrogation** Law related to interrogation, interviewing of the criminals; methods used by the police in getting information from the criminal; the ethical issues related to the same	**6**
Unit 4	Examination in the Court, Expert Testimony: The role of the expert-witness; acceptance of evidence in the court; Direct examination, re-examination and cross – examination of prosecution lawyer and defense lawyer.	**8**
Unit 5	**Divisions and Scope of Forensic Investigations [3]** Mobile Lab, CSI and its relevance, Toxicology, Forensic Chemistry, Arson, Explosives, NDPS, Scope, Serology, Forensic Biotechnology, Scope, DNA Profiling, Questioned Documents, Digital Forensics, Forensic Ballistics, Forensic Physics	**7**
Text Books		
1	James, S.H., and Nordby, J.J., (Eds), Forensic Science; An Introduction to Sci and Investigative Techniques, CRC Press, London, 2003	
2	Fisher, B., Techniques of Crime Scene Investigation (6th Edn.) CRC Press, Boca Raton, Florida, 2000.	
Reference Books		
1	Bodziak, W., Footwear Impression Evidence (2nd Edn.) CRC Press, Boca Raton, Florida, 2000.	
2	DeForest, P., Gaensslen, R., and Lee, H., Forensic Science - An Introduction to Criminalistics, McGraw Hill, New York, 1983.	

FS20.505	FORENSIC PHYSICS and TRACE EVIDENCES	3-0-0-3
Objective:	To learn various aspects of forensic physics and trace evidences	
Unit 1	**SOIL** Physical Evidence and Role of Probability**;** Formation and types of soil, composition of soil, particle size distribution, microscopic examination, density gradient analysis, interpretation of soil evidence, Discussion on important case studies related to soil evidence	**6**
Unit 2	**GLASS** Types of glass and their composition, Forensic examination of glass fractures, determination of direction of impact: cone fracture, rib marks, hackle marks, colour and fluorescence, physical matching, refractive index, and interpretation of glass evidence.	**8**
Unit 3	**PAINT and FIBER** Types of paint and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis, solubility test, pyrolysis chromatographic techniques, IR spectroscopy and X-ray diffraction, interpretation of paint evidence. Types of fibres, forensic aspects of fibre examination-fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy, Py-GCMS. Difference between natural and man-made fibres. chemical compositions of papers, examination of wood and paper fibers, elemental analysis.	**8**
Unit 4	**TOOL MARKS & RESTORATION OF ERASED / OBLITERATED MARKS** Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks, class characteristics and individual characteristics, tracing and	**8**

	lifting of marks, Photographic examination of tool marks . Method of making-cast, punch, engrave; methods of obliteration, method of restoration.	
Unit 5	**SPEAKER IDENTIFICATION AND TAPE AUTHENTICATION** Vocal anatomy, Speech signal processing and pattern recognition – basic factors of sound in speech, acoustic characteristics of speech signal, Fourier analysis, analysis of audio-video signal for authenticity, Introduction to the techniques of pattern recognition and comparison.	**9**
Text Books		
1	R. Saferstein, Forensic Science Handbook, Vols. I, II, (Ed), Prentice Hall, Eaglewood Cliffs, NJ; 1988.	
2	B. Caddy, Forensic Examination of glass and paints analysis and interpretation, ISBN 078405749 2001.	
Reference Books		
1	Bengold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons, USA, 1999.	
2	James, S.H., and Nordby, J.J., (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003	

FS20.507	**FINGERPRINTING and FORENSIC PHOTOGRAPHY**	**3-0-0-3**
Objective:	To learn various aspects of fingerprinting and forensic photography	
Unit 1	**Introduction to Photography** Introduction to forensic photography; Required equipments for photography – Camera, lens, shutter, depth of field, film; Importance of Forensic photography in a crime scene investigation.	**7**
Unit 2	**Types of Photography & Photo Prints**	**8**

	History and Development of Photography. Basic principles and techniques of Black & White and colour photography. Developing techniques and methods of photography, Different kinds of developers and fixers, modern developments in photography, linkage of cameras and film negatives	
Unit 3	**Introduction and Classification of fingerprints** Origin & History of fingerprints, Principles of Fingerprints identification, Searching, location and significance of fingerprints in criminal investigation; Biological significance of skin pattern, Types of fingerprints, Fingerprint characteristics: class and individual, Collection, lifting and preservation of fingerprints	**7**
Unit 4	**Classification Systems and AFIS** Historical Systems, Vucetich Classification, Henry's system of classification, Batley's Single Digit classification, NCIC; AFIS, History and Development, French, UK, Japanese Initiatives, Biometric System Classification, Basic Biometric Systems, Introduction to Traits, FAR and FRR Applications	**8**
Unit 5	**Fingerprint Developmental Techniques** Methods of lifting and developing latent fingerprints – Physical methods - Powder method (Black, silver, florescent, red, yellow), Iodine fuming etc.; Chemical methods - Ninhydrin, silver nitrate method, cyno-acrylate, Osmium tetra-oxide etc., Photography of latent fingerprints and presentation of fingerprint evidence in court.	**9**
Text Books		
1	Redsicker, D. R., The Practical methodology of Forensic Photography, CRC Press, London, 1994.	
2	Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.	
Reference Books		
1	B.H.E. Jacobson, Ray GG Attridge; The Manual of Photography, Focal	

	Press, London (1988)
2	Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Edn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
3	H.L. Blitzer and J. Jacobia; Forensic Digital Imaging and Photography, Academic Press (2002)

FS20.509	**Introduction to Digital Forensics**	**3-0-0-3**
Objective:	To learn various aspects of Digital Forensics	
Unit 1	**Cyber Crime in India** Introduction to Digital Forensics, Classification, Definition and types of cybercrimes, electronic evidence and handling, electronic media, collection, searching and storage of electronic media, introduction to internet crimes, hacking and cracking, credit card and ATM frauds, web technology, cryptography, emerging digital crimes and modules.	**7**
Unit 2	**Basics of Computers** Computer Classification, Hardware, Classification and Types, Memory, I/O Devices, Cloud Storage, Software, Programing and Algorithms, Flowcharts, Operating Systems, Networks: Architecture and Basic Configurations	**8**
Unit 3	**Incident Response Management** Introduction to Incident Response Process, Preparing for Incident Response, detection of an Incident, IRM life cycle-preparation, Identification, Detection, Containment, Eradication, Recovery, lessons learnt, Investigations of Cyber Crime cases as per IRM cycles, opinion formatting for cyber-crime cases, court testimonies, case studies.	**7**
Unit 4	**File Forensics** Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Forensic Analysis of File Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, Embedded System Analysis, Network Forensic Analysis Overview, Cloud Computing-an introduction.	**8**
Unit 5	**Forensic Tools and Processing of Electronic Evidence [9]** Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital	**9**

	investigations, processing of digital evidence, digital images.	
Text Books		
1	James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.	
2	Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.	
Reference Books		
1	Tessarolo, A.A. and Marignani, A., Forensic Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.	
2	Bernad Jahne: Digital Image processing, Springer Verlag (1993)	

FORENSIC PRACTICAL I

FS20.511 **0-0-4-2**

1. Searching for evidence at scene of crime.
2. Recording and sketching of crime scene.
3. Collection, packaging and preservation of physical evidence.
4. Crime scene videography of simulated crime scene and recording logs of video camera settings.
5. Determination of the fracture pattern, perforation and direction in glass evidence in burglary, firearms and hit & run cases.
6. Analysis of the impressions made by different tools on different surfaces using forensic photography.
7. Lifting of Paint Samples from accident cases.
8. Collection of the broken glass evidence in burglary case to determine the direction of force.
9. Comparison of soil samples using microscopic and density-gradient distribution of particles method.
10. Microscopic examination of hair and fibres.
11. Comparison of different cloth pieces from crime scene.
12. Recording of speech samples using tape recorder & digital recorders and measures for keeping it in the safe custody.
13. Comparison of linguistic and phonetic features of audio recording voice samples of two speakers.

FORENSIC PRACTICAL II

FS20.513 **0-0-4-2**

1. Indoor and outdoor crime scene photography.
2. Presentation of evidence through photography and charts.
3. Recording of evidence and collection of clues in hit and run cases by forensic photography and Sketching.
4. Recording of various evidences in cases of sexual offences/homicide/ property offence cases by forensic photography and Sketching.
5. Analysis of skid marks and tire tread impressions using photographic evidence and Sketching.
6. Photography of crime-scene involving firearms.
7. Use of oblique light, transmitted light and side light photography in cases of indented writing and document examination.
8. Photography of writings on unusual surfaces.
9. Crime-scene photography, screenshots, capturing of screen video for collection of Digital Evidence in Cyber-crime Investigation.
10. Lifting of Fingerprints & Footprints from different surfaces and analysis of the pattern details.
11. Development of latent fingerprints on different surfaces followed by their lifting, preservation and comparison.
12. Recording of the fingerprints/palm prints/lip prints/bite-marks from the suspects in cases of forensic importance.
13. Perform Steganography and Steganalysis.
14. Encrypting and Decrypting the partition using Bit locker.
15. Collection and preservation of Volatile data from standalone computer.
16. Imaging and recovery of deleted files and folders from storage media.

SECOND SEMESTER

FS20.502	FORENSIC BALLISTICS	3-0-0-3
Objective:	To learn various aspects of forensic ballistics	
Unit 1	**Introduction to Ballistics** Firearms, Indian Arms Act, Characteristic features of the firearms, various types of modern firearms, classification of firearms on different basis, bore characteristics.	**6**
Unit 2	**Internal and External Ballistics** Definition, ignition of propellants, shape and size of propellants, manner of burning, various factors affecting the internal ballistics: lock time, ignition time, barrel time, erosion, corrosion and gas cutting, equation of motion of projectile, principal problems of exterior ballistics, vacuum trajectory, effect of air resistance on trajectory, base drag, yaw, shape of projectile and stability, trajectory computation, ballistics coefficient and limiting velocity, Ballistics tables, measurements of trajectory parameters, introduction to automated system of trajectory computation and automated management of ballistics data.	**8**
Unit 3	**Terminal Ballistics** Effect of projectile on hitting the target: function of bullet shape, striking velocity, striking angle and nature of target, Tumbling of bullets, effect of instability of bullet, effect of intermediate targets, influence of range, Cavitation – temporary and permanent cavities, Ricochet and its effects, stopping power, Wound Ballistics; Threshold velocity for penetration of skin/flesh/bones, preparation of gel block, penetration of projectiles in gel block and other targets, nature of wounds of entry, exit, initial track with various ranges and velocities with various types of projectiles, explosive wounds, evaluation of injuries caused due to shot-gun, rifle, handguns and country made firearms, methods	**8**

	of measurements of wound ballistics parameters, post-mortem and anti-mortem firearm injuries.	
Unit 4	**Examination and identification** Firearms, ammunition and their components identification and examination, different types of marks produced during firing process on cartridge-firing pin marks, breech face marks, chamber marks, extractor and ejector marks and on bullet number/direction of lands and grooves, striation marks on lands and grooves, identification of various parts of firearms, techniques for obtaining test material from various types of weapons and their linkage with fired ammunition, class and individual characteristics, determination of range of fire- burning, scorching, blackening, tattooing and metal fouling, shots dispersion and GSR distribution, time of firing – different method employed, and their limitations, stereo & comparison microscopy, automatic bullet and cartridge comparison system. GSR analysis:Mechanism of formation of GSR, source and collection, spot test, chemical test, identification of shooter and instrumental methods of GSR Analysis, Management and reconstruction of crime scene; suicide, murder and accidental and self defence cases.	**8**
Unit 5	**Explosives &Explosion Scene Investigation** Explosive Act, nature and classification, composition and characteristics of explosives, pyrotechnics, IEDs, Explosion process and affects, types of hazard, effect of blast wave on structures, human etc.Specific approach to scene of explosion, post-blast residue collection, Reconstruction of sequence of events, Evaluation and assessment of scene of explosion, systematic examination of explosives and explosion residues in the laboratory	**9**
Text Books		
1	Sharma, B.R.; Firearms in Criminal Investigation & Trials, 4th Ed, Universal LawPublishing Co Pvt Ltd, New Delhi, 2011	
2	Mathews, J.H; Firearms Identification, Vol I, II and III, Charles C. Thomas, USA, 1977.	
Reference Books		

1	Hatcher, Jury and Weller; Firearms Investigation, Identification and Evidence, StackpoleBooks, Harrisburg, Pennsylvania,1997.
2	Heard, B.J; Handbook of Firearms and Ballistics, John Wiley, England, 1997.
3	Warlow, T.A.; Firearms, The Law and Forensic Ballistics, Taylor and Francis, London,1996.
4	Schooeble, A.J. and Exline, L.D; Current methods in Forensic Gunshot Residue Analysis, CRC Press, New York, 2000.
5	Wilber; Ballistic Science for the Law Enforcement Officer, Charles C. Thomas, USA, 1977
6	Di Maio, JM; Gunshot Wounds, CRC Press, New York, 1999.

FS20.504	**Forensic Anthropology**	**3-0-0-3**
Objective:	To learn various aspects of Forensic Anthropology	
Unit 1	**Personal Identification** Genesis and development of forensic anthropology. Personal identification of living persons- Identification through somatometric and somatoscopic observation, nails, occupation marks, scars, tattoo marks and deformities; handwriting and mannerisms. Genetic traits of forensic significance: Colour blindness, ear lobe, brachydactyly, polydachtyly,widow's peak, eye colour, hair colour, face form, frontal eminences, nasalprofile, nasal tip,lips,chin form.Identification of the recently dead and decomposed bodies.	**6**
Unit 2	**Human Growth and Development** Major stages of human growth and development- Prenatal growth, Postnatal growth and their characteristics, Factor affecting growth- Genetic and Environmental. Methods of studying Human Growth, Significance of age in growth studies Methods of assessing age-chronological age, dental age, skeletal age, secondary sex character age and morphological age	**8**
Unit 3	**Forensic Morphometry of Skeletal Remains** Techniques for recovering skeletonised human remains. Laboratory analysis of skeletal and decomposing remains; maceration, skeletal analysis. Human and Animal remains. Bone fragments, Attribution of sex, estimation of age and reconstruction of stature from skeletal remains.	**8**

Unit 4	Trauma analysis and identifying skeletal pathology. Antimortem, perimortem, post- mortem and pseudo mortem trauma. Pathological changes in bone. Establishment of partial and complete identity of skeletal material and dead bodies-morphometric techniques.	**8**
Unit 5	**Forensic Odontology** Tooth structure and growth. Estimation of age from odontological evidences.Population differencesin size and morphology.Individualisation of tooth pulp. Bite marks and its forensic significance. Photography, lifting and preservation of bite marks. Comparison and evaluation of bite mark evidences.	**9**
Text Books		
1	Reddy,V.R; Dental Anthropology, Inter-India Publication, New Delhi, 1985.	
2	Singh, I.P. &Bhasin M.K; A manual of biological Anthropology, Kamla Raj Enterprises, New Delhi, 2004.	
Reference Books		
1	Kroeber; Anthropology, Oxford & IBH Publishing Company, New Delhi, 1972.	
2	Pickering, R. & Bachman D; The use of Forensic Anthropology, CRC Press, Costa Rica, 2009.	
3	Bose, N K; Anthropology, Narayana Press, Denmark, 1972.	
4	Michael, W. Haney, H.A. &Freas, L.E; The Forensic Anthropology Laboratory, CRC Press, 2008.	
5	Eveleth, P.B. & Tanner, J.M; Worldwide Variation in Human Growth, Cambridge University Press, London, 1976.	

FS20.506	**Introduction to Questioned Document Examination**	**3-0-0-3**
Objective:	To learn various aspects of questioned document examination	
Unit 1	**Introduction to Questioned Documents** Documents and Questioned documents: various types, Forgery and its types, characteristic features of genuine handwriting/ signatures, characteristic components of forged documents and their examination, Procedure adopted for collection of standards for comparison of documents, admittedly genuine documents/signature/writing, contemporaneous documents/ signature/writing, specimen signature/writings.	**6**
Unit 2	**Principles of Handwriting Identification** Introduction of Handwriting, Physiology of Handwriting, Handwriting characteristics: Class and individual characteristics, Natural variations in handwriting, causes of variations, Disguised writings, features of disguised writings and its examination, Principle of handwriting identification, Tampered Documents: addition, alteration, erasure, obliteration, interlineation, page substitution, secret writing. Automated Signature Verification System.	**8**
Unit 3	**Author Determination** Examination of anonymous letters- Identification of writer of the letter, Features indicating religion, region, sex and educational background of the writer, Importance of preserving envelope containing anonymous letters, Types of anonymous letters and various methods used for their communication, Case studies. Linguistics, stylistics, forensic stylistics- Definition, Methodology, Use in personal identification, Application in different Indian vernacular languages, Limitations, Case studies.	**8**
Unit 4	**Determination of Age** Determination of relative age of writing and signatures, determination of relative age by examination of signatures/rubber	**8**

	stamp impression in chronological order, Determination of relative age of document by - Examination of writing paper and ink, Examination of sequence of intersecting strokes, Addition of text with ink or typescript, Anachronistic features and their importance. Stabilization of charred documents- Decipherment of charred documents, Reconstruction of torn documents, Case studies.	
Unit 5	**Instrumentation in Questioned Documents** Document photography using Camera, Color filters, Various light sources based on: Angle of incidence (Transmitted light, Oblique light etc) and Wavelength (UV and IR radiations etc), Apparatus for specialized photographic techniques; magnifying glasses, illuminated torch, measuring equipment, geometrical requirements, Compound microscope, Stereo microscope, Electron Microscopy, Video Spectral Comparator, Docu-centre, Projectina, ESDA, Paper Chromatography, Thin Layer Chromatography, Neutron Activation Analysis, Raman Spectroscopy.	**9**
Text Books		
1	Huber, A. R. & Headrick, A. M. (1999). The Discrimination and Identification of writing. Handwriting Identification Facts and Fundamentals, CRC Press, Boca Raton London	
2	Kelly, J. S. & Lindblom, B. S. (2006). Science, Handwriting Examination and the Courts. Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group	
Reference Books		
1	Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998	
2	Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997	
3	Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED.,	

	Elsevier, New York, 1982
4	Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971
5	Koppenhaver, K. M. (2007). Forensic Document Examination. In Humana Press
6	Ron N. Morris, Forensic Handwriting Identification: Fundamental Concepts and Principles, Academic Press, 1st ed. (2000)
7	David Ellen Scientific Examination of Documents, Second edition Taylor & Francis Forensic Science Series
8	Forensic Linguistics - Advances in Forensic Stylistics - G. McMenamin (CRC, 2002)
9	Malcom Coulthard & Alison Johnson; An Introduction to Forensic Linguistics, Taylor & Francis Group London & New York.
10	McMenamin Gerald R; Forensic Linguistics- Advances in Forensic Stylistics, CRC Press, Washington Dc, 2002.
11	Hobart Willard; "Instrumental Methods of Analysis", Wadsworth Publishing Company, 1988

FS20.508	INTRODUCTION TO FORENSIC CHEMISTRY, TOXICOLOGY and PHARMACOLOGY	3-0-0-3
Objective:	To learn various aspects of to forensic chemistry, toxicology and pharmacology	
Unit 1	**Introduction to Forensic Chemistry** Introductionto Forensic chemistry, sampling of chemical evidences, presumptive, screening (colour/ spot test), inorganic analysis. Detective dyes- cases and importance in trap cases. Arson Chemistry of fire, searching of fire scene, collection, preservation and examination of arson evidences.Adulteration in Petroleum products. Forensic analysis of Fertilizers/ insecticides/ pesticides/ biocides.	**6**
Unit 2	**Toxicology of alcohol &Examination of Alcoholic Beverages** The fate of alcohol in the body, alcohol in the circulatory system, breath test instruments, field sobriety testing, Examination of alcoholic beverages; country made liquor, illicit liquor.Analysis of blood for alcohol.	**8**
Unit 3	**Drugs of Abuse** Introduction, classification of drugs of abuse, drugs of abuse in sports and doping, narcotics drugs and psychotropic substances, designers drugs and their forensic examination, Drugs and Cosmetic Act, Excise Act, NDPS Act.	**8**
Unit 4	**Introduction to Toxicology** Definition, Law relating to poison, Classification of poisons. Action of poisons & factors modifying its action, routes of administration of poisons.	**6**
Unit 5	**Forensic Pharmacology** Pharmacology and toxicology of Psychotropic Drugs: Sedatives, Stimulants, Opiates and drugs of abuse. Extraction, Isolation of drugs from viscera, tissues and body fluids.	**6**
Text Books		

1	Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.
2	Modi, JP, Textbook of Medical Jurisprudence & Toxicology, N.M. Tripathi Pub,2001
Reference Books	
1	Chadha, PV; Handbook of Forensic Medicine & Toxicology, Jaypee Brothers, New Delhi,2004
2	Parikh, C.K; Text Book of Medical Jurisprudence, Forensic Medicine & Toxicology, CBS Pub. New Delhi,1999

FS20.510	**Introduction to Forensic Biotechnology**	**3-0-0-3**
Objective:	To learn various aspects of Forensic Biotechnology	
Unit 1	**Serology and Immunology** Cell structure and functions. Structure and function of carbohydrates, fats and proteins, serum proteins, haemoglobin and its variants, haptoglobins, HLA, polymorphic enzymes, blood groups-history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from fresh blood and biological stains, body fluids, determination of secretor status, polymorphic enzyme typing, serogenetic markers, determination of origin of species, immunology, immune response, antigens, haptens and antibodies, function and rising of antisera, lectins.Bloodstains investigations: Blood pattern analysis, ageing of bloodstains, difference between human and animal bloodstains, spectroscopic analysis.	**6**
Unit 2	**Forensic Biology** General plant classification schemes. Sub specialisation of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology.Wood and timber analysis.Diatoms and their forensic importance.Study and identification of various diatoms.Paper and pulp identification.	**8**
Unit 3	**Hair examination** Collection and preservation of hair samples.Morphological and microscopic examination of human and animal hair. Hair growth and development, determination of origin, race, sex, site from hair. Comparison between human and non-human hair.Macroscopic and microscopic features of hair.	**8**
Unit 4	**Wildlife Forensics** Introduction and importance of wild life. Protected and endangered species of animals and plants.Sanctuaries and their	**8**

	importance.Introduction to Wildlife (Protection) Act 1972 and CITES, Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife animals	
Unit 5	**DNA Profiling** Double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA.Nature and structure of human genome and its diversity.mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans, Forensic DNA profiling and its application in criminal and civil investigations.	**9**
Text Books		
1	Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.	
2	Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.	
Reference Books		
1	Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.	
2	Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.	
3	Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwellpublishing, London, 2006	

FORENSIC PRACTICAL III

FS20.512 **0-0-4-2**

1. Study of details of various small arms – caliber, choke, firing mechanisms, trigger pull, proof marks, etc.
2. Study of details of Shotgun ammunitions and rifle ammunitions.
3. Determination of shot-size from diameter and weight of shots.
4. Examination of comparison of class and individual characteristics of fired bullets.

5. Examination and comparison of fired cartridge cases (caliber, firing pin marks, breech face marks, chamber marks, extractor and ejector marks).
6. Qualitative and Quantitative analysis using UV-Visible Spectrophotometer.
7. Sample preparation and analysis using IR Spectrophotometer.
8. Analysis using Chromatographic Techniques such as Thin Layer Chromatography, High Performance Liquid Chromatography and Gas Chromatography.
9. Analysis using Microscopy-working of Compound microscopes and Stereoscopic microscopes.
10. Working with Density Gradient and Refrigerated Centrifuges.
11. Field test for detection of indentation marks.
12. Field test for the secret/invisible writings.
13. Field test for detection of counterfeit bank notes.
14. Care, handling, preservation, marking, packing and forwarding of documents.
15. Determination of GSM and thickness of papers.
16. Examination of documents under stereo zoom microscope, UV rays, IR rays and oblique light.

FORENSIC PRACTICAL IV

FS20.514 **0-0-4-2**

1. Preparation of the Normal, Molar and Standard & buffer solutions.
2. Field tests for the detection and identification of narcotic drugs.
3. Determine the density of alcohol by using pycnometer.
4. Determination of pH of a solution using pH meter.
5. Use of breath analyzer for measuring blood alcohol concentration.
6. Identification of ethyl alcohol and methyl alcohol by colour tests and microscopic examination.
7. Identification of commonly encountered inorganic poisons Arsenic, Antimony, Bismuth, Mercury by colour test and microscopic examination.
8. To separate the dyes and inks/plant pigments/body fluids/explosives by thin layer chromatography.
9. Field tests for the detection and identification of blood stain evidence.
10. Identification of blood stains using enzymatic and crystal tests.
11. Field tests for the detection and identification of seminal stains.
12. Identification of seminal stains using presumptive test, crystal test and detection of spermatozoa.
13. Identification of saliva stains.
14. Identification of urine stains.
15. Microscopic Examination of Human and Animal Hairs.
16. Microscopic Examination of Vegetable Fibers.

THIRD SEMESTER

FS20.601	Analytical Instruments & Techniques	3-0-0-3
Objective:	To learn various aspects instrumental techniques	
Unit 1	**Basic Concepts of Method Validation** Introduction to measurement and instrumentation, methods of measurement. Performance characteristics of Instruments: static characteristics- accuracy, precision, sensitivity, linearity, reproducibility, repeatability, resolution, threshold, drift, stability, tolerance, range or span & dynamic characteristics -speed of response, measuring lag, fidelity, dynamic error, Limit of Detection, Limit of Quantitation. Signal and Data: signal-to-noise ratio, source of noise, signal- to-noise enhancement.	**6**
Unit 2	**Microscopy Techniques** Microscope, Compound Microscope, Polarized Light Microscopy, Fluorescence Microscopy, Comparison Microscope, Stereo-zoom Microscope. Transmission Electron Microscope, Video-zoom Microscope. Scanning Electron Microscope – Energy Dispersive X-Ray. Atomic Force Microscope.	**8**
Unit 3	**Basic concepts of Spectroscopic techniques** Introduction to spectrophotometry, Interaction of electromagnetic radiations with matter: phenomena of absorption, emission, reflection, fluorescence, phosphorescence. Detection of radiations: Photographic detectors, thermal detectors, photoelectric detectors. Basic concepts of atomic spectra, energy levels, quantum numbers, designation of states, selection rules, atomic spectra. Ultraviolet and visible spectrophotometry: types of sources, stability, wavelength selection, filter cells, sampling devices, Lambert and Beers Law, calibration of instrument, Infrared spectrophotometry, Raman Spectroscopy, High Resolution Hyper Spectral Comparator. Detectors. Atomic Absorption Spectrophotometry.	**8**
Unit 4	**Separation and Detection Techniques** Chromatographic Techniques: General Principles, stationary phase, mobile phase, Classification of chromatographic techniques, Column chromatography, High Performance Liquid Chromatography.	**8**

Unit 5	**Radio chemical techniques** Basic principles and theory introduction about nuclear reactions and radiations, Neutron sources, Neutron Activation Analysis. Basics of Electrostatic Detection Apparatus, Centrifugation techniques, Electrophoretic techniques.	**9**
Text Books		
1	Hobart Willard; "Instrumental Methods of Analysis", Wadsworth Publishing Company, 1988.	
2	Douglas Skoog, James Holler and Stanley Crouch; "Principles of Instrumental Analysis" 7th Edition, Cengage Learning, 2017.	
Reference Books		
1	V.B Patania; "Spectroscopy", Campus Books International, 2004.	
2	R.S Khandpur; "Handbook of Analytical Instruments", Tata Mac Graw Hill Publ. Co., 2004.	
3	G.R Chatwal & S.K Anand; "Instrumental Methods of Chemical Analysis", Himalaya Publ. House, 2004.	

FS20.603	**Elements of Forensic Medicine**	**3-0-0-3**
Objective:	To learn various aspects of Forensic Medicine	
Unit 1	**Medico legal aspects of death** Death: Signs of death and changes after death. Somatic death, molecular death ,early changes after death - Algor mortis, rigor mortis, cadaveric spasm, heat stiffening, cold stiffening, changes in blood, chemical changes in cerebrospinal fluid, changes in vitreous humour, post mortem lividity, fluidity of blood,. Late changes – putrefaction- external and internal changes. Adipocere, mummification, gastric content and bladder content and time of death from growth of hair and nails .destruction of body and tissues by maggots and other insects, rodents, fish and crabs, moulds . Sudden death, post-mortem demonstration of myocardial infarction	**6**
Unit 2	**Medico legal aspects of death** Asphyxia, syncope, coma, death by starvation, drowning, hanging and strangulation. Causes and mechanism of traumatic death, manner of death. Classification of traumatic deaths.	**8**

Unit 3	**Injuries and investigations** Mechanical Injuries: Abrasions, Bruises, Lacerations, Incised wounds, Stab wounds, Firearm injuries, Defence injuries, fabricated injuries. Traffic accident injuries: vehicular injuries, railway injuries and aircraft injuries. Thermal injuries: Burn and scalds, Lightning, Electricity, Explosions. Chemical trauma.	**8**
Unit 4	Injuries- Accidental, self-inflicted, or inflicted by others. Ante - mortem and post-mortem, artificial injuries and aging of injuries. Fractures, Dislocations Secondary causes of death Regional injuries- wound of the scalp- incised, contusions, lacerations, firearm injuries. Fractures of the skull from direct & indirect impact.	**8**
Unit 5	**Forensic Entomology** Forensic Entomology- History, significance, determination of time since death- Dipterean larval development & successional colonization of body, determining whether the body has been moved, body disturbance, presence and position wounds, linking suspect to the scene, identification of drugs and toxins from the insects and larvae feeding on the body, entomology as an evidentiary tool in child and senior abuse cases and animal abuse cases, collection of entomological evidence.	**9**
Text Books		
1	Mclay, W.D.S; Clinical forensic medicine, Cambridge University Press, London,1990.	
2	Shepherd, R; Simpson's forensic medicine, Oxford University press, London, 2003	
Reference Books		
1	Mant, A.K; Taylor's priniciples& practice of medical jurisprudence, Wingking Tong company ltd., Hong Kong, 2003	
2	Maio, D.J. &Maio V.J; Forensic pathology, CRC press, Costa Rica, 1993.	
3	Wecht, C.H; Legal medicine annual, Academic Press Publisher, Massachussets, 1970.	
4	Polson C.H; Essentials of forensic medicine, Pergamon press, London, 1973.	
5	Lahiri, S.K; Elements of medical jurisprudence ,Prabasi press, Calcutta, 1973.	

FS20.605	**Forensic Psychology**	**3-0-0-3**
Objective:	To learn various aspects of Forensic Psychology	
Unit 1	**Basics of Forensic Psychology** Definition and fundamental concepts of forensic psychology and forensic psychiatry. Psychology and law. Ethical issues in forensic psychology. Assessment of mental competency. Mental disorders and forensic psychology. Psychology of evidence – eyewitness testimony, confession evidence. Criminal profiling. Psychology in the courtroom, with special reference to Section 84 IPC.	**8**
Unit 2	**Psychology and Criminal Behavior** Psychopathology and personality disorder. Psychological assessment and its importance. Serial murderers. Psychology of terrorism. Biological factors and crime – social learning theories, psycho-social factors, abuse. Juvenile delinquency – theories of offending (social cognition, moral reasoning), Child abuse (physical, sexual, emotional), juvenile sex offenders, legal controversies.	**8**
Unit 3	**Investigative Psychology** Police Psychology, Victimology, Criminal Profiling, Cognitive Psychology and Applications, Uses. Psychological Sketch: Crime Scene Profiling, Suspect-Based Profiling and The Psychological Autopsy. Geographical Profiling and mapping, Psychological profiling.	**8**
Unit 4	**Detection of Deception** Tools for detection of deception – interviews, non-verbal detection, statement analysis, voice stress analyzer, hypnosis. Polygraphy – operational and question formulation techniques, ethical and legal aspects, the guilty knowledge test. Narco analysis and brain electrical oscillation signatures – principle and theory, ethical and legal issues.	**8**

Unit 5	**Correctional Psychology** Institutional Corrections, Correctional facilities, Correctional Psychologists, Treatment and Rehabilitation in correctional facilities, Treatment of special populations: substance abuse offenders, violent offenders, criminal psychopaths, sex offenders, women prisoners, juvenile corrections.	**7**
Text Books		
1	Curte R. Bartol and Anne M. Bartol (2012). Introduction to Forensic Psychology: Research and Application, 3rd Edition, SAGE Publications, Inc, USA	
2	David Canter (2010). Forensic Psychology: A Very Short Introduction, Oxford University Press, New York	
Reference Books		
1	Irving B. Weiner & Randy K. Otto (2014). The Handbook of Forensic Psychology, 4th Edition, Wiley & Sons, Inc., New Jersey	
2	David Canter (2012). Forensic Psychology for Dummies, John Wiley & Sons, Ltd, England	
3	. Esgate, A. et al. (2005). An Introduction to Applied Cognitive Psychology. Psychology Press: New York.	
4	Durso, F. T. (2007). Handbook of Applied Cognition (2nd Ed). New West Sussex : Wiley & Sons	
5	A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, The Foundation Press, Inc., New York (1995).	
6	R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).	
7	J.C. DeLadurantey and D.R. Sullivan, Criminal Investigation Standards, Harper & Row, New York (1980).	
8	J. Niehaus, Investigative Forensic Hypnosis, CRC Press, Boca Raton (1999).	
9	E. Elaad in Encyclopedia of Forensic Science, Volume 2, J.A. Siegel, P.J. Saukko and G.C. Knupfer (Eds.), Academic Press, London (2000).	

FS20.607	Statistics & Research Methodology	2-0-0-2
Objective:	To learn various aspects of statistics and research methodology	
Unit 1	**Introduction to Research** Research– its definition and objectives, Philosophy of research, Types of Research, Research process, defining the research problem, Selection of Research Design, Review of Literature, Mendeley Desktop, Writing strategies and Ethical considerations, Purpose statement, Research questions and Hypotheses, Quantitative, Qualitative, and Mixed-methods of research.	**5**
Unit 2	**Sampling Techniques** Principles, methods: census and sample survey, sample design. Sample size, Sampling error, non-sampling error, Types of sampling, rationale for using a particular sampling procedure.	**5**
Unit 3	**Tools of Data Collection** Primary and Secondary data collection. Observation, Interview, Questionnaires, Reporting, Survey, Ethnography, Case study methods.	**5**
Unit 4	**Descriptive Statistics** Introduction to Statistics, Statistical analysis software. Measures of Frequency: Count, Percent, Frequency; Frequency distribution, class intervals; Graphical presentation: bar diagram, histogram, pie chart; Measures of Central Tendency: Mean, Median, Mode; Measures of Dispersion: Range, Variance, Standard Deviation; Measures of Position: Percentile ranks, Quartile ranks, Standard scores; Measure of shape: Skewness, Kurtosis.	**5**
Unit 5	**Inferential Statistics** Hypothesis testing, Parametric, Nonparametric tests, One sample test of difference/One sample hypothesis test, Confidence Interval, Contingency Tables, Chi-square Statistic, t-test/ANOVA, Types of correlation, Regression analysis.	**6**

Text Books	
1	Creswell, John W. (2013). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. London: Sage
2	C. George Thomas (2016). Research Methodology and Scientific Writing, Ane Books Pvt. Ltd.
Reference Books	
1	Flick, Uwe (2009). An introduction to qualitative research. London:Sage.
2	Goertz, Gary & James Mahoney (2012). A tale of two cultures: qualitative and quantitative research in the social sciences.N.J. :Princeton University Press.
3	Hart, Chris (1998). Doing a literature review: releasing the social science research imagination. London: Sage.
4	Healey, J. F. (1993). Statistics: A Tool for Social Research.Belmont, CA: Wadsworth Publishing Company.
5	Scott, John (2000). Social Network Analysis: A handbook, London: Sage.
6	Yin, Robert (2009). Case study research: design and methods. London: Sage.
7	C. R. Kothari (1985) Research Methodology: Methods and Techniques, 2nd Edition

FORENSIC PRACTICAL V

FS20.609 **0-0-6-3**

1. To determine of age from skull and teeth.
2. To determine of sex from skull.
3. To determine sex from pelvis.
4. To study identification and description of bones and their measurements.
5. To investigate the differences between animal and human bones.
6. To perform somatometric measurements on living subjects.
7. To carry out craniometric measurements of human skull.
8. To estimate stature from long bone length.
9. To conduct portrait parley.
10. To design a questionnaire for the first responder to the death scene.
11. To design a checklist for the forensic scientists at the death scene.
12. To analyze and preserve bite marks.
13. To cite a crime case where legal procedures pertaining to psychic behavior had to be invoked.
14. To prepare a report on relationship between mental disorders and forensic psychology.

15. To review a crime case involving serial murders. Comment on the psychological traits of the accused.
16. To cite a crime case involving a juvenile and argue for and against lowering the age for categorizing an individual as juvenile.
17. To study a criminal case in which hypnosis was used as a means to detect deception.
18. To prepare a case report on thematic appreciation test.
19. To prepare a case report on Minnesota multiphasic personality inventory test.
20. To prepare a case report on word association test.
21. To cite a criminal case in which narco analysis was used as a means to detect deception.

Specialization A: FORENSIC CHEMISTRY AND TOXICOLOGY

FS 20.611	Advanced forensic chemistry	**2-0-0-2**
Objective:	To learn various aspects of forensic chemistry	
Unit 1	**Arson** Scientific Inestigation of Fire, NEPA 921 and NEPA 1033, The chemistry and physics of combustion, Dynamics of Fire, Development of fire patterns, Separation and analytical techniques of ignitable liquid residues, Field tests, Interpretation of Data Obtained from Fire Debris, Quality Assurance in Fire debris Analysis, Report Writing and Court Testimony	**5**
Unit 2	**Motor Vehicle Fires** Causes, investigation, collection, preservation, packaging and analysis of evidences	**8**
Unit 3	**Analysis of Petroleum Products, Organic and Inorganic Substances** Petroleum products and their adulterations: Chemical composition of various fractions of Petroleum Products, Marketing Disciplinary Guidelines for sampling of petrol and diesel. Analysis of petrol, kerosene, diesel, lubricants by BIS methods and ASTM methods. Detection of adulterants of Gasoline, Diesel and Engine oils. Analysis of adulterants in forensic exhibits by Gas Chromatography, Analysis of dyes of Petrol, Kerosene and Engine oils. Essential Commodity Act & Petroleum Act.	**8**
Unit 4	**Expert Witness**	**8**

	The role of Chemist as an expert witness. Presentation of the report in the court, Cross-examination of the expert	
Unit 5	**Explosives** Classification, composition and characteristics of explosives, pyrotechnics, IEDs, systematic examination of explosives and explosion residues in the laboratory using chemical and instrumental techniques in the laboratory and interpretation of results, Explosives Act.	**9**
Text Books		
1	James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.	
2	John J. Lentini, Scientific Protocols for Fire Investigation, Third Edition	
Reference Books		
1	Klaassen, C. D.,:Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed, McGraw-Hill, 1995.	
2	"Laboratory Procedure Manual: Petroleum Products", Directorate of Forensic Science, MHA, Govt. of India, 2005.	
3	Beveridge, A; "Forensic Investigation of Explosives", Taylor & Francis, 2000	
4	James, S. H. and Nordby, J. J.: Forensic Science: An Introduction to Scientific and Investigative Techniques, 2003.	

FS20.613	**ADVANCED FORENSIC PHARMACOLOGY & TOXICOLOGY**	**2-0-0-2**
Objective:	To learn various aspects of pharmacology & toxicology	
Unit 1	**Pharmacology-I** Sites and mechanisms of action of drugs, Dose-effect relationships; agonists, partial agonists and antagonists. Factor that modify drug actions; side effects, overdose, idiosyncratic and allergic reactions; teratogenesis and fetal toxicity. Drug interactions.	**6**
Unit 2	**Pharmacology-II** The movement of drug molecules across cell membranes, the blood-brain barrier and the placental filter. Routes of administration and drug adsorption. Binding to plasma proteins. Drug distribution, metabolism and elimination. Drug bioavailability and half-life.	**5**
Unit 3	**Toxicology and Isolation techniques of toxins** Definition of Toxicology, Principle of Toxicology, Mechanism of Toxicology Risk Assessment and Safety evaluation of chemicals, Isolation of Toxic substances from viscera and other relevant materials. The role of drug recognition expert.	**5**
Unit 4	**Different Toxins-I** Nature, administration, sign & symptoms, Fatal dose, postmortem findings, Detection and medicolegal aspects of- **a) Metallic poisons** Arsenic, Mercury, Lead. **b) Vegetable poisons** Abrus Precatorius, Calotropis gigantia, Castor ,Oleander, Aconite.	**5**
Unit 5	**Different Toxins-II** **Insecticides** Organ phosphorous compounds, Organochloro Compounds and Carbamates **Volatile Poisons** Methyl alcohol, Chloroform, Ethyl Alcohol **Asphyxiants** Cyanide, Carbon monoxide **Animal Poisons** Snake venom, Cantharides, Insect bite.	**6**
Text Books		
1	Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.	
2	Curry A.S; "Analytical Methods in Human Toxicology: Part II", CRC Press	

	Ohio, 1986.
Reference Books	
1	Parikh C. K; "Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology", CBS Publ. New Delhi, 1999.
2	"Laboratory Procedure Manual, Forensic Toxicology", Directorate of Forensic Science MHA Govt, 2005.3. Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
3	Casarett, L J and Doul John; "Toxicology: The Basic Science of Poison", Macmillan Publishing Co. New York, 1975.
4	Paranjape, H.M., Bothara, G.K., Jain, M.M; "Fundamentals of Pharmacology", 1st edition, Nirali Prakashan, 1990
5	Chadha PV; "Handbook of Forensic Medicine and Toxicology", J.P Brothers New Delhi, 2004.

FORENSIC PRACTICAL IV
(Chemistry, Pharmacology, Toxicology)

FS 20.615 **0-0-8-4**

1. Isolation techniques of different toxic substances.
2. TLC of insecticides, Barbiturates and other drugs.
3. Analysis of volatile and non-volatile poisons.
4. Analysis of vegetable poisons.
5. Spot test of nitrates, nitrites, carbonates, sulphates, sulphites, chlorates.
6. Spot test of mercury, iron, copper, Aluminum and cadmium and zinc and other metallic poisons.
7. Determination of alcohol in blood and urine sample.
8. Analysis of dye in petrol and kerosene by UV spectrophotometer and TLC.

Specialization B: FORENSIC BIOTECHNOLOGY and DNA PROFILING

FS20.617	Advanced molecular biology	2-0-0-2
Objective:	To learn various aspects of molecular biology	
Unit 1	**Population Genetics** Concept of population structure Indian population structure Hardy-Weinberg equilibrium Causes of evolution- admixture, selection, mutation, drift Linkage disequilibrium Phylogenetic tools Paternity/ maternity indices, sibship indices Population Genetics in Forensic DNA typing Factors affecting accuracy of Forensic DNA typing DNA databases	**8**
Unit 2	**Advanced Methodologies in Forensic DNA Analysis** Fundamentals of RFLP and PCR based DNA typing. STR genotyping Result of STR marker analysis and its interpretation. Single Nucleotide Polymorphism (SNP) and its applications in forensic investigation LCN typing Mitochondrial DNA analysis in Forensic investigation. Y-STR analysis and its significance in establishing paternal relationships. Non-human DNA analysis	**9**
Unit 3	**Recent Developments and future Directions in DNA profiling** Methods of DNA sequencing Prediction of physical characteristics, such as eye, hair, and skin color based solely on DNA Molecular autopsy Genetic genealogy in the genomic era Evolving technologies in forensic dna analysis Forensic tissue identification with nucleic acids: Classical, RNA based and DNA methylation based approaches	**9**
Text Books		
1	Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.	
2	Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.	

Reference Books	
1	Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.
2	Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.
3	Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwellpublishing, London, 2006

FS20.619	**Advanced Forensic serology and Bioinformatics**	**2-0-0-2**
Objective:	To learn various aspects of Forensic serology and Bioinformatics	
Unit 1	Determination of species of origin-ring test, single diffusion in one dimension and two-dimension, double diffusion in one dimension and two dimensions, immune-electrophoresis, Rocket immune-electrophoresis, Two dimensional electrophoresis, cross-over electrophoresis, Anti-human globulin serum inhibition test, passive heam-agglutination method, precipitin-inhibition test, mixed agglutination method, sensitized latex particle method. Testing Procedures and factor effecting precipitin tests. Raising of Anti-sera, buffers and serological reagents, Lectins and their forensic significance, methods of sterilization employ for serological work	**10**
Unit 2	Introduction to bioinformatics and its application in forensics. Integrated information retrieval. Major databases in bioinformatics. Sequence alignment, Phylogenetic analysis and related tools. Gene identification and prediction. FASTA and BLAST algorithm.	**8**
Unit 3	Bioinformatics analysis of DNA Microarray, Bioinformatics tools of forensic applications- Clustal family, BioEdit, MEGA, Arlequin, Protein structure prediction and visualization tools. Tools used in proteomics, In-silico simulation for molecular biology experiments. Basic theory of probability and statistics. Bayesian analysis. Likelihood ratio. Statistical evaluation of DNA profiles using Bioinformatics tools.	**8**
Text Books		
1	Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.	
2	S.C. Rastogi, N. Mendiratta & P. Rastogi; “Bio-informatics – Methods and Applications”, PHI learning Pvt. Ltd., 2009.	

Reference Books	
1	Dr. Westhead, JH Parish & R.M. Twyman; "Bio-informatics", Viva Books Ltd., 2003.
2	Prakash, M; "Physicology of Blood", Anmol Publications, 1998.
3	Wiener, Alexander S; "Advances in Blood Grouping II", Grune & Stratton, 1965.

FS20.621 Forensic Practical VI (Forensic Biotechnology) 0-0-8-4

1. Validation and calibration of various instruments and glassware's
2. Preparation of Buffers (DNA Extraction and Gel electrophoresis)
3. DNA Extraction from Blood samples (Dried/ Wet) using Organic (Phenol-Chloroform) Method
4. DNA Extraction from Tissue and other biological samples using Organic (Phenol-Chloroform) Method
5. DNA Extraction from biological samples using commercially available kits
6. DNA Estimation through Spectroscopic Methods
7. DNA separation through Agarose gel electrophoresis
8. Polymerase chain reaction
9. STR Genotyping and interpretation
10. Sequence comparison using BLAST
11. Construction of Phylogenetic tree from nucleotide and protein sequences.
12. Analysis of protein structure using RASMOL

Specialization C: QUESTIONED DOCUMENT EXAMINATION

FS20.623	**Advanced Questioned Documents Examination I**	**2-0-0-2**
Objective:	To learn various aspects of examination of mechanical impressions, printed matter and photocopies.	
Unit 1	**Examination of Mechanical Impressions** Rubber stamps, Metallic seals, examination of stamp/seal impressions. Working of standard mechanical and electrical typewriters and examination of typescripts therein, identifying features of standard typewriters, features arising due to defects in main machine and fonts. Working and examination of electric, electronic and daisywheel printer, high speed mainframe line printer (drum and chain print heads), Cheque writers, Identification of typist of typescripts.	**5**
Unit 2	**Examination of Printed Matter-I** Types of computer printers, Working of computer printers- dot matrix printers, ink jet printer, laser jet printers, thermal printers, digital offset printers, Identifying features of different computer printouts, methods of identification of toners and inks used in printing. Examination and identification of digitally manipulated documents using computers and printers, Case studies.	**5**
Unit 3	**Examination of Printed Matter-II** Principle and working of different conventional printing processes- letterpress, offset printing, Intaglio Printing, Flexography printing, Thermography printing, Digital printing and Screen printing, Various type of security printing, Identifying features of the printed matter of various printing processes.	**6**
Unit 4	**Examination of Photocopies** Examination of black and white and colour photocopies and their identifying features, process of collection of sample photocopies for the purpose of comparison, examination of fax message,	**5**

	scanned documents, carbon copies and carbonless copies. Difference between Photocopies, Computer Printouts and Scanned copies. Case studies.	
Unit 5	**Legal Aspects in QDE** Report writing including different types of opinions on handwriting, mechanical impressions, computer printers, photocopies and alterations. Importance of no opinion and qualified opinion, marking of demonstrative photographs and preparation of juxta pose charts, reasons for opinion expressed, Debonair of expert in court room, examination in chief, cross examination by defense and cross examination by expert, moot courts and various court rulings.	**5**
Text Books		
1	Kelly, J. S. Lindblom, B. S. (2006). Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group	
2	David Ellen Scientific Examination of Documents, Second edition Taylor & Francis Forensic Science Series	
Reference Books		
1	Koppenhaver, K. M. (2007). Forensic Document Examination. Humana Press	
2	Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998	
3	Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997	
4	Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982	
5	Ellen Davin; "Questioned Documents – Scientific Examination", Taylor & Francis, Washington, 1997.	

FS20.625	**Advanced Questioned Documents Examination II**	**2-0-0-2**
Objective:	To learn various aspects of travel documents, bank documents, security documents, digital documents, bank frauds and forensic accounting	
Unit 1	**Travel and Bank Documents** History of travel documents, International Civil Aviation Organization guidelines for travel documents. Various types of Indian passports and visa and their security features. Detection of Forged passports, Air tickets and travelers cheque. Lottery tickets. Case studies. History and development of banknotes in India, Different denomination of bank notes and their security features. Security features introduced at the time of paper making and printing. Special security features of bank notes of higher denomination. Modus operandi of counterfeiting of bank notes and their detection. Indian coins and their counterfeiting. Case studies.	**5**
Unit 2	**Security Documents and Plastic Cards** Examination of judicial/ non-judicial stamp papers, revenue stamps, postal stamps and special stamps and their security features- watermarks, wire marks, UV features, security fibers, security thread, perforations and high-quality printing. Methods of detection of forged stamp papers/security documents. Examination of the security features of plastic cards- credit cards, debit card, PAN card, Aadhar card, smart card and other plastic cards. Methods of detection of fake plastic cards, electronic transactions. Case studies.	**5**
Unit 3	**Digital Documents** Introduction to Computer forensics, pre-search consideration, acquisition, collection and preservation of volatile/non-volatile data, Imaging & hashing of Digital Evidence, Recovery & Analysis of deleted files/Partitions, Overview of Cryptography, bitcoins, cryptocurrency, digital signatures. Automated signature	**5**

	verification system.	
Unit 4	**Bank Frauds & Forensic Accounting** Types of companies and role of key managerial personnel, Basic accounting principles. Types of banks, Bank instruments-legal tenders, bank notes, FDRs, Cheques/drafts, Bank guarantee, Bonds and certificates. Types of accounts – Saving account, Current account, account opening forms, credentials of introducers, guarantor, D Mat accounts, Public Provident fund, Recurring Deposits, and special accounts, Alterations in Pass Books, Credit Debit/ATM card frauds, Ledger entries, Withdrawal slips, Cheques, Documents for loan, Bank guarantee, Corporate frauds and banking frauds. Case studies. Difference between audit and investigations, skills of a fraud investigator, conducting fraud investigation. Investigation of external fraud schemes-corporate espionage, investment schemes, pyramid or Ponzi schemes, securities fraud, hidden income or assets, insurance fraud and bankruptcy fraud, evaluating frauds, fraud deterrence, money laundering, types of money laundering. Case studies.	**8**
Unit 5	**Laboratory Requirements for QDE** Quality management in document laboratory, safety management in document laboratories, various formats used for recording, chain of custody, Laboratory examination and report writings, NABL guidelines for Accreditation of document laboratories, best practices in document laboratories.	**3**
Text Books		
1	Kelly, J. S. Lindblom, B. S. (2006). Scientific Examinations of Questioned Documents, 2nd edition, CRC Press, Taylor & Francis group	
2	John Sammons; “The basics of Digital Forensics: The Primer for getting started in Digital Forensics”, Elsevier, Syngress, 2014.	
Reference Books		

1	LNJN National Institute of Criminology and Forensic Science, "A Forensic Guide for Crime Investigators – Standard Operating Procedures", LNJN NICFS, 2015.
2	Koppenhaver, K. M. (2007). Forensic Document Examination. Humana Press
3	David Ellen Scientific Examination of Documents, Second edition Taylor & Francis Forensic Science Series
4	Rudolf L. van Renesse, Optical Document Security, Second Edition, Artech House, 1998
5	Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998
6	Eoghan Casey; "Handbook of Digital forensics and Investigation", Elsevier Academic Press, 2009.
7	Manning CA; "Financial Investigation & Forensic Accounting", CRC Press, 1999.
8	Stephen Pedneault, et al; "Forensic Accounting and Fraud Investigation for Non-Experts", John Wiley & Sons, 2012.
9	Madinger J & Zalopany AR; "Money Laundering", CRC Press, 1999.
10	ISO/IEC 17025:2005, NABL 113,113A, 131, guidelines of NABL.

FORENSIC PRACTICAL VI (FORENSIC DOCUMENT EXAMINATION)

FS20.627 **0-0-4-4**

1. Identification of normal / disguised writings.
2. Detection of various types of forgeries.
3. Examination of anonymous letters.
4. Application of Forensic Stylistics in personal identification.
5. Examination of alterations, additions, obliterations, overwriting and erasures, secret writings.
6. Examination of rubber stamp impressions and other mechanical impressions.
7. Examination of charred documents and torn documents.
8. Examination of sequence of strokes.
9. Examination of computer printouts.
10. Examination of photocopies and scanned documents.
11. Examination of Indian Bank Notes.

12. Examination of Travel Documents – Indian Passports and Visas.
13. Examination of Plastic Cards.
14. Examination of judicial/non-judicial stamp paper.
15. Determination of Relative Age of documents.
16. Imaging and Hashing of Digital Evidences.
17. Recovery of deleted files and folders from storage media and their analysis.
18. Preparation of synopsis
19. Various formats of writing of expert's report and reasons thereof
20. Examination of Bank instruments.

FOURTH SEMESTER
DISSERTATION: RESEARCH WORK BASED PROJECT

FS20.602 **Credits: 20**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curricula where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

1. A short account of the activities that were undertaken as part of the project;

2. A statement about the extent to which the project has achieved its stated objectives;

3. A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;

4. Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;

5. Any problems that have arisen and may be useful to document for future reference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the lay out of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

Title or Cover Page

The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.

Acknowledgement(s)

Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.

Abstract

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any.

It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.

While presenting the results, write at length about the the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather, it should lead to generalization of data on the chosen sample.

Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporing or contradicting the present case of research.

Conclusion(s) & Recommendations

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:

1. Did the research project meet its aims (check back to introduction for stated aims)?
2. What are the main findings of the research?
3. Are there any recommendations?
4. Do you have any conclusion on the research process itself?

Implications for Future Research

This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.

Appendices

The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References

References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples:

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect* , **8** (suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

The Layout Guidelines for the Project File & Project Report:

1. A4 size Paper
2. Font: Arial (10 points) or Times New Roman (12 points)
3. Line spacing: 1.5
4. Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT

Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfill the following ***assessment objectives:***

1. Range of Research Methods used to obtain information
2. Execution of Research
3. Data Analysis (Analyze Quantitative/ Qualitative information)
4. Quality Control
5. Conclusions

Assessment Scheme:

Continuous Evaluation:

40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/ mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:

60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.

OUT HOUSE TRAININGS

FS20.604 **Credit: 4**

The students are supposed to prepare a report on the basis of the out- house trainings at FSLs/ CFSLs/University and Research laboratories/ GEQD's for 2-3 weeks and submit a brief report on the work done

Assessment Scheme:

Marks: 100 (70 marks for Out House Trainings Report and 30 marks for viva voce)

Mody University of Science & Technology

M.Sc. Chemistry
Session 2020-2021

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

MASTER OF SCIENCE IN CHEMISTRY
2019-20 Onwards
M. Sc. - Chemistry

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

No. of Seats: 20
M Sc First Year curriculum will be common for ALL specialization

History:

There has been rapid increase in demand of Chemical science professionals. Considering such a requirement, it is proposed to start a new postgraduate programme namely Master of Science in Chemistry with aim of acquiring the knowledge and developing the skills to plan, design and build complex applications which are highly valued in all sectors like pharmaceutical, fertilizer, education, chemical, biotechnology etc.
The first batch of the revised programme in MUST is proposed to be admitted in the session 2019-2020.

Input Qualification:

Bachelor's degree with Chemistry as a subject for three years / six semesters/ B. Sc. Applied Chemistry / B. Sc. Biochemistry / B.Sc. Industrial Chemistry with 50 % of marks.

Evaluation Procedure:

All the Rules and Regulations as provided in the Ordinances and Regulations of Postgraduate Programmes of MUST shall be followed.

M. Sc.-Chemistry
Academic Curriculum (2019-2020 onwards)
First Year-Common to ALL Specialization

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 511	Inorganic Chemistry-I	3	-	-	3	3	25	25	50
	CH 513	Organic Chemistry-I	3	-	-	3	3	25	25	50
	CH 531	Physical Chemistry-I	3	-	-	3	3	25	25	50
	CH 523	Spectroscopy-I	3	-	-	3	3	25	25	50
	CH 551▲/ **BC 531▲▲**	Mathematics for Chemists▲/ **Biomolecules ▲▲**	3	-	-	3	3	25	25	50
	CH 571	Inorganic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 581	Organic Chemistry Laboratory -I	-	-	4	2	4	25	25	50
	CH 591	Physical Chemistry Laboratory -I	-	-	4	2	4	25	25	50
		Sub Total	**15**	-	**12**	**21**	-	-	-	-
		Foreign Language –I ‡	3	-	-	3	-	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 512	Inorganic Chemistry-II	3	-	-	3	3	25	25	50
	CH 514	Organic Chemistry-II	3	-	-	3	3	25	25	50
	CH 532	Physical Chemistry-II	3	-	-	3	2	25	25	50
	CH 524	Spectroscopy-II	3		-	3	3	25	25	50
	CH 536	**Advanced Applications in Chemistry**	3		-	3	3	25	25	50
	CH 562	Inorganic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 572	Organic Chemistry Laboratory -II	-	-	4	2	4	25	25	50
	CH 582	Physical Chemistry Laboratory -II	-	-	4	2	4	25	25	50
		Sub Total	**15**		**16**	**21**	-	-	-	-
		Foreign Language-II‡	3	-	-	3	-	25	25	50

Total Credits 42

▲ *For students without Mathematics in B. Sc.*

▲▲ *For students without Biology in B. Sc.*

‡ *Refer to Foreign Language Section*

M. Sc.-Chemistry
(Specialization in Organic Chemistry)
Two-Year Programme
Academic Curriculum (2019 – 2020 onwards)
Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Autumn Semester	CH 611	Photochemical Reactions	3	-	-	3	3	25	25	50
	CH 623	**Enzyme Chemistry**	3	-	-	3	3	25	25	50
	CH 631	Organic Synthesis-I	3	-	-	3	3	25	25	50
	CH 641	Separation Techniques and Data Analysis	3	-	-	3	3	25	25	50
	CH 651	Environmental and Green Chemistry	3	-	-	3	3	25	25	50
	CH 661	Advanced Organic Chemistry Laboratory-I	-	-	4	2	4	25	25	50
	CH 671	Advanced Organic Chemistry Laboratory-II	-	-	4	2	4	25	25	50
	CH 681	Advanced Organic chemistry Laboratory-III	-	-	4	2	4	25	25	50
		Sub Total	**15**	**-**	**12**	**21**	**-**	-	-	-

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW*	MTE	ETE
Spring Semester	CH 612	Organic Synthesis-II	3	-	-	3	3	25	25	50
	CH 622	Heterocyclic Chemistry	3	-	-	3	3	25	25	50
	CH 632	Chemistry of Natural Products	3	-	-	3	3	25	25	50
	CH 642	Medicinal Chemistry	3	-	-	3	3	25	25	50
	CH 652	Dissertation[#]	-	-	-	10	-	100		
		Sub Total	**12**	**-**	**-**	**22**	**-**	-	-	-

**Course work (CW) would include Regularity, evaluation of assignments, surprise tests, etc.*

[#]Student will perform project work for a period of 2 months and submit two copies of Dissertation report to the department. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.

COURSE DESCRIPTION
M. Sc. (Chemistry)

CH 511 **Inorganic Chemistry-I** **3-0-0-3**

Stereochemistry and Bonding in Main Group Compounds: Walsh diagrams (tri-atomic and penta-atomic molecules), dπ-pπ bond, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules. [9]

Metal-Ligand Equilibria in Solution : Stepwise and overall formation constants and their interaction, trends in stepwise constant, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand. Chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. [8]

Reaction Mechanism of Transition Metal Complexes : Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. [15]

Metal-Ligand Bonding: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. [7]

Suggested Books:

1. Advanced Inorganic Chemistry; F.A. Cotton and G. Wilkinson, 6th Edn. John Wiley & Sons.
2. Inorganic Chemistry; James E. Huheey, 4th Edn. Addison-Wesley Pub. Co.
3. Physical Methods in Inorganic Chemistry; R. S. Drago, International Edn. East-West Press.
4. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.

CH 513 **Organic Chemistry-I** **3-0-0-3**

Nature of Bonding in Organic Molecules: Delocalized chemical bonding, conjugation, cross conjugation, resonance hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckel's rule, energy level of π-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity. [6]

Stereochemistry: Conformational analysis of cycloalkanes, Decalines. Chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, stereospecific and stereoselective synthesis, Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. [10]

Reaction Mechanism, Structure and Reactivity: Type of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation. [8]

Aliphatic Nucleophilic Subsitution: The SN2, SN1 mixed SN1 and SN2 and SET mechanism. Neighbouring group participation mechanism by σ and π bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. The SN i mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Ambident nucleophile, regioselectivity. [5]

Aliphatic Electrophilic Substitution: Bimolecular mechanisms SE2 and SEi, The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving groups and the solvent polarity on the reactivity. [6]

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack. Diazonium coupling, Vilsmeir reaction, Gatterman-Koch reaction. [4]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, 5th Edition. John Wiley & Sons.
2. A Guide book to Mechanism in Organic Chemistry; Peter Sykes, 6th Edition, Orient Longman Ltd..
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Organic Chemistry; R.T. Morrison and R.N. Boyd, Prentice- Hall of India.

6. Organic Reactions and Their Mechanisms; P.S. Kalsi, New Age International Publication.

CH 531 Physical Chemistry-I 3-0-0-3

Quantum Chemistry:

A. Introduction to Exact Quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

B. Approximate Methods: The variation theorem, linear variation principle. Perturbation theory (First order and nondegenerate). Applications of variation method and perturbation theory to the Helium atom.

C.Angular Momentum: Ordinary angular momentum, generalized angular momentum, eigenfucntions for angular momentum, eigenvalues of angular momentum, operator using ladder operators, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

D. Molecular Orbital Theory: Huckel theory of conjugated systems, bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene etc. Introduction to extended Huckel theory.

[15]

Thermodynamics:

A. Classical Thermodynamics: Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; Partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Activity, activity coefficient, Debye Huckel theory for activity coefficient of electrolytic solutions; determination of activity and activity coefficients; ionic strength. Application of phase rule to three component systems, second order phase transitions.

B. Statistical Thermodynamics: Concept of distribution, thermodynamic probability and most probable distribution. Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions-translational, rotational, vibrational and electronic partition functions, Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behaviour of solids-chemical equilibria and equilibrium constant in terms of partition functions, Fermi-Dirac Statistics, distribution law and applications to metal. Bose-Einstein statistics; distribution Law and application to helium.

C. Non Equilibrium Theromodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsager's reciprocity

relations, electrokinetic phenomena, diffusion, electric conduction. [15]

Symmetry and group theory in chemistry: Symmetry elements and symmetry operations, definitions of group, subgroups, relation between orders of a finite group and its subgroup, similarity transformation and classes, point groups, Schonflies symbols, representation of groups by matrices(representation for the Cn, Cnv, Cnh, Dnh, etc. groups to be worked out explicity), character of a representation, the great orthogonality theorem (without proof) and its importance, character tables and their use. [9]

Suggested Books:

1. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
2. Chemical Kinetics; K. J. Laidler, Harper & Row.
3. Physical Chemistry; P. W. Atkins, Oxford University Press.
4. Physical Chemistry; I.N. Levine, Tata McGraw Hill Pub. Co. Ltd.
5. Kinetics and Mechanism of Chemical Transformations; J. Raja Ram and J.C. Kuriacose, MacMillan Indian Ltd.
6. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.

CH 523 Spectroscopy-I 3-0-0-3

Microwave Spectroscopy: Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field, applications [8]

Vibrational Spectroscopy: Symmetry and shapes of AB2, AB3, AB4, AB5 and AB6, mode of bonding of ambidentate ligands, ethylenediamine and diketonato complexes, application of resonance Raman spectroscopy particularly for the study of active sites of metalloproteins. [8]

Raman Spectroscopy: Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle, Resonance Raman spectroscopy, coherent anti stokes Raman spectroscopy (CARS). [8]

Electron Spin Resonance Spectroscopy: Basic principles, zero field splitting and Kramer's degeneracy, factors affecting the 'g' value. Isotropic and anisotropic hyperfine coupling constants spin Hamiltonian, spin densities and Mc Connell relationship, measurement techniques, applications. [7]

Mossbauer Spectroscopy: Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of
(1) Bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin.
(2) Sn^{+2} and Sn^{+4} compounds; nature of M-L bond, coordination number, structure.

(3) Detection of oxidation state and inequivalent MB atoms. [8]

Suggested Books:

1. Modern Spectroscopy, J.M. Hollas, John Viley.
2. NMR, NQR, ESR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
3. Physical Methods in Chemistry, R.S. Drago, Saunders College.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, Mc Graw Hill.
5. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill.
6. Infrared and Raman Spectral : Inorganic and Coordination Compounds K. Nakamoto, Wiley.

CH 551 **Mathematics for Chemists** **3-0-0-3**

Vectors and Matrix Algebra: A. Vectors: Vectors, dot, cross and triple products etc The gradient, divergence and curl, Vector Calculus.

B. Matrix Algebra: Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, Skew-Hermitian, unit, diagonal, unitary etc.) and their properties. Matrix equations: Homogeneous, non-homogeneous linear equations and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

[12]

Differential and Integral Calculus: Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus.Functions of several variables, partial differentiation, co-ordinate transformations (e.g. cartesian to spherical polar).

[8]

Elementary Differential equations: Exact First-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc, second order differential equation and their solutions.

[10]

Permutation and Probability: Permutations and combinations, probability and probability theorems, average, root means square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc) with a general polynomial fit.

[9]

Suggested Books:

1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemists, Doggett and Suiclific, Longman.
3. Mathematical preparation for Physical chemistry: F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Bararnte, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.

CH 561 **Biology for Chemists** **3-0-0-3**

Cell Structure and Functions: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP - the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of bio-macromolecules. [8]

Carbohydrates: Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides; cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway. [8]

Lipid: Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-β-oxidation of fatty acids. [8]

Amino-acids, Peptides and Proteins: Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. Force responsible for holding of secondary structures. α- helix, -β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure, Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination: chemical / enzymatic / mass spectral, racemization / detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH). [8]

Nucleic Acids: Purine and pyrimidine bases of nucleic acids, base pairing via H -bonding. Structure of ribonucleic acid (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside [7]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 571 Inorganic Chemistry Laboratory - I 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $VO(acac)_2$
b) Cis-$K[Cr(C_2O_4)_2(H_2O)_2]$
c) $Na[Cr(NH_3)_2(SCN)_4]$
d) $Mn(acac)_3$
e) $K_3[Fe(C_2O_4)_3]$
f) Prussian Blue, Turnbull's Blue

II. Qualitative and Quantitative Analysis; Two metal ions in cationic/ anionic forms.

Rare elements: Tl, W, Se, Mo, Ti, Zr, Ce, Th, V, U, LiInsolubles: Oxides, sulphates and halides

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, ***G.H. Jeffery and J. Mendham, ELBS.***
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experimens, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 581 Organic Chemistry Laboratory - I 0-0-4-2

*Qualitative Analysis****: Separation, purification and identification of compounds of binary mixture (one liquid and one solid / two liquids / two solids) using TLC and Column Chromatography, chemical tests. IR spectra to be used for functional group identification.***

Organic Synthesis:

a) Acetylation: Acetylation of cholesterol and separation of cholesterylacetate by column chromatography.
b) Oxidation : Adipic acid by chromic acid oxidation of cyclohexanol
c) Grignard reaction : Synthesis of triphenylmethanol from benzoic acid
d) Aldol condensation: Dibenzal acetone from benzaldehyde.
e) Sandmeyer reaction: p-Chlorotoluene from p-toluidine.

Suggested Books:

1. Experiments and Techniques in Organic Chemistry, D.P. Pasto, C. Johnson and M. Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Health.

CH 591 Physical Chemistry Laboratory - I 0-0-4-2

a) To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water).
b) To determine the electron polarization and electron polarizability of a liquid refractometrically.
c) To determine the concentration of a given solution of an optically activesubstance by polarimetric measurements.
d) To determine the specific and molar rotation of an optically active substance, like cane sugar at a number of concentrations and hence findthe intrinsic rotation of the substance.
e) To verify the Beer's law for the solution of the potassium permanganate and determine the concentration of the given aqueous solution of unknown concentration of this salt.
f) To determine the equilibrium constant of the given reaction, potentiometrically.
g) To determine the heat of neutralization of hydrochloric acid using a classical calorimeter.
h) To determine the stability constant of a $FeSCN^{2+}$ complex ion keeping ionic strength constant.
i) To determine the solubility of Ca $(IO_3)_2$ in deionized water and in dilute solution of potassium chloride at room temperature. Also evaluate the thermodynamic solubility product.
j) To determine the formula and the stability constant of a metal ion complex (Lead oxalate complex.)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 512 **Inorganic Chemistry-II** **3-0-0-3**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes: Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of D_q, B and β parameters, charge transfer spectra, spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

[10]

Metal π-Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation,important reactions of metal carbonyls; preparation, bonding, structure and important reaction of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphene as ligand.

[8]

Metal Clusters: Higher boranes, carboranes, metalloboranes and metallocarboranes compounds with metal metal multiple bonds

[5]

Role of metal ions in biological processes: Brief study of various metal ions (Fe, Mo, Cu, Co, Ni, V, Cr, Mn, Zn, Se, B, Na, K and Ca) in biological processes.

[10]

Isopoly and Heteropoly Acids and Salts: Brief study

[6]

Suggested Books:

1. Mechanism of Inorganic Reactions; F. Basalo and R.G. Pearson,Wiley Eastern Ltd.
2. Inorganic Chemistry; D. F. Shriver and P. W. Atkins, ELBS.
3. Advanced Inorganic Chemistry; F. A. Cotton and G. Wilkinson, Edn. John Wiley & Sons.
4. Electronic Absorption Spectroscopy and Related Techniques; D.N. Sathyanarayana, Universities Press (India) Ltd.
5. Inorganic Chemistry; Keith F. Purcell and John C. Kotz, W. B. Sauders Com.
6. Inorganic Reaction Mechanisms; Martin L. Tobe and John Burgess, Longmans.

CH 514 **Organic Chemistry-II** **3-0-0-3**

Aromatic Nucleophilic Substitution: The SNAr, SN1, benzyne and SRN1 mechanism, Reactivity; effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet - Hauser, and Smiles rearrangments. [5]

Free Radical Reactions: Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction. [7]

Addition to Carbon Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio-and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration, Michael reaction, sharpless asymmetric epoxidation. [7]

Addition to Carbon-Hetero Multiple bonds: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acid, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. [7]

Elimination Reactions: The E2, E1 and E1CB mechanisms and their spectrum. Orientation of the double bond. Mechanism and orientation in pyrolytic elimination. [5]

Pericyclic Reactions: Molecular orbital symmetry, Electrocyclic reactions, cycloaddition reactions and sigmatropic reactions, FMO and PMO approach. Correlation diagram, selection rules. Claisen, Cope and aza-Cope rearrangements, Ene reaction [8]

Suggested Books:

1. March's Advanced Organic Chemistry; M.B. Smith & Jerry March, John Wiley & Sons.
2. A Guide Book to Mechanism in Organic Chemistry; Peter Sykes, Orient Longman Ltd.
3. Reaction Mechanism in Organic Chemistry; S. M. Mukherjee and S.P. Singh, Macmillan India Ltd.
4. Mechanism and Theory in Organic Chemistry; T.H. Lowry and K.S. Richardson, Addison – Wesley Longman Inc.
5. Mechanism and Theory in Organic Chemistry; S.M. Mukherjee and S.P. Singh, Mac Millan India.

6. Organic Reactions and Their Mechanisms; P. S. Kalsi, New Age International Pub.

CH 532 Physical Chemistry II 3-0-0-3

Surface Chemistry:

A. Adsorption -Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of dropletes (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), Surface films on liquids (Electro-kinetic phenomenon).

B. Micelles: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization-phase separation and mass action models, solublization, micro emulsion, reverse micelles. [12]

Macromolecules: Polymer-definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimension of various chain structures. [8]

Electrochemistry: Electrochemistry of solutions. Debye-Huckel-Onsager treatment and its extension, ion solvent interactions. Debye-Huckel-Jerum mode. Thermodynamics of electrified interface equations. Derivation of electro capillarity, Lippmann equations (surface excess), methods of determination. Structure of electrified interfaces. Guoy-Chapman, Stern, Graham- Devanathan - Mottwatts, Tobin, Bockris, Devanathan models, Overpotentials, exchange current density, derivation of Butler Volmer equation, Tafel plot. Quantum aspects of charge transfer at electrodes-solution interfaces, quantization of charge transfer, tunneling. Semiconductor interfaces-theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interface. Polarography theory, Ilkovic equation; half wave potential and its significance. [10]

Chemical Dynamics: Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions, treatment of unimolecular reactions. Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and homogenous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method, dynamics of unimolecular reactions (Lindemann Hinshelwood and Rice-Ramsperger-Kassel-Marcus (RRKM) theories of unimolecular reactions). [9]

Suggested Books:

1. Modern Electrochemistry; J.O'M. Bockris and A. K. N. Reddy, Plenum Press.
2. Physical Chemistry; P. W. Atkins Oxford University Press.
3. Physical Chemistry; I. N. Levine, Tata McGraw Hill Pub. Co. Ltd.
4. Statistical Thermodynamics; Andrew Maczek, Oxford University Press.
5. Text Book of Polymer Science; F.W. Billmayer, Wiley-Interscience.
6. Modern Electrochemistry;J.O. M. Bockris and A. K. N. Reddy,Vol. 2 A & B, Second Edition, Plenum Press.
7. Chemical Kinetics; K. J. Laidler, Harper & Row.

CH 524 Spectroscopy-II 3-0-0-3

Ultraviolet and Visible spectroscopy: Various electronic transitions (185-800 nm) Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls. [7]

Infrared Spectroscopy: Instrumentation and Sample handling.Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. [7]

Nuclear Magnetic Resonance Spectroscopy: General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism, mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), Stereochemistry, hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplifications of complex spectranuclear magnetic double resonance, NMR shift reagents, solvent effects. Fourier transform technique, nuclear overhauser effect (NOE). [8]

Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic, olefinic , alkyne, aromatic, heteroaromatic and carbonyl carbon), coupling constants. Two dimension NMR spectroscopy-COSY, NOSY, DEPT, INEPT, APT and INADEQUATE techniques. [6]

Mass Spectrometry: Introduction ion production EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Example of mass spectral fragmentation of organic compounds with [6]

respect to their structure determination.

Problems: Structure elucidation based on spectroscopic data. [5]

Suggested Books:

1. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J. Martin, Heyden.
2. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler adn T.C. Morrill, John Wiley.
3. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
4. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
5. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 534 Colloids and Surface Chemistry 3-0-0-3

Introduction: Introduction: Colloid & surface science - small particles, association structures, surfaces, interfaces, interphases and macromolecules, Survey of technologies reliant upon colloid and surface science. [5]

Particulate Dispersions (solids dispersed in fluids): Single particles, Scattering of electromagnetic radiation from matter, Single particles in external fields (gravity, electrical, etc.), Particle sizing (microscopy, scattering (ILS, DLS, x-ray, neutron), sedimentation, centrifugation, chromatography, acoustics, adsorption), Particles in fluids, Particle trajectories' Transport phenomena; Brownian motion, diffusion; Rheology & rheology of dispersions; Particle-particle interactions, potential energy diagrams; Colloid stability - aqueous, non-aqueous; Consequences of colloid stability (dispersal, flocculation, coagulation, phase separation); Measuring colloid stability; Particle-particle interactions: Dispersion forces (Hamaker theory); Solid-liquid interfaces (charging of surfaces, Electrical Double Layer, adsorption); Particle-particle interactions: Electrostatic forces; Analysis of surface charge and surface chemistry (electrokinetics [electrophoresis, streaming; potential, electro-osmosis, sedimentation potential], electroacoustics, surface spectroscopy, ESR); Particle-particle interactions: steric forces & polymer-mediated forces'' Particle-particle interactions: hydrophobic forces, Analysis of particle interactions (rheometry, AFM, CFM, MASIF, SFA); Flocculation & coagulation - Schulze-Hardy rule, inorganic coagulants, polymeric flocculants ; wastewater treatment

[15]

Wetting & Capillarity: Surface and interfacial tension; Phenomena of liquid surfaces - Phenomena of liquids near solid surfaces Wetting, spreading, penetration, film formation, adhesion, detergency and floation; Contact angles, their analysis and interpretation - component analysis; Surface roughness, chemical heterogeneity, contamination; Surface energy methods on planar, particulate, hollow and fiber surfaces; Relation of capillarity to phase diagrams; Adhesion & Contact mechanics.

[10]

Bubbles and Foams (gases dispersed in liquids): Foam stability; Film drainage; Film rupture; Film rheology; Emulsion and pseudo-emulsion films; Phase diagrams; Measuring thin film properties - disjoining pressure, thin film balance, Frothing agents', Foam breaking, Antifoaming agents & mechanisms, Flotation. [9]

Suggested Books:

1. Colloidal Dispersions: Suspensions, Emulsions, and Foams I.D. Morrison and ***S. Ross (2002, Wiley Interscience, NY; ISBN: 0-471-17625-7).***
2. Basic Principle of Colloid Science, D.H. Everett (1988, Royal Society of Chemistry, London, ISBN : 0-85186-443-0)

CH 562 Inorganic Chemistry Laboratory - II 0-0-4-2

I. Synthesis and characterization of the following inorganic complex compounds

a) $[Co(NH_3)_6]$ $[Co(NO_2)_6]$
b) Cis-$[Co(trien)(NO_2)_2]$ $Cl.H_2O$
c) $Hg[Co(SCN)_4]$
d) $[Co(Py)_2Cl_2]$
e) $[Ni(NH_3)_6]Cl_2$
f) $Ni(dmg)_2$
g) $[Cu(NH_3)_4]SO_4H_2O$

II. Qualitative and Quantitative Analysis; Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.

III. Chromatography; Separation of cations and anions byPaper Chromatography.
Column Chromatography : Ion exchange

Suggested Books:

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R.C. Denney, G.H. Jeffery and J. Mendham, ELBS.
2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly.
3. Inorganic Experiments, J. Derek Woolings, VCH.
4. Microscale Inorganic Chemistry, Z. Szafran, R.M, Pike and M.M. Singh, Wiley.
5. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Van Nostrad

CH 572 Organic Chemistry Laboratory - II 0-0-4-2

I. Organic Synthesis:

a) Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate.
b) Friedel Crafts reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
c) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. The Products may be Characterized by Spectral Techniques
d) Acetoacetic ester Condensation : Synthesis of ethyl-n-butylacetoacetateby A.E.E. condensation

II. Quantitative Analysis:

a) Determination of the percentage or number of hydroxyl groups in anorganic compound by acetylation method.
b) Estimation of amines/phenols using bromate bromide solution/oracetylation method.
c) Determination of lodine and Saponification values of an oil sample.
d) Determination of DO, COD and BOD of water sample.
e) To estimate the percentage of sulphur in the given organic sample byMessenger's method
f) To estimate the percentage of nitrogen in the given organic sample by Kjeldahl's method.
g) To estimate a halogen in the given sample by the alkaline reductionmethod (Modified Stepenow method).

Suggested Books:

1. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
2. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
3. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

CH 582 Physical Chemistry Laboratory - II 0-0-4-2

a) To determine the molecular weight of a macromolecule by viscometry.

b) To determine the order with respect to Ag(I) in the oxidation of Mn(II) by $S_2O_8^{2-}$ and the rate constant for the uncatalyzed reaction.

c) To determine the formation constant for the $[Ce^{IV}\text{-}H_3PO_2]$ intermediate complex and also the rate constant of its decomposition at $45^{\cdot}$ C.

d) Study the effect of hydrogen ion on the $H_2O_2 - I^-$ reaction and to determine the rate constants K_1 and K_2 of the given rate equation.

e) To determine the equivalent conductivity of an electrolyte at infinite dilutions, and to determine the dissociation constant of an acid at different dilutions.

f) To determine the standard electrode potential of the ferrous ferric system by titrating ferrous ammonium sulphates against potassium dichromate potentiometrically.

g) To determine the surface tension of an organic liquid (Ethyl acetate) at different temperatures by double capillary method and hence test the constancy of parachor.

h) To determine the critical micelle concentration of a soap (sodium laurate, sodium palmitate etc.) by surface tension measurements.

i) To determine the solubility and solubility product of sparingly soluble salts e.g. PbSO4, BaSO4) conductometrically.

j) To determine the strength of the given acid conductometrically using standard alkali solution. Select suitable pair for titration. (SA-SB, SA-WB, WA-SB, WA-WB)

Suggested Books:

1. Advanced Practical Physical Chemistry, J. B. Yadav, Goel P.H.
2. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
3. Findley's Practical Physical chemistry, B.P. Levitt, Longman.
4. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.

CH 611 Photochemical Reactions 3-0-0-3

Photochemical Reactions: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. [7]

Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy state; determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions-photo dissociation, gas-phase photolysis. [8]

Photochemistry of Alkene: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes. [5]

Photochemistry of Carbonyl Compounds: Intramolecular reactions of carbonyl compounds-saturated, cyclic and acyclic, β,γ unsaturated and α, β unsaturated compounds, cyclohexadienones. Intermolecular cyloaddition reactions-dimerisations and oxetane formation. [8]

Photochemistry of Aromatic Compounds: Isomerisations, additions and substitutions. [5]

Miscellaneous Photochemical Reactions: Photo-Fries reactions of anilides, Photo-Fries rearrangement, Barton reaction, Singlet molecular Oxygen reaction, Photochemical formation of smog. Photodegradation of polymers. Photochemistry of vision. [6]

Suggested Books:

1. Fundamentals of photochemistry, K.K. Rohtagi - Mukherjee, Wiley-Eastern.
2. Essentials of Molecular Photochemistry, A Gilbert and J. Baggott, Blackwell Scientific Publication.
3. Molecular Photochemistry, N.J. Turro, W.A. Benjamin.
4. Introductory Photochemistry, A. Cox and t. Camp, McGraw Hill.
5. Photochemistry, R.P. Kundall and A. Gilbert. Thomson Nelson.
6. Organic Photochemistry, J. Coxon and B.halton, Cambridge University Press.

CH 621 Bioorganic Chemistry 3-0-0-3

Introduction: Basic considerations, Proximity effects and molecular adaptation. [4]

Enzymes: Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and

enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver - Burk plots, reversible and irreversible inhibition.

[11]

Mechanism of Enzyme Action: Transition-state theory, orientation and Steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chemotrypsin, ribonuclease, lysozyme and carboxypeptidase A. [6]

Kinds of Reactions Catalysed by Enzymes: Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in Isomerisation reactions, β-Cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. [9]

Industrial Applications of Enzymes : Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-Brewing and cheese-making, syrups from corn starch, enzymes as targets for drug design. [9]

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

CH 631 Organic Synthesis-I 3-0-0-3

Reagents and reactions: ***Gilman's reagent – Lithium dimethylcuprate, Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DDC), 1,3-Dithiane (Umpolungreagent), trimethylsilyliodide, Petersons synthesis, Bakers yeast, Organophosphorus compounds (Wittig reaction), Sulphur ylides, Phase transfer catalysts: Quaternary***

ammonium and Phosphonium salts, Crown ethers. Heck reaction, Suzuki coupling and Mukaiyama reaction. [9]

Oxidation: Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated) Alcohols, diols, aldehyde's, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium. (III) Nitrate. [9]

Reduction: Introduction, Different reductive processes. Alkanes, alkenes, alkynes, and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides. Nitro, nitroso, azo and oxime groups. Epoxide, Nitro, Nitroso, azo and oxime groups. Hydrogenolysis. [8]

Rearrangements: General mechanistic considerations-nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements. Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil – Benzillic acid. Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiro reaction. [8]

Metallocenes, Nonbenzenoid Aromatics and Polycyclic Aromatic Compounds: General consideration. Synthesis and reactions of some representative compounds. (Tropone, tropolone, azulene, ferrocene, phenanthrene, fluorine and undone). [5]

Suggested Books:

1. Modern Synthetic Reactions. H.O. House, W.A. Benjamin.
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Uni. Press.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure, J. March. John Wiley.
4. Principles of Organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Advanced Organic Chemistry Part B.F.A. Carey and R.J. Sundberg Plenum Press.
6. Rodd's Chemistry of Carbon Compounds. Ed. S. Coffey, Elsevier

CH 641 Separation Techniques and Data Analysis 3-0-0-3

Adsorption and partition chromatography:
(a) Definition of terms, techniques and chemical concepts
(b) Column adsorption chromatography
(c)Partition chromatography-column, paper and TLC [8]

High performance liquid chromatography -
Introduction, choice of the system, instrumentation and applications. [5]

Gas liquid chromatography: Introduction, choice of the system, instrumentation, qualitative and quantitative analysis of mixtures. [5]

Gel permeation/size exclusion Chromatography: Introduction, theory and applications. [5]

Ion exchangers: Theory, action of ion-exchange resins, ion exchange chromatography, exchange capacity, ion-exchange resins and liquid ion-exchange resins, applications of cation and anion ion exchangers. [5]

Solvent Extraction: - Introduction, principles, factors that influence solvent extraction, ion association complexes and applications of solvent extraction. [5]

Data analysis: Types of errors, propagation of errors, accuracy and precision, and least- square analysis, average standard deviation. [6]

Suggested Books:

1. Principles of Instrumental Analysis; D.A. Skoog, SaundersCollege Publishing.
2. Instrumental Methods of Chemical Analysis; G.W. Ewing, McGraw Hill Books Co.
3. Modern Methods of Chemical Analysis; R. L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, John Wiley.
4. Analytical Chemistry: Principles; J.H. Kennedy, Saunders Holt.

CH 651 Environmental and Green Chemistry 3-0-0-3

Atmosphere: Regions of the atmosphere, Reactions in atmospheric chemistry, Earth's radiation balance, Particles, ion and radicals in the atmosphere, stratospheric chemistry: The chemistry of ozone layer, The role of chemicals in ozone destruction, The green-house effect and Global warming, El-Nino phenomenon. [8]

Hydrosphere : Complexation in natural water and waste-water, Micro-organism in aquatic chemical reactions, Eutrophication, Re-cycle of waste-water in process industry, Treatment of sewage and reuse of water in industry and agriculture, Microbiology mediated redox reactions and Nitrogen transformation by bacteria. [8]

Lithosphere : The terrestrial environment, Soil formations, soil properties (physical/chemical), inorganic and organic components in soil, acid-base and ion-exchange reactions in soil, micro and macro nutrients, nitrogen pathways and NPK in soil, waste and pollutants in soil, waste classification and disposal. [8]

Chemical Toxicology: Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monooxide, nitrogen oxides, sulphur oxides, ozone, PAN, cyanide, pesticides, insecticides and carcinogens. [7]

Green Chemistry: Green chemistry – Green reagent-dimethyl carbonate and other polymer supported reagents, green catalysts-acid catalyst, basic catalysts, oxidation catalysts, polymer supported catalysts, photocatalyst, green synthesis-phase transfer catalyst. Microwave induction, ultrasound assisted, green solvents- reactions in acidic and neutral ionic liquids, green synthesis of polycarbonates, paracetamol, ibuprofen , citral, urethane, adipic acid and styrene. [8]

Suggested Books:

1. Green Chemistry, P. Anastas, RSC.
2. Environmental Chemistry, S.E. Manahan, Lewis Pub.
3. Environmental Chemistry, Sharma and Kaur, Krishna Pub.
4. Environmental Chemistry, A.K. De, Wiley Eastern
5. Environmental Chemistry, C. Baird, W.H. Freem

CH 661 Advanced Organic Chemistry Laboratory - I 0-0-4-2

I. Qualitative Analysis: Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid or two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

II. Multi –step Synthesis of Organic Compounds: The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques. (Any Five)

a) Photochemical reaction Benzophenone - Benzpinacol - Benzpinacolone
b) Beckmann rearrangement : Benzanilide from benzene Benzene - ***Benzophenone - Benzphenone oxime - Benzanilide***
c) Benzilic acid rearrangement : Benzilic acid from benzoin Benzoin - Benzil ***-Benzilic acid.***
d) Synthesis of heterocyclic compounds Skraup synthesis: Preparation of quinoline from aniline Fisher Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine.
e) Enzymatic synthesis; Enzymatic reduction : reduction of ethyl acetoacetate using Baker's yeast to yield enantiomeric excess of S (+) ehtyl-3- hydroxybutanoate and determine its optical purity.
f) Biosynthesis of ethanol from sucrose.
g) Synthesis using microwave Alkylation of diethyl malonate with benzyl chloride.
h) Synthesis using phase transfer catalyst. Alkylation of diethyl malonate or ethylacetoacetate with an alkyl halide.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R.Tatchell,J.Wiley

CH 671 Advanced Organic Chemistry Laboratory - II 0-0-4-2

Extraction of Organic Compounds from Natural Sources. (Any Five)

a) Isolation of caffeine from tea leaves.
b) Isolation of benzoic acid from tea leaves.
c) Isolation of casein from milk (the students are required to try some typicalcolour reactions of proteins).
d) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf values reported).
e) Isolation of nicotine dipicrate from tobacco.
f) Isolation of cinchonine from cinchona bark.
g) Isolation of piperine from black pepper.
h) Isolation of lycopene from tomatoes.
i) Isolation of β-carotene from carrots.
j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid).
k) Isolation of eugenol from clove.
l) Isolation of (+) limonine from citrus rind.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

CH 681 Advanced Organic Chemistry Laboratory - III 0-0-4-2

I. Separation and identification of the sugars and Amino acids present in the givenmixture by paper chromatography and determination of Rf values

II. Identification of organic compound with the help of spectral datas.

Suggested Books:

1. Handbook of Organic Analysis-qualitative and Quantitative. H. Clark, Adward Arnold.
2. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley
3. Practical NMR Spectroscopy, M.L. Martin. J.J. Delpeuch and G.J.

Martin, Heyden.
4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, ***G.C. Bassler adn T.C. Morrill, John Wiley.***
5. Introduction to NMR spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
6. Application of Spectroscopy of Organic Compounds, J.R. Dyer Prentice Hall.
7. Spectroscopic Methods in Organic Chemistry D.H. Williams, I. Fleming, Tata McGraw-Hill.

CH 612 Organic Synthesis-II 3-0-0-3

Disconnection Approach: An introduction to synthons and synthetic equivalents. Disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reaction, amine synthesis. [8]

Protecting Groups: Principle of protection of alcohol, amine, carbonyl and carboxyl groups. [6]

One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic Nitro compounds in organic synthesis. [6]

Two Group C-C Disconnections: Diels-Alder Reaction, 1,3-difunctionalised compounds, α, β- unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation. [6]

Ring Synthesis: Saturated heterocycles, synthesis of 3-, 4-, 5- and 6-membered rings. aromatic heterocycles in organic synthesis. [5]

Synthesis of Some Complex Molecules: application of the above in the synthesis of following compounds : Camphor, Longifoline, Cortisone, Reserpine, Vitamin D, Juvabione, Aphidicolin and Fredericamycin A. [8]

Suggested Books:

1. Designing Organic Synthesis, S.Warren. Wiley.
2. Organic Synthesis-Concept, Methods and Starting Materials, J. Fuhrhop.
3. Some Modern Methods of Organic Synthesis. W. carruthers,Cambridge Univ. Press.
4. Modern Synthetic Reactions H.O. House, W.A Benjamin.
5. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March. Wiley.
6. Principles, of Organic Chemistry Part B. F.A. Carey and R.J. Sundberg, Plenum Press.

CH 622 Heterocyclic Chemistry 3-0-0-3

Aromatic Heterocycles: Nomenclature, General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra. Empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltations). Heteroaromatic reactivity and tautomerism in aromatic heterocycles. [6]

Non-aromatic Heterocycles: Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1, 3-diaxial interaction. Stereo-electronic effects, anomeric and related effects, Attractive interactions-hydrogen bonding and intermolecular nucleophilic electrophilic interactions. Heterocyclic Synthesis Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions. [7]

Small Ring Heterocycles: Three-membered and four-membered heterocycles-synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes. [4]

Benzo-Fused Five-Membered Heterocycles: Synthesis and reactions including medicinal applications of benzopyrroles, benzofuranes and benzothiophenes. [4]

Meso - ionic Heterocycles: General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. [4]

Six - Membered Heterocycles with one Heteroatom: Synthesis and reactions of pyrilium salts and pyrones and their comparison with pyridinium & thiopyrilium salts and pyridones. Synthesis and reactions of quinolinium and benzopyrylium salts, coumarins and chromones. [6]

Six Membered Heterocycles with Two Heteroatoms: Synthesis and reactions of diazines, triazines, tetrazines and thiazines. Seven-and Large-Membered Heterocycles Synthesis and reactions of azepines, oxepines, thiepines, diazepines thiazepines, azocines, diazocines, dioxocines and dithiocines. [8]

Suggested Books:

1. Heterocyclic Chemistry Vol. 1-3, R.R. Gupta, M. Kumar and V.Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Techinal.

5. Contemporary Hetrocyclic Chemistry, G,.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M.Acheson, Johnwiely.
7. Comprehensive Heterocyclic Chemistry, A.R. Katrizky and C.W. Rees, eds. Pergamon Press.

CH 632 Chemistry of Natural Products 3-0-0-3

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Gereniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene. [9]

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of the following: Ephedrine, (+)-Coniine, Nicotine, Atropine, Quinine and Morphine. [9]

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone, Biosynthesis of Steroids. [9]

Flavonoids and Anthocyanins: Occurrence, nomenclature, biogenesis and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidine, Hirsutidin. [9]

Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll. [3]

Suggested Books:

1. Natural Products : Chemistry and Biological Significance, J. Mann, ***R.S. Davidson, J.B. Hobbs, D.V. Banthrope adn J.B. Harbome, Longman, Esses.***
2. Organic Chemistry: Vol. 2 1L. Finar, ELBS
3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A. Marston. harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm. Harwood AcademicPublishers.
7. New Trends in Natural Product chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Insecticides of Natural Origin, Sukh Dev, Harwood Academic

Publishers.

CH 642 Medicinal Chemistry 3-0-0-3

Structure and activity : Relationship between chemical structure and biological activity (SAR). Receptor Site Theory. Approaches to drug design. Introduction to combinatorial synthesis in drug discovery. [9]

Antibiotics and antibacterials: Introduction (i) Antibiotic β-Lactam type Penicillins, Cephalosporins (ii) Antitubercular Streptomycin(iii)Broad spectrumantibiotics-Tetracyclines (iv)Anticancer-Dactinomycin (Actinomycin D) (v)Antifungal –polyenes(vi) Antibacterial Ciprofloxacin,Norfloxacin(vii) Antiviral – Acyclovir [9]

Antimalarials: Chemotherapy of malaria. SAR. Chloroquine, Chloroguanide and Mefloquine. [4]

Non-steroidal Anti-inflammatory Drugs : Diclofenac Sodium, Ibuprofen and Netopam [4]

Antihistaminic and antiasthmatic agents: Terfenadine,Cinnarizine, Salbutamol and Beclomethasone dipropionate [4]

Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurines. Recent development in cancer chemotherapy. Hormone and natural products. [9]

Suggested Books:

1. Medicinal Chemistry; Burger, Wiley Interscience Publications.
2. Principles of Medicinal Chemistry; W. O. Foye Lea & Febiger:Varghese Publishing House
3. The Organic Chemistry of Drug Synthesis; D. Lednicer and L. A.Mitscher Wiley Interscience.

CH 536 Advanced Applications in Chemistry 3-0-0-3

Supramolecules: Basic concept and definition, nature of supramolecular interactions, Host-guest interaction, Cation-binding hosts, Anion-binding hosts and Neutral molecules. Molecular recognition by Crown Ethers, Cyclodextrin, Calixarene. The Art of Building Supermolecules: Fullerenes, Dendrimers, Rotaxanes, Catenanes. Applications of Supramolecular Chemistry: Molecular Devices and Nanotechnology. Biological supramolecular systems. [8]

Nanomaterials: Beginning of nanoscience, Moore's law, Nanomaterials,Properties of nanomaterials, seeing Nano objects, preparation of nanomaterials, From nanoscience to nanotechnology, graphene, & CNT. Application of nanomaterials: Nano cosmetics, Textiles, Nano sensors, drug delivery, Cancer therapy, Tissue engineering, water purification, Nano computers, DPN, MRI, Nano catalysis, nanomaterials and energy. [8]

Green chemistry: Goalsof Green Chemistry. Basic principles of Green Chemistry. Examples of green synthesis/reaction: Green starting materials, Green reagents, Green solvents (super critical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent, PEG). Green catalysis, Green synthesis- Real world cases.Future Trends in Green Chemistry: Combinatorial green chemistry, Proliferation of solvent less reactions and Biocatalysts. [7]

Organic Electronic Materials: Advantages of Organic Electronics, electronic structure of materials, electrical properties of materials and optical absorption, electrically conducting polymers, concepts of polarons and solitons, Theory of charge transport and mobility in organic materials, basic electronic devices: organic solar cells, organics thin film transistors, Organic ElectroChemical Transistors (OECTs), Organic Field Effect Transistors (OFETs). Organic semiconductors, organic light-emitting diodes, flexible organic light emitting diode (OLED), memories, organic electronics in sensors and biotechnology. [8]

Computer Applications in Chemistry:Idea and use of word processing software including documents, presentation and graphics. Handling numeric data: spreadsheet software (Excel), simple calculations, statistical analysis, plotting graphs using a spreadsheet.Principles of computational chemistry, Computer-based molecular design, molecular mechanical and quantum mechanical models. Idea and use of scientific software- ChemOffice, ISIS Draw, ArgusLab, MOLDEN, Dalton, and Gaussian. [8]

Suggested Books:

Text Books:

1) Supramolecular Chemistry by J. W. Steed & J. L. Atwood, 2nd Edn John Wiley, 2009

2) J. M. Lehn, Supramolecular Chemistry, VCH, Weinheim, 1995.

3) Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.

4) Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998.

5) Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001

6) NANOWORLD-An introduction to nanoscience and technology by C N R Rao.

Reference Books:

1) Nanoscience and Nanotechnology by T. Pradeep, McGraw Hill Education.

2) Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.

1) Supramolecular Chemistry – Fundamentals and Applications by Kunitake, T. and Ariga, K. Berlin: Springer-Verlag Heidelberg, 2006. 208 p. ISBN 978-3-540-01298-6.

2) Renewables-Based Technology: Sustainability Assessment; Dewulf, J.; Langenhove, H. V., Eds.; John Wiley & Sons, Ltd.: Chichester, UK, 2006.

BC 531 Biomolecules 3-0-0-3

Basic Concept of Biomolecules: Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Importance of buffers with reference to biological aspect, Isoelectric points, pK values, Morality and Molality, Thermodynamics law, Free energy, Gibbs law, High energy compounds and their biological importance**.** [5]

Carbohydrates: Structure, Classification and important reactions of monosaccharides and their derivatives, Synthesis of biologically important structural and Storage carbohydrates.Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway [8]

Lipids: Structure and classification of lipids, Fatty acids, Properties of fatty acids, Glycerolipids, Sphingolipids, Cholesterol and their biosynthesis, Alkaloids, Steroids and Flavonoids- properties and synthesis,Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Lipids as signal molecules, Alpha, beta and omega-oxidation, Lipopolysaccharides- structure and function. Lipoproteins-composition and function, role in atherosclerosis. [7]

Proteins: Structural unit of proteins, Classification of amino acids, Properties of amino acids on the basis of $-NH_2$ and –COOH group, Protein structure and classification, Ramachandran plots, Stability of proteins, Folding and unfolding of proteins, Polypeptide synthesis and sequencing, Protein evolution, Structure and function of globular and fibrous proteins. Amino acid metabolism-degradation and biosynthesis of amino acids.Classification of enzymes, MichelisMenten equation Km value, Linweaver-Burk equation. [8]

Nucleic Acids: Nucleosides and nucleotides, Nucleic acid classification, Bond stability between purines and pyrimidines, Structure and reactions of purines and pyrimidines and their derivatives, Metabolism of purines and pyrimidines, Protein and nucleic acid interactions. [6]

Vitamins: Role of vitamins in growth and differentiation in human beings, Chemistry of fat and water-soluble vitamins, Vitamins as co-enzymes. [5]

Suggested Books:

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

CH 623 Enzyme Chemistry 3-0-0-3

Introduction: Units of activity, Specific activity of enzymes and methods of enzyme assay, Enzyme specificity, Uni substrate enzyme kinetics, Factors affecting the rate of enzyme catalyzed reaction, Derivation of Michelis-Menten equation, Significance of V_{max} and $K_{m,}$ Enzyme inhibition- type of inhibition, Competitive non Competitive and uncompetitive kinetics.Proximity effects and molecular adaptation. [5]

Enzyme Catalytic Efficiency: Factors associated with catalytic efficiency such as proximity, Orientation-distortion of strain, base nucleophilic catalysis with equation, Protein ligand binding co-operativity, Hill and Sat Chard plot protein sequencing. [6]

Allosteric Theory: Allosteric enzymes, Sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of Allosteric enzyme and their significance. [6]

Multi-enzyme System: Occurrence, Isolation and their properties, Polygenic nature of multi-enzyme systems, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, Coenzymes and co-factors, Detailed mechanism of catalysis of serine proteases, ribonuclease and triose phosphate isomerase. [8]

General Mechanism of Enzyme Regulation: Feedback inhibition and feed forward stimulation, Enzyme repression, Induction and degradation, Control of enzyme activity by products and substrates, Reversible and irreversible covalent modifications enzymes, Enzyme engineering and its applications. [8]

IndustrialApplicationsofEnzymes: [6]
Techniquesandmethodsofimmobilizationof enzymes, effectofimmobilizationonenzymeactivity,applicationofimmobilizedenzymes, useofenzymes infood anddrinkindustry-Brewing andcheese-making, syrupsfromcorn starch,enzymesastargetsfordrug design.

Suggested Books:

1. Bioorganic Chemistry: A chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer Verlag.
2. Understanding Enzymes, Trevor Palmer, Prentice Hall.
3. Enzyme Chemistry: Impact and applications, Ed. Collin J suckling, Chapman and Hall.
4. Enzyme Mechanisms Ed. M.I. Page and A Williams, Royal Society of Chemistry.
5. Fundamentals of Enzymology, N.C. Price and L. Stevens. Oxford University Press.
6. Immobilized Enzymes: An Introduction and Applications in Biotechnology, Michael B. Trevan, John Wiley.
7. Enzymatic Reaction Mechanisms. C. Walsh. W.H. Freeman.
8. Enzyme Structure and Mechanism, A Fersht, W.H. Freeman.
9. Biochemistry: The Chemical Reactions of Living Cells, D.E. Metzler, Academic Press.

Mody University of Science & Technology

M.Sc. Physics

Session 2020-2021

Curriculum Structure

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

M.Sc. Physics

Academic Curriculum (2015 – 16 onwards)

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 511	Mathematical Physics-I	3	1	0	4	3	25	25	50
	PH 521	Classical Mechanics	3	0	0	3	3	25	25	50
	PH 531	Classical Electrodynamics and Plasma Physics	3	1	0	4	3	25	25	50
	PH 541	Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 551	Statistical Physics and Thermodynamics	3	1	0	4	3	25	25	50
	PH 561	General Physics and Optics Laboratory	0	0	4	2	4	100		
	PH 571	Programming Language Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**4**	**8**	**23**	**-**	**-**		
		Foreign Language-I (Non-Credit)‡	3	0	0	3	3	25	25	50

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 512	Mathematical Physics -II	3	1	0	4	3	25	25	50
	PH 522	Atomic & Molecular Physics and Lasers	3	1	0	4	3	25	25	50
	PH 532	Condensed Matter Physics	3	0	0	3	3	25	25	50
	PH 542	Computational Physics	3	0	0	3	3	25	25	50
	PH 552	Elements of Nuclear and Particle Physics	3	0	0	3	3	25	25	50
	PH 562	Computational Physics Laboratory	0	0	4	2	4	100		
	PH 572	Advance Physics Laboratory	0	0	4	2	4	100		
	Sub Total		**15**	**2**	**8**	**21**	**-**	**-**		
		Foreign Language-II (Non-Credit)‡	3	0	0	3	3	25	25	50

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Autumn Semester	PH 611	Semiconductor Physics and Devices	3	1	0	4	3	25	25	50
	PH 621	Digital Electronics	3	1	0	4	3	25	25	50
	PH 631	Physics of Nano-Materials	3	0	0	3	3	25	25	50
	PH 641	Ancient Indian Science	2	0	0	2	3	25	25	50
	PH 651	Electronics Laboratory	0	0	4	2	4	100		
		Specialized Paper –I	3	1	0	4	3	25	25	50
		Specialized Paper –II	3	1	0	4	3	25	25	50
	Sub Total		**17**	**4**	**4**	**23**	**-**	**-**		

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
			L	T	P		Hours	CW*	MTE**	ETE
Spring Semester	PH 612	Advance Quantum Mechanics	3	1	0	4	3	25	25	50
	PH 622	Instrumentation and Characterization Techniques	3	0	0	3	3	25	25	50
		Specialized Paper –III	3	1	0	4	3	25	25	50
		Specialized Paper –IV	3	1	0	4	3	25	25	50
	PH 682	Project	0	0	0	8	-	100		
	Sub Total		**12**	**3**	**0**	**23**	**-**	**-**		

Total Credits = 90

Specializations:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW*	MTE**	ETE
A	**Nanoscience**								
PH 661	Elements of Nanoscience	3	1	0	4	3	25	25	50
PH 671	Nano-Fabrication Techniques	3	1	0	4	3	25	25	50
PH 632	CNT and Sensor Applications	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
B	**Photonics**								
PH 681	Advance Opto-Electronics	3	1	0	4	3	25	25	50
PH 691	Fiber and Non-linear Optics	3	1	0	4	3	25	25	50
PH 652	Quantum Optics	3	1	0	4	3	25	25	50
PH 642	Nanophotonics	3	1	0	4	3	25	25	50
C	**Condensed Matter Physics**								
PH 613	Advance Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 623	Soft Condensed Matter Physics	3	1	0	4	3	25	25	50
PH 662	Material Science	3	1	0	4	3	25	25	50
PH 672	Smart Materials	3	1	0	4	3	25	25	50

CW: *Course Work;* ***MTE:*** *Mid Term Examination;* ***ETE:*** *End Term Examination*

* *Course work (CW) would include regularity, evaluation of assignments, surprise tests, etc.*

[#]*Student will perform* ***project work*** *for a period of 2 months and submit two copies of Dissertation report to the Ddepartment. Presentation and viva voce of project report will be conducted at the end of the spring semester. Dissertation report and presentation will carry 50% weightage each.*

Detailed Syllabus (M.Sc. Physics):

PH 511 **Mathematical Physics-I** **3 - 1 - 0 - 4**

1. **Vector Analysis:** Gradient, divergence, Curl and their representations in Orthogonal curvilinear coordinates. [11]

   Linear algebra: Linear vector spaces, linear operators, dual space, ket and bra notation, Hilbert space, Metric space, Function spaces.

   Matrices: The algebra of matrices, Special matrices, Rank of a matrix. Elementary transformations, Elementary matrices, Equivalent matrices, Solution of linear equations. Linear transformations, Change of Basis, Eigenvalues and eigenvectors of matrices, The Cayley-Hamilton theorem, Diagonalisation of matrices.

2. **Tensor Analysis:** Tensor analysis, Coordinate transformations, scalars, Covariant and Contravariant tensors, Addition, Subtraction, Outer product, Inner product and Contraction, Symmetric and antisymmetric tensors, Quotient law, Metric tensor, Conjugate tensor. [8]

3. Partial Order Differential Equations and Special Functions: Separation of variables-ordinary differential equations, singular points, Bessel, Leguerre, Legendre, Hermite equations. Recurrence relations, generating functions and Rodrigues formulae for the Bessel, Leguerre, Legendre and Hermite functions [11]

4. **Greens Functions:** Sturm-Lioville operators and eigen values and eigen functions. Dirac delta functions-properties and representations, Definitions and physical significance of Greens functions, Eigen function expansion of Greens function, Greens function for ordinary differential operators [9]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990.
3. M.D. Greenberg:Advanced Engineering Mathematics, 2nd Edition, PHI, New Jersey, 1998.
4. B.D. Gupta: Mathematical Physics, 3rdedition, Vikas Publishing House, New Delhi. , 2006.

Reference Books:

1. E. Kreyszig: Advanced Engineering Mathematics, 8th ed., Wiley, New York, 1999.
2. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
3. Satyaprakash, Mathematical Physics, Sultan Chand & sons, 6th edition, New Delhi, 2004.

PH 521 **Classical Mechanics** **3 - 0 - 0 - 3**

1. **Fundamental Principles and Lagrangian Formulation and Applications:** Newtonian Mechanics: Mechanics of a particle and system of particles, Conservation laws, Constraints, Generalized coordinates, D' Alembert's principle and Lagrange's equation, Hamilton's Variational principle, **Lagrangian Problems:** Double Pendulum, Spherical pendulum, Cylinder rolling down an inclined plane. [8]

2. **Hamiltonian Formulation and Application:** Hamilton's equations, cyclic variables, Principle of least action, **Hamiltonian Problems:** motion of a particle in a central force field, charged particle moving in an electromagnetic field, Equations of motion and first integrals, Kepler's laws, Scattering by central potential, Transformation from center of mass to laboratory frame. [10]

3. **Rigid Body Dynamics and Canonical Transformations:** Rigid body motion – Kinematics - Euler's angles - Angular momentum and kinetic Energy – Moment of inertia tensor - Euler's equations of motion –Canonical transformation and their generators – simple examples, Poisson brackets. [8]

4. **Jacobi Theory and Theory of Small Oscillations :** Hamilton-Jacobi equations – application to Linear Harmonic Oscillator problem - Action Angle variables - Application to Kepler's problem - Oscillatory motion - Theory of small oscillation –Two coupled pendulums, Vibrations of a triatomic molecule. [8]

5. **Relativity:** Reviews of basic ideas of special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence [5]

Text Books:

1. H. Goldstein, C.Poole and J.Safko; Classical Mechanics, Pearson, New Delhi, 3rd ed 2002.
2. N.C.Rana and P.S.Joag; Classical Mechanics, Tata Mc: Graw Hill, New Delhi, 1991.

Reference Books:

1. L. D. Landau E.M. Lifshitz; Mechanics: Volume 1 (Course of Theoretical Physics), Pergamon Press Ltd, 2nd ed. 1969.

PH 531 Classical Electrodynamics and Plasma Physics 3 - 1 - 0 - 4

1. **Electrostatics:** Electric potential, Poisson and Laplace‟sequations.Boundary value problems, Uniqueness theorems, Green‟stheorem.Method of images, Method of separation of variables (Cartesian Coordinates, Spherical and Cylindrical Coordinates), Multipole expansion. [6]

2. **Electromagnetic Waves:** Maxwell‟s equations, Boundary conditions, Wave equation and its complex notation, Electromagnetic waves in vacuum, Electromagnetic waves in non-conducting and linear media, Electromagnetic waves in linear conducting media. Poynting theorem, Reflection, refraction and polarization of electromagnetic waves, [6]

3. **Waveguides and Cavities:** Metallic boundary conditions, Electromagnetic waves confined to hallow metallic pipe,TE, TM and TEM modes, TE and TM modes in rectangular waveguides, Bessel‟s function, TE and TM modes in cylindrical waveguides, Dielectric waveguides, TE and TM modes in rectangular and cylindrical Resonant cavities. [6]

4. **Potential, Fields and Radiations:**

   Scalar and vector potentials, Gauge transformation, Coulomb and Lorentz gauge, Retarded potential, Lienard-Wiechert potentials, Fields due to moving charge, Power radiated by an accelerated charge and angular distribution, Bremstrahlung Cerenkov and Synchrotron radiations. [6]

5. **Relativistic Electrodynamics:** Four vectors, Lorentz transformation in terms of Four vectors, Lorentz transformation matrix, Transformation of electromagnetic fields, Field Tensor, Dual field strength tensor, Maxwell's equations in terms of strength tensors, [6]

6. **Plasma Physics:** Elementary Concepts: Plasma Oscillations, Debye Shielding, Plasma Parameters, Magnetoplasma, Plasma Confinement, Motion of charged particles in electric and magnetic fields, Adiabatic Invariants Wave in Plasma: Polarisation, Phase Velocity, Group Velocity, Cut-offs, Resonance for Electromagnetic Wave Propagating Parallel and Perpendicular to the Magnetic Field Propagation at Finite Angle. [9]

Text Books:

1. David J. Griffith; Introduction to Electrodynamics, PHI Private Limited, 1999
2. John D. Jackson; Classical Electrodynamics, Wiley Eastern Limited, 1998
3. F.F. Chen; Plasma Physics and Controlled Fusion,Springer,2006

Reference Books:

1. Edward C. Jordan and Heith G. Balmain; Electromagnetic Waves and Radiating Systems, PHI, 1991
2. W.K.H. Panofsky and M. Phillips; Classical Electricity and Magnetism, Dover Publications; 2nd Ed., 2005
3. J A Bittencourt; Fundamentals of Plasma Physics, 3rd Ed, Springer, 2004

PH 541 **Quantum Mechanics** **3 - 1 - 0 - 4**

1. Limitations of classical mechanics, development of Schrodinger equation, continuity equation, wave packet, admissible wave functions, stationary states. Formalism of wave mechanics, expectation values, quantum mechanical operators for position and momentum in the coordinate representation, Construction of quantum mechanical operators for other dynamical variables from those of position and momentum, Ehrenfest‟s theorem, momentum Eigen functions in the coordinate representation, box normalization and Dirac delta function. Coordinate and momentum representations, Schrodinger equation in momentum representation [10]

2. Brief revision of linear vector spaces, inner or scalar product, Schwarz inequality, state vectors, general formalism of operator mechanics vector, operator algebra, commutation relations, Eigen values and Eigen vectors, Hermitian operators degeneracy, orthogonality eigenvectors of Hermitian operators, noncommutativity of two operators and uncertainty in the simultaneous measurements of the corresponding dynamical variables, the fundamental expansion postulate, representation of state vector, Dirac's bra-ket notations. Matrix representation of operators, change of basis, unitary transformations, quantum dynamics, Schrodinger, Heisenberg and interaction picture. [10]

3. Solution of Schrodinger equation for simple problems, 1-D Square well, step and barrier potentials, 1-D harmonic oscillator, zero point energy. harmonic oscillator problem by operator method. Angular momentum operator, commutation relations, expression for L2 operator in spherical polar coordinates, Role of L2 operators in central force problem, eigen value problem for L2 , separation of Schrodinger equation in radial and angular parts, solution of radial equation for hydrogen atom, 3-d square well potential, parity of wave function, parity operator. [10]

4. Generalized angular momentum, raising and lowering operators, matrices for J2, Jx, Jy, Jz operators, Pauli spin matrices, Addition of angular momenta, Clebich-Gordon Co-efficient, spin angular momentum, spin momentum functions. [9]

Text Books:

1. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
2. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

Reference Books:

1. L.I.Schiff; Quantum Mechanics, TMH, 2010.
2. Mathews and Venkatesan; A Textbook of Quantum Mechanics, TMH 1976,
3. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
4. J.J.Sakurai; Modern quantum Mechanics, Addison Wesley; 2 ed., 2010

PH 551 Statistical Physics and Thermodynamics 3 - 1 - 0 - 4

1. **Review: (Elementary Probability Theory & Thermodynamics):** Preliminary concepts, Random walk problem, Binomial distribution, mean values, standard deviation, various moments, Gaussian distribution, Poisson distribution, mean values. Extensive and intensive variables, laws of thermodynamics, thermodynamic potentials, Maxwell relations, applications of thermodynamics to (a) ideal gas, (b) magnetic material, and (c) dielectric material. Laws of thermodynamics [4]

2. **Statistical Description of System of Particles and Statistical Thermodynamics:** State of a system, microstates, ensemble, basic postulates, behavior of density of states, density of state for ideal gas in classical limit. Thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of density of states on external parameters, Statistical calculation of thermodynamic variables [10]

3. **Classical Statistical Mechanics :** Microcanonical ensembles and their Equivalence, Canonical and grand canonical ensembles, partition function, thermodynamic variables in terms of partition function and grand partition function, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem. Maxwell-Boltzmann gas velocity and speed distribution. Chemical potential, Free energy and connection with thermodynamic variables, First and Second order phase transition; phase equilibrium. [10]

4. **Quantum Statistical Mechanics :** Formulation of quantum statistics, Density Matrix, ensembles in quantum statistical mechanics, simple applications of density matrix. The theory of simple gases : Maxwell-Boltzmann, Bose-Einstein, Fermi Dirac gases. Statistics of occupation numbers, Evaluation of partition functions, Ideal gases in the classical limit. [10]

5. **Ideal Bose System :** Thermodynamic behavior of an Ideal Bose gas, Bose-Einstein condensation. Thermodynamics of Black body radiation, Stefan-Boltzmann law, Wien's displacement law. [5]

Text Books:

1. B. B. Laud; Fundamentals of Statistical Mechanics, New Age International, 2007.
2. F. Reif; Fundamentals of Statistical and Thermal Physics, McGraw Hill, 1965
3. S. Loknathan&Gambhir; Statistical and Thermal Physics: An Introduction, PHI Learning, 1991.

Reference Books:

1. K. Huang; Statistical Mechanics, 2nd ed, John Wiley & Sons, 1987.
2. R. K.Pathria, Paul D. Beale, Statistical Mechanics;Butterworth-Heinemann Press, 2011.
3. L. D. Landau and E. M. Lifshitz; Statistical Physics: Volume 5 (Course of Theoretical Physics), 3rd ed Butterworth-Heinemann Press, 1980.

PH 561 General Physics and Optics Laboratory 0-0-4-2

Experiments based on Mechanics, Optics, Basic Electronics, PH 531.

PH 571 Programming Language Laboratory 0-0-4-2

Programming based on C^{++} related to Physics.

PH 512 Mathematical Physics -II 3 - 1 - 0 - 4

1. **Complex Analysis :**Analyticity and Cauchy-Reimann Conditions, Cauchy's integral theorem and formula, Taylor's series and Laurent's series expansion, Zeros and singular points, Multivalued functions, Branch Points and Cuts, Riemann Sheets and surfaces, Residues, Cauchy's Residue theorem, Evaluation of definite integrals. [11]

2. **Group Theory:** Definition of groups e.g. matrix groups- transformation groups , Representation of groups: matrix, faithful, Unitary, reducible and irreducible representations' Lie groups and algebras: Definition of Lie groups with examples- O(3), SO(3), SU (2) groups- representation of SU(2), SO(3). [9]

3. **Fourier Series & Transforms**: Integral transforms, Fourier transform, Sine, Cosine and Complex transforms with examples, Properties of Fourier Transforms, Transforms of derivatives [9]

4. **Laplace Transforms:** Convolution Theorems, Momentum representation, Laplace transform, Properties and examples of Laplace Transform, Laplace transforms of derivatives, Use for solving differential equations [10]

Text Books:

1. G. Arfken and H.J. Weber: Mathematical Methods for Physicists, 5th Ed., Harcourt (India), New Delhi, 2001.
2. M. R. Spiegel: Theory and Problems of Complex Variables, Schaum's outline series, 6thed., 2008
3. P.K. Chattopadhyay: Mathematical Physics, Wiley Eastern, Madras, 1990,
4. B.D. Gupta: Mathematical Physics, 3rd edition, Vikas Publishing House , New Delhi. , 2006,

Reference Books:

1. T. Das and S.K. Sharma: Mathematical Methods in Classical and Quantum Physics, University Press India, 1998.
2. E. Kreyszig: Advanced Engineering Mathematics, 8thed., Wiley, New York, 1999.
3. M.D. Greenberg: Advanced Engineering Mathematics, 2nded., PHI, New Jerrsey, 1998,

1.	Time independent perturbation theory, First order perturbation theory applied to nondegenerate states, second order perturbation extension to degenerate state, Application of perturbation theory to the ground state energy, He atom (calculation given in Pauling and Wilson), Normal and anomalous Zeeman effect, First order Stark effect in the ground and first excited states of H atom and second order Stark effect of H atom, an-harmonic	[11]
2.	**Pauli's Principle and Shell Structure:** Systems with several electrons and spin functions.	[2]
3.	**Complex Spectra:** LS-Coupling scheme, normal triplets, basic assumptions of the theory, identification of terms, selection rules, jj- coupling (Qualitative).	[2]
4.	**Infrared and Raman Spectra:** Rigid rotator, energy levels, spectrum (no derivation of selection rules), Harmonic oscillator: energy levels, eigenfunctions, spectrum, comparison with observed spectrum, Raman effect, Quantum theory of Raman effect, Rotational and Vibrational Raman spectrum. Anharmonic oscillator: energy levels, Infrared and Raman Spectrum, Vibrational frequency and force constants. Non-rigid rotator: energy levels, spectrum, Vibrating-rotator energy levels, Infrared and Raman spectrum (no derivation of Dunham coefficients), Symmetry properties of rotational levels, influence of nuclear spin.	[12]
5.	**Electronic Spectra:** Electronic energy and potential curves, resolution of total energy,Vibrational Structure of Electronic transitions. General formulae, Deslandre's table, absorption sequences (qualitative) and Vibrational analysis, Rotational Structure of Electronicbands: General relations, branches of a band, band-head formation, Intensity distribution in avibrational band system.	[6]
6.	**Lasers:** Basic concept and principle of laser, Component of lasers, Einstein's and Gain coefficient, Types of lasers and pumping, Gas laser, YAG laser and chemical laser, Erbium lasers, Fibre lasers, Erbium-doped fibre lasers. Q-Switching:Laser Spiking and relaxation oscillations, Rate equations, TW and PW laser systems, Application of lasers.	[6]

Text Books:

1. Kuhn H., Atomic Spectra, Academic Press, 1962
2. Herzberg I G., Molecular Spectra and Molecular Structure Van-Nostrand Rein-hold, 1950

Reference Books:

1. White H.E., Atomic Spectra, Mc-Graw Hill, 1934.
2. C N Banwell and E M McCash, Fundamentals of Molecular Spectroscopy: Tata Mc-Graw Hill, 2008
3. Chandra S., Molecular Spectroscopy, Narosa, 2009.
4. Vishwakarma H. L., Applied Physics, Wiley India Pvt. Ltd., 1st Edition, 2013.

PH 532 **Condensed Matter Physics** **3 - 0 - 0 - 3**

1. **Elastic Constants:** Binding in solids; Stress components, stiffness constant, elastic constants, elastic waves in crystals. [5]

2. **Lattice Dynamics and Thermal Properties:** Rigorous treatment of lattice vibrations, normal modes; Density of states, thermodynamic properties of crystal, anharmonic effects, thermal expansion. [5]

3. **Energy Band Theory**: Electrons in a periodic potential: Bloch theorem, Nearly free electron model; tight binding method; Semiconductor Crystals, Band theory of pure and doped semiconductors; elementary idea of semiconductor superlattices. [8]

4. **Transport Theory:** Electronic transport from classical kinetic theory; Introduction to Boltzmann transport equation; electrical and thermal conductivity of metals; thermoelectric effects; Hall effect and magnetoresistance. [7]

5. **Dielectric Properties of Materials:** Polarization mechanisms, Dielectric function from oscillator strength, Clausius-Mosotti relation; piezo, pyro- and ferro-electricity. [6]

6. **Liquid Crystals:** Thermotropic liquid crystals, Lyotropic liquid crystals, long range order and order parameter, Various phases of liquid crystals, Effects of electric and magnetic field and applications, Physics of liquid crystal devices. [8]

Text Books:

1. Kittel C., Introduction to Solid State Physics, Wiley, New York, 2005.
2. Kittel C., Quantum Theory of Solids, Wiley, New York, 1987.
3. Ziman J., Principles of the Theory of Solids, Cambridge University Press, 1972.

Reference Books:

1. Ibach H. and Luth H., Solid State Physics, Springer Berlin, 3rd ed. 2002.
2. Walter A. Harrison Solid State Theory, Tata McGraw-Hill, New Delhi, 1970.
3. Chandrasekhar S. Liquid Crystals, Cambridge University, 2nd ed. 1992.
4. Sluckin T.J., The Liquid Crystal Phases, Physics & Technology, Contemporary Physics Taylor & Francis, 2000.

PH 542 **Computational Physics** **3 - 0 - 0 - 3**

1. **Errors analysis and curve fittings:** General formula for errors – Errors of observation and measurement, Empirical formula, Graphical method, Method of averages, Least square fitting, curve fitting, parabola, exponential. Least square curve fittings methods for linear and polynomial functions. [7]

2. **Numerical solution of algebraic and transcendental equations:**

   The bisection method, the iteration method, The method of false position, Newton – Raphson method. [7]

   Linear systems of equations: Direct methods, Gauss elimination method, Gauss–Seidel method.

3. **Interpolation:** Finite differences (Forward, backward and central difference), Newton Interpolation formula, Central difference Interpolation formula, Cubic spline interpolation formula, Newton's interpolation formula for unequal intervals. [8]

4. **Numerical Differentiation and Integration:** Newton's forward and backward difference formula for numerical derivatives, Numerical Integration: the trapezoidal rule and Simpson's rule. [7]

5. **Numerical Solutions of Ordinary and Partial Differential Equations:** Taylor's method, modified Euler's method, second and fourth order Runge-Kutta methods, Predictor-Corrector methods. Finite-difference approximation to derivatives, S.O.R. and Jacobi methods for solving Laplace equations, Parabolic equations and Hyperbolic equations. [10]

Text Books:

1. S.S. Sastry; Introductory Methods of Numerical analysis, PHI New Delhi, 3rd Ed, 2003.
2. E. Balagurusamy; Numerical methods, Tata Mc Graw Hill, New Delhi, 2008.

Reference Books:

1. Erwin Kreyszig; Advanced Engineering Mathematics, 10thed, John Wiley and Sons, 2011.
2. W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling ; Numerical Recipes in C, , Cambridge University, 1996.

PH 552 **Elements of Nuclear and Particle Physics** **3 - 0 - 0 - 3**

1. **Nuclear Properties and Models:** General properties of Nuclei: nuclear size, Rutherford scattering, nuclear radius and charge distribution, nuclear form factor, mass and binding energy, Angular momentum, parity and symmetry, Magnetic dipole moment and electric quadrupole moment. Liquid drop model, Bethe-Weizs¨acker binding energy/mass formula, Fermi model, Shell model. [6]

2. **Nuclear Two-body Problem:** Properties of deuteron, Schr¨odinger equation and its solution for ground state of deuteron, rms radius, spin dependence of nuclear forces, electromagnetic moment and magnetic dipole moment of deuteron and the necessity of tensor forces. Experimental n-p scattering data, Partial wave analysis and phase shifts, scattering length, magnitude of scattering length and strength of scattering, Significance of the sign of scattering length; Scattering from molecular hydrogen and determination of singlet and triplet scattering lengths, effective range theory, low energy p-p scattering, Nature of nuclear forces: charge independence, charge symmetry and iso-spin invariance of nuclear forces. [10]

3. **α, β and γ Decay:** α-decay, Gamow theory, Barrier penetration, fine structure of α spectrum. alpha decay, neutrino hypothesis β emission and electron capture, Fermi's theory of allowed β decay, Selection rules for Fermi and Gamow-Teller transitions, Parity non-conservation and Wu's experiment, Gamma decay- Multiple transitions in nuclei- Angular momentum and parity selection rules [8]

4. **Nuclear Reactions and Fission:** Different types of reactions, Quantum mechanical theory, Resonance scattering and reactions — Breit Wigner dispersion relation; Compound nucleus formation and break-up, Statistical theory of nuclear reactions and evaporation probability, Optical model; Principle of detailed balance, Transfer reactions, Nuclear fission and fusion. [8]

5. **Elementary Particle Physics:** Elementary particles: Photons, quarks, baryons, mesons, leptons, hadrons, Elementary idea of quark model. Conservation laws in particle reactions, Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula, C, P, T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic Kinematics. [7]

Text Books:

1. B L Cohen; Concepts of Nuclear Physics, Tata-McGraw Hill, 2008
2. Kenneth S. Krane; Introductory Nuclear Physics, Wiley India Pvt., 1988.
3. I.Kaplan;Nuclear Physics; Addison-Wesley, 1955

Reference Books:

1. S S M Wong; Introductory Nuclear Physics, Wiley, 1998.
2. S.B.Patel; Introductory Nuclear Physics, New Age International, 1991.
3. D.C.Tayal; Nuclear Physics, Himalayan Publishing House, 5th Edition, 2014.
4. R. R. Roy and B. P. Nigam; Nuclear Physics: Theory and Experiments, John Wiley & Sons, 1967.

PH 562 Computational Physics Laboratory **0-0-4-2**

Practical exercises based on 542, 512 and computational methods in Physics

PH 572 Advance Physics Laboratory **0-0-4-2**

Practical exercises based on 522, 532, 552 and related experiments.

PH 611 Semiconductor Physics and Devices 3 - 1 - 0 - 4

1. **Network Theorems:** Thevenin's, Norton's theorem and analysis of equivalent Circuits of networks. [9]

   Power Supplies: Half-Wave, Full-Wave and Bridge rectifiers with Capacitive input, Inductance input and PI filters, Shunt regulated power supplies using Zener diodes, Series regulated power supply. I. C. Voltage regulators.

2. **Transistor Amplifiers:** The CE, CB and CC configurations. Class A, Class B and Class C amplifiers. Low-frequency amplifiers. The transistor hybrid model and the h-parameters for a transistor. Conversion formulae for the h-parameters of the different transistor configurations. Analysis of a transistor CE amplifier at low frequencies using h-parameters. The CE amplifier with un-bypassed emitter resistor. The emitter follower at low frequencies. The emitter-coupled differential amplifier and its characteristics. Low frequency power amplifiers. The push-pull and the complementary - symmetry power amplifiers. Transistor biasing, Self-bias and thermal stability. [10]

3. **BJT and FET:** The BJT at high frequencies – the hybrid – model. Analysis of CE amplifier at high frequencies. Single stage CE amplifier and the gain-bandwidth product. Cascaded amplifiers. The emitter follower at high frequencies. The field effect transistor and its small signal model. The CS and CD amplifiers at low frequencies. Biasing the FET. The CS and CD amplifiers at high frequencies. [7]

4. **Feedback:** The Gain of an amplifier with feedback. General characteristics of negative feedback amplifiers. Stability of feedback amplifiers, The Barkhaussen Criteria. Grain and Phase margins. Compensation. Sinusoidal oscillators: RC oscillators – The Phase shift and the Wien's bridge oscillators. LC oscillators. Frequency stability and the crystal oscillators. [7]

5. **Operational Amplifiers:** Characteristics of an ideal operational amplifier. Applications of operational amplifiers – Inverting and Non-inverting amplifiers. Summing circuits, integration and Differentiation. Waveform generators. [6]

Text Books:

1. Maillman and Halkias, Integrated Electronics, Tata McGraw-Hill 1972.
2. V K Mehta; Principal of Electronics S. Chand and Sons 2008.
3. Donald Neamen; Semiconductor Physics and Devices, McGraw-Hill; 4th ed. 2011.

Reference Books:

1. M K Achuthan and K N Bhat; Fundamental of Semiconductor Devices, TMH 2006.
2. Rolf Enderlein, Norman J. M. Horing; Fundamentals of semiconductor physics and devices, World Scientific Pub, 1997.
3. John D. Ryder & Charles M. Thomson; Electronic Circuits & Systems, PHI Publication, 1976.

PH 621 **Digital Electronics** **3 - 1 - 0 - 4**

1. **Binary Number System:** Binary number system and other codes, binary arithmetic series and parallel processing of bites, logic of the addition operation, logic fundamentals, Boolean theorems, synthesis of Boolean functions, Karnaugh diagram. [8]

2. **Basics of Digital Electronics**: Basics and derived gates: OR gate, AND gate, NOT gate, NAND gate, NOR gate, XOR gate, Boolean identities and logic circuits using gates, Boolean algebra- DeMorgans Theorems, Sum of products and product of sums expressions, Minterm, Maxterm, SOP and POS from truth tables. [10]

3. **Combinational and Sequential Circuits:** Parity checker and generator, Half adders, full adders, Binary adders, decoders, multiplexer, demultiplexer, encoders, ROM and applications, Digital comparator, Flip-Flops- RS, JK, master slave JK, T-type and D-type flip flops, Shift-register and applications, Asynchronous counters and applications, A/D and D/A converters; Microprocessor and microcontroller basics. [12]

4. **Digital Circuits with MOS:** MOSFET, MOS invertors- static inverter, dynamic inverter, two phase inverter, MOS NAND gates, NOR gates, complementary MOSFET technology, CMOS inverter, CMOS NOR gates and NAND gates, MOS shift register and RAM. [9]

Text Books:

1. Malvino & Brown:Principle Of Digital Computer Electronics, 3rd Ed., McGraw-Hill, 1992.
2. Morris Mono: Digital logic Design, 4th edition, PHI, 2006.
3. J. Millman and C.C. Halkias: Integrated Electronics, Tata McGraw Hill, New Delhi, 1991.

Reference Books:

1. Mottershed: Electronics fundamentals and application, 8th edition, PHI, 2009.
2. A.P. Malvino and D.P. Leach, Digital Principles and. Applications, 6thed., TMH, 2003.

PH 631 **Physics of Nano-Materials** **3 - 0 - 0 - 3**

1. **Introduction**: An overview of quantum mechanical concepts related to low dimensional systems. [12]

   Concepts related to Electronic Structure: direct lattice, Reciprocal lattice, Brilloujn zones, Diffraction from 2D structures, Free —electron approximation, periodic boundary Conditions, allowed k values, Fermi energy, density of electronic states for electron gas, Energy bands, Electron statistics, carrier concentration and Fermi level, Direct- and Indirect- gap semiconductors, Lattice matching, Effective mass, Variation of energy bands with alloy compositoin and its exploitation for devices.

2. **Hetrostructures and Electron States**: Hetero junctions, Type I and Type II hetero structures, Classification of Quantum confined systems, Electrons and holes in Quantum wells. Surface to volume ratio in quantum confined systems, Electronic wave functions, energy sub bands and density of electronic states in Quantum wells, Quantum wires, and Quantum dots, Effective mass mismatch in hetero structures. Coupling between Quantum wells, Super lattices, Wave functions and Density of States for super lattices, Unit cell for quantum well, for quantum wire and for quantum dot. [12]

   EXCITONS: Excitons in bulk, in Quantum structures and in hetero structures.

3. **Nanoclusters and Nanoparticles**: Introduction, Particle shape and the surface, Collective surface area, Porosity, Spherical cluster approximation, Metal nanoclusters – Magic numbers, Geometric structures, Electronic structure, Bulk to nanotrasition, Magnetic clusters; Semiconducting nanoparticles; Rare-gas and molecular Clusters. [6]

4. **Carbon nanotubes**: Chiral vector, Chiral angle and the Unit cell for the Carbon nanotubes. [5]

5. Bulk Nanostructurs Materials: Solid disordered nanostructures, Nanostructured crystals, photonic crystals. [4]

Text Books:

1. V.V. Mitin, V.A. Kochelap, and M.A. Stroscio; Quantum Heterostructures: Microelectronics and Optoelectronics, Cambridge University Press, 1999.
2. C.P. Poole, Jr. and F.J. Owens; Introduction to Nanotechnology, Wiley India, 2003.
3. T. Pradeep; Nano: The essentials, Tata McGraw-Hill, New Delhi, 2007.
4. P. Harrison; Quantum Wells, Wires, and Dots: Theoretical and Computational Physics of Semiconductor Nanostructures, Wiley, 2009.

Reference Books:

1. G. Streetman and S. Banerjee; Solid State Electronic Devices, Prentice Hall of India, 6th Edition, 2005.
2. A. Y. Shik ; Quantum Wells: Physics and Electronics of two-dimensional systems, World Scientific, 1997.
3. G.L. Hornyak, J. Dutta, H.F. Tibbals and A.K. Rao; Introduction to Nanoscience, CRC Press, 2009.

PH 651 Electronics Laboratory 0-0-4-2

Practical exercises based on 611, 621 related to analog and digital electronics.

PH 641 Ancient Indian Science 2 - 0 - 0 - 2

1. **Reference of Science in Vedas** [3]

2. **SAGE Scientists and Their Achievements:** Baudhayan, Aryabhatta,Brahmgupta, Bhaskaracharya , varahamihira, Mahaviracharya, Acharya Kanad, Varahamihira, Nagarjuna, Acharya Bhardwaj, SusrutaAtreya, Acharya Charak, Patanjali. [8]

   Scientists of modern era: C. V. Raman (1888-1970), S. Ramanujan (1887-1920), J. C. Bose (1858-1937), H. J. Bhabha (1909-1966), V. A. Sarabhai (1919-1970), H. G. Khorana (1922-2011), Harish Chandra (1923 - 1983), S. N. Bose (1894 - 1974)), S. S. Bhatnagar (1894 – 1955), Visvesvaraya (1860 –1962)[, MeghnadSaha (1893–1956) etc.

3. **Discoveries in Astronomy and Physics of Ancient India:** Earth's rotation, Gravity, Speed of light, Lunar Eclipse, Planetary motion, Mechanics, Matter, Magnetism and Optics [5]

4. **Vedic Mathematics**: Algebra & Arithmetic, Geometry, Trigonometry [5]

5. **Chemical and Biological advancement of Ancient India**: Chemistry (Distillation, Caustic Alkali, Cell and Explosives), Metallurgy (Crucible, Furnaces, Air Blowers, Metal Powder, Binder), Botany, Medicine and Pharmacology. [5]

Text Books:

1. Pride of India- A Glimpse into India's Scientific Heritage. SamskritaBharati, New Delhi, 2006.
2. Science in Samskrit, SamskritaBharati, New Delhi, 2007.
3. N. K. Jain; Science and Scientists in India. Kalyani India, Delhi, 2001.
4. Awakening Indians to India, All India ChinmayaYuvaVendra, Central Chinmaya Mission Trust, Mumbai, 2003.

Reference Books:

1. N.K. Jain; History of Science and Scientific Methods. Oxford and IBM Publishing Co. Pvt. Ltd., New Delhi, 1990.
2. S. Soni; India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd., New Delhi, 2006.

PH 612 **Advance Quantum Mechanics** **3 - 1 - 0 - 4**

1. Time dependent perturbation theory, transition rate, Fermi Golden rule, constant perturbation harmonic in time, radiative transitions, absorption and induced emission,atomic radiation, dipole approximation, Einstein's atomic radiation, Einstein‟s A and b coefficients and their calculations.Approximation methods: W. K. B. method and its application to barrier penetration.Variational principle and its application to simple cases like ground state of He atom and deuteron in Yukawa potential. [10]

2. System of identical particles, exchange and transposition operators, totally symmetric and antisymmetric wave function and their expressions for a system of non-interacting particles, statistics of systems of identical particles, Relation of statistics with spin, Ortho and para states of the helium atom and their perturbation by Coulomb repulsion.Hamiltonian of a molecule, Born-Oppenheimer approximation, outline of Heitler-London theory of the hydrogen molecule. [11]

3. Scattering theory, scattering cross-section in laboratory and centre of mass system, scattering by a central potential , Partial wave method, phase shifts and their importance, scattering by a square well; potential and a perfectly rigid sphere, resonance scattering. [6]

4. Relativistic wave equation, the Klein-Gordon equation and initial difficulties in interpreting its solutions, Dirac‟s relativistic equation, Dirac's matrices, explanation of the spin of the electron, equation for an electron in an electromagnetic field and explanation of the magnetic moment due to the electron spin, spin-orbit interaction, solution for hydrogen atom in Dirac‟s theory, negative energy states and their qualitative explanations. [12]

Text Books:

1. B.Crasemman and J.D.Powell; Quantum Mechanics, Addison-Weslev, 1965.
2. L.I.Schiff; Quantum Mechanics, TMH, 2010.

Reference Books:

1. E. Merzbacher, Quantum Mechanics, Wiley and Sons, 1998
2. Ghatak and Loknathan; Quantum mechanics, Springer; 2004
3. D.J. Griffith; Introduction to Quantum Mechanics, Addison Wesley; 2 Ed., 2004.

4. Pauling, Introduction to Quantum Mechanics, Dover Publication 2008.

PH 622 **Instrumentation and Characterization Techniques** **3 - 0 - 0 - 3**

1. **Imaging Techniques:**

Optical microscopy: Use of polarized light microscopy, Phase contrast microcopy, Interference Microscopy, hot stage microscopy - surface morphology. [2]

Scanning electron microscopy: Basic design of the scanning electron microscopy , Modes of operation, Backscattered electrons, secondary electrons, X-rays – typical forms of contrast, Resolution and contrast, Specimen Preparation, application of SEM. [5]

Transmission electron microscopy: Basic principles, Modes of operation, Specimen preparation, Diffraction in imperfect crystals, Dislocations, precipitates, Structure of Grain boundaries and interface. [4]

Force microscopy: Basic concepts-Interaction force, AFM and the optical lever, force curves, measurements and manipulation, feedback control, different modes of operation, contact non-contact and tapping mode, Imaging and manipulation of samples in air or liquid environments-Imaging soft samples, Applications . [6]

Scanning tunneling microscopy: Principle, Instrumentation, importance of STM for nanostructures, surface and molecular manipulation using STM. [4]

2. **Qualitative and Quantitative analysis**

X-Rays powder diffraction: Single crystal diffraction techniques, Determination of accurate lattice parameters, structure analysis , profile analysis, particle size analysis using Scherer formula. [3]

Thermal analysis methods: Principle and Instrumentation of Thermogravimetry, Differential Thermal Analysis and Differential scanning calorimetry. Electron Energy Loss Spectroscopy; Atom probe field ion microscopy-X-Ray Photoelectron Spectroscopy, X-Ray Characterization, EDAX and WDA analysis, EPMA, ZAP corrections. [7]

Spectroscopic techniques: Introduction to Molecular Spectroscopy and Differences-With Atomic Spectroscopy-Infrared (IR) Spectroscopy and Applications- Microwave Spectroscopy-Raman Spectroscopy and CARS Applications-Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique. [8]

Text Books:

1. Cullity, B. D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
2. Loretto, M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.

Reference Books:

3. Rose, R.M., Shepard, L.A. and Wulff, J., The Structure and Properties of Materials, 2nd Ed., Wiley Eastern Ltd, 2005.

PH 661 **Elements of Nanoscience** **3 - 1 - 0 - 4**

1. **History , Scope and Classes of Nanomaterials:** Pre-nanotechnology, origins of concepts of Nano, Basics and basis of Nanotechnology, Generations and Development, Molecular aspects, Top down and Bottom up approaches, fullerenes: properties of fullerenes [8]

2. **Nanomagnetics**: Basics of Ferromagnetism, effect of bulk nanostructuring of magnetic properties, dynamics of nanomagnets, nanopore containment, giant and colossal magnetoresistance, applications in data storage, ferrofluids, Superparamagnetism, effect of grain size, magneto-transport, Magneto-electronics, magneto-optics, spintronics. [12]

   Quasicrystals: Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

3. **Optical and Vibrational Spectroscopy**: spectroscopy of semiconductor; infrared surface spectroscopy, Raman spectroscopy, Brillouin spectroscopy, luminescence (photoluminescence, thermoluminescence), [7]

4. **Biological Materials**: biological buildings blocks, nucleic acids, biological nanostructures. [6]

5. **Nanomachines and Nanodevices**: MEMS, MEMSs, molecular and super molecular switches. [6]

Text Books:

1. S. Shanmugam; Nanotechnology, MJP Publishers, Chennai, 2010.
2. Guozhong Cao; Nanostructures and Nanomaterials, Imperial College Press, London, 2004.
3. Charles P. Poole, Frank J Owens; Introduction to Nanotechnology, Wiley, 2003.
4. T. Pradeep; Nano: The Essentials, TMGH, New Delhi, 2009.

Reference Books:

1. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002

PH 671 **Nano-Fabrication Techniques** **3 - 1 - 0 - 4**

1. **Physical and Chemical Methods:** Ball Milling – Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE), Sol-Gel Process — Self-assembly – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Photochemical Synthesis - Sonochemical Routes – Reverse Micelles and Micro emulsions - Combustion Method – Template Process - Chemical Vapor Deposition (CVD) – Metal Oxide Chemical Vapor Deposition (MOCVD) [12]

2. **Optical Lithography:** Introduction - Necessity for a clean room- different types of clean rooms-construction and maintenance of a clean room- Lithography -Optical lithography- Optical projection lithography- Multistage scanners resolution- Photomask- Binary mask- Phase shift mask - Attenuated phase shift masks - alternating phase shift masks - Off axis illumination- Optical proximity correction - Sub resolution assist feature enhancement-Optical immersion lithography- Optical interferometric lithography- Holographic lithography. [9]

   Maskless optical projection lithography - Zone plate array lithography-Extreme ultraviolet lithography.

3. **Electron Beam and Ion Beam Lithography:** Scanning electron-beam lithography- maskless EBL- parallel direct-write e-beam systems-electron beam projection lithography - Scattering with angular limitation projection e-beam lithography- Projection reduction exposure with variable axis immersion lenses. [8]

   Focusing ion beam lithography - Ion projection lithography - Projection focused ion multi-beam - Masked ion beam lithography- Masked ion beam direct structuring- atom lithography.

4. **Nanoimprint Lithography and Soft Lithography**: Nanoimprint lithography (NIL)- NIL- hot embossing- UV-NIL- Soft Lithography- Moulding/Replica moulding: Printing with soft stamps- Edge lithography -Dip-Pen Lithography-set up and working principle. [5]

5. **Etching Techniques**: Reactive Ion etching- RIE reactive ion etching- Magnetically enhanced RIE- IBE Ion beam etching- Other etching techniques. [5]

Text Books:

1. Zheng Cui; Nanofabrication-Principles, Capabilities and Limits, Springer, 2008
2. Guozhong Gao; Nanostructures & Nanomaterials: Synthesis, Properties & Applications, , Imperial College Press, 2004.

Reference Books:

1. K. Suzuki and B W Smith, Microlithography: Science and Technology, 2nd Ed., CRC Press, 2007.
2. M.Ratner, D Ratner. Nanotechnology - A Gentle Introduction to the Next Big Idea, Pearson, 2003.
3. Bhushan, B., Handbook of nanotechnology, 2nd Ed., Springer, 2007.

PH 632 CNT and Sensor Applications 3-1-0-4

1. Structure of CNTs

Allotropes of carbon, Buckminsterfullerene, Fullerene-related carbon nanotubes, Single- and double-walled nanotubes, Catalytically produced carbon nanotubes, Bonding in carbon materials, Vector notation for carbon nanotubes, Unit cells of nanotubes, Symmetry classification of nanotubes, Defects in the hexagonal lattice, The layer structure of multiwalled nanotubes, Theory of nanotube capping, multiwalled nanotubes produced by arc-evaporation, multiwalled nanotubes produced by catalysis, experimental studies: single-walled nanotubes General features Electron diffraction of SWNTs, HRTEM of SWNTs, Scanning tunnelling microscope of SWNTs, Neutron diffraction.

[9]

2. Physical properties of CNTs

Electronic properties of graphite, Electronic properties of nanotubes, Band structure of single-walled tubes, Effect of curvature and of tube–tube interactions, Electron transport in nanotubes, Effect of a magnetic field, Correlation between electronic properties and structure of single-walled nanotubes, Quantum conductance, Electronic properties of nanotubes in a magnetic field, Superconductivity, Mechanical properties of carbon nanotubes, Optical properties of nanotubes, Thermal properties of nanotubes.

[8]

3. Chemistry and biology of CNTs

Covalent functionalization, Functionalization of nanotube ends and defects, Functionalization of sidewalls, Non-covalent functionalization, Characterizing chemically functionalized nanotubes, Biological functionalization, Proteins, Nucleic acids, Toxicity of carbon nanotubes.

[6]

4. Synthesis, Purification and processing of CNTs

Production of multiwalled nanotubes by arc-evaporation, Growth mechanisms of multiwalled nanotubes in the arc, Production of multiwalled nanotubes by high-temperature heat treatments, Production of single-walled nanotubes by arc-evaporation, Production of single-walled nanotubes by laser vaporization, Growth mechanisms of SWNTs in the arc and laser methods, Purification of single-walled and multiwalled tubes, Processing of single-walled and multiwalled nanotubes.

[10]

5. Probes and sensors Applications

Nanotube tips for atomic force microscopy, Preparing nanotube tips: mechanical assembly, Preparing nanotube tips: chemical vapour deposition, Imaging using nanotube AFM tips, Gas sensors, Biosensors, Physical sensors.

[6]

Text Books

1. Applied Physics of Carbon Nanotubes: Fundamentals of Theory, Optics and Transport Devices, Rotkin Slava V. , Subramoney Shekhar, Springer (2005)
2. Aligned Carbon Nanotubes: Physics, Concepts, Fabrication and Devices, Zhifeng Ren, Yucheng Lan, Yang Wang, Springer-Verlag Berlin Heidelberg (2013)

3. Carbon Nanotube and Graphene Device Physics, H.-S. Philip Wong, Deji Akinwande , Cambridge University Press (2011)

Reference Books

1. Carbon Nanotubes – Growth and Applications Edited by Mohammad Naraghi Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia (2011)
2. Carbon nanotubes : properties and applications Edited by Michael J O'Connell, CRC Press (2006)
3. Carbon Meta-Nanotubes: Synthesis, Properties and Applications, Edited by Mark Monthioux, Willey (2011)

PH 642 Nanophotonics 3 - 1 - 0 - 4

1. **Photons and electrons:** Isomorphism of Schrodinger and Helmholtz equations, free space propagation. Confinement of photons and electrons. Bloch waves, reciprocal space, and Brrilouin zones Propagation through well and barriers, Cooperative effects for photons and electrons. [8]

2. **Quantum Confinement Effect:** Quantum confinement effects in solids, nanoscale interaction dynamics, quantum wells, quantum wired, quantum dots, quantum rings. Manifestation of quantum confinement: linear and nonlinear optical properties. [10]

3. **Photonic Crystals**: Basics Concepts, Light in periodic nanostructures, Features of Photonic Crystals, photonic bandgaps, Band gap and band structures in 1-D, 2-D and 3-D photonic lattices. Photonic Crystal Sensors, Microstructure Fibers: Photonic crystal fiber, photonic band gap fibers (PBG), band gap guiding, single mode and multi mode, dispersion and nonlinear effect of Photonic crystal devices using crystal fibers. [12]

4. **Plasmonics:** Optical response of metals, plasmons, shell nanoparticles, metal-dielectric shell nanoparticles, Nonlinear optics with surface plasmons, Plasmon waveguides, Applications of Metallic Nanostructures: nanolasers, nanowire lasers, resonant cavity LED, Metamaterials. [9]

Text Books:

1. Paras N Prasad: Nanophotonics, John Wiley & Sons, 1st edition, NJ, 2004.
2. S V. Gaponenko, Introduction to Nanophotonics, 1st ed., Cambridge University Press, NY, 2010.
3. J D Joannopoulos, R.D. Meade and J.N.Winn: Photonic Crystals: Modelling Flow of Light; 2nd ed. , Princeton University Press, NJ, 2008.

Reference Books:

1. Lukas Novotny and Bert Hecht: Principles of Nano Optic,2nd ed., Cambridge Univ. Press, 2012.
2. J MLourtioz, H Benisty; V Berger, Jean-Michel Gerard: Photonic Crystals: Towards Nanoscale Photonic Devices, 2nd ed., Springer, Berlin 2008.

PH 681 **Advance Opto-Electronics** **3 - 1 - 0 - 4**

1. **Optical Properties of Semiconductors:** Basic of semi-conductors, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, External quantum efficiency, double hetero-junction, fabrication of hetero-junction, Solar cells, photo-resistors quantum wells and super lattices. [6]

2. **Optical Sources:** Current Densities and Injection Efficiency, Injection Luminescence and the Light-Emitting Diode, Spectrum of Injection Luminescence, Selection of Materials for LEDs, Internal/External Quantum Efficiency The Hetero-junction, Surface-Emitting LEDs, Edge-Emitting LEDs, Super-luminescent Diodes, LASER as an amplifier of light and necessary conditions for amplification, special properties of LASER- monochromatic, coherent and light power nature, directionality, divergence and attenuation of LASER beam. Study of three level Laser (Ruby LASER), Study of four level laser (He-Ne laser), semiconductor laser and applications of high power, low power continuous wave and pulse lasers [14]

3. **Light Detectors:** Idea of light detectors and their basic types, Optical Absorption Coefficient and Photocurrent, Quantum Efficiency, Responsivity, Long-Wavelength Cut-off, p-i-n-Photodiode, Avalanche photodiodes (APDs) [4]

4. **Opto-electronic Modulator and Display Devices:** Optical polarization, Electro-optic effect, Longitudinal and Transverse Electro-optic modulator, Acousto-optic effect, Raman-Nath Modulator, Bragg Modulator. Display devices, Photoluminescence, cathodo luminescence, EL display, LED display, drive circuitary, plasma panel display, liquid crystals, properties, LCD displays, numeric displays. [9]

5. **Organic Optoelectronic Devices:** Organic Light-Emitting Diodes (OLEDs), Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs Organic photovoltaic diodes (OPVDs), Exciton absorption, Exciton dissociation ,Charge collection Characterization of OPVDs [6]

Text Books:

1. A. YarivOptical Electronics,4thed, Saunders Collage Press, 1991.
2. A. Ghatak&K.Thyagarajan; Optical Electronics, Cambridge University Press, 1989.
3. R. P. Khare; Fiber Optics and Optoelectronics, Oxford University Press, 2004.
4. Wolfgang Brutting;Physics of Organic Semiconductors, Wiley, 2006.

Reference Books:

1. Pallabh Bhattacharya, Semiconductor Optoelectronics Devices, Prentice Hall; 2nd ed. 1996.
2. A. Roger, Essentials of Optoelectronics, Chapman Hall, 1997.
3. Jasprit Singh, Electronic & Optoelectronic properties of Semiconductor, Cambridge University Press, 2007.

PH 691 **Fiber and Non-linear Optics** **3 - 1 - 0 - 4**

1. **Basic Optics :** Basic optical laws, reflection at plane interface, Brewster angel and total internal reflection, Linear and nonlinear medium, Maxwell's equations, Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides, polarization, dielectric susceptibility, first and higher order susceptibilities. [6]

2. **Optical Fiber Waveguides and Sources:** Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays, evanescent field and Goos-Haechen shift, step index and graded index fibers, single and multi-mode fibers. [5]

3. **Transmission Characteristics of Optical Fibers:** Attenuation , material absorption losses in silica fibers, linear and nonlinear scattering losses, fiber bend loss, mid-infrared and far-infrared transmission, intra-modal and inter-modal dispersion, overall fiber dispersion in multimode and single-mode fibers, modal birefringence. [8]

4. **Fabrication Techniques and Connection of Optical Fibers:** Glass fibers, Preparation of optical fibers, Liquid-phase (melting) and Vapour-phase deposition techniques, characteristics of single-mode, multimode, plastic-clad and all-plastic fibers, Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen absorption, fiber alignment and joint loss, fiber splices, Fiber connectors, Fiber couplers, Sources to Fiber Power launching. [8]

5. **Nonlinear Optical Effects in Fiber and Solitons in Optical Fiber Communication:** Refractive index, frequency and intensity dependent refractive index, group velocity dispersion, self-phase modulation, Kerr effect, chirping, stimulated Raman scattering , stimulated Brillouin scattering, self-steepening, self-focusing, self-defocusing, concept of solitons, formation of solitons, Nonlinear Schrödinger equation for solitons, soliton switching, soliton laser, advantages of soliton based communication. [12]

Text Books:

1. AGhatak and K. Thyagarajan; Introduction to fiber optics, Cambridge University press, 6th ed., 2006.
2. K. Thyagarajan and A Ghatak; Fiber Optic Essentials, , Wiley-IEEE Press, 2007.
3. G. Keiser, Optical Fiber Communications, Mc Graw-Hill, 5th ed., 2013.
4. Govind P. Agrawal, Nonlinear Fiber Optics, Academic Press, 2001

Reference Books:

1. John M. Senior; Optical fiber communications: Principles and practice, PHI, 3rded, 2009.
2. B.B. Laud; Lasers and Non-Linear optics, John Wiley & Sons, 1985.
3. Robert W Boyd; Nonlinear fiber optics, Elsevier, 2nd ed., 2006.

PH 652 **Quantum Optics** **3 - 1 - 0 - 4**

1. **Quantized States of Radiation**: Quantization of the radiation field, quantum harmonic oscillator, the zero-point energy. the connection between the positive and negative frequency parts of the electric field operator; states of the quantized radiation field - single mode number states, thermal states, phase states, the minimal uncertainty states; the coherent and squeezed coherent states. [6]

2. **Semi-classical and Quantum Descriptions of a Radiation Field**: Various definitions of a coherent state: the minimal uncertainty states, the states with classical motion, the displacement operator eigen states etc; the Glauber-Sudarshan P-function, the Q-function and other quasi-probability distribution functions and their use in the semi-classical description of a radiation field; Nonclassical aspects like squeeezing and antibunching and examples of nonclassical states and experimental status. Important experiments in Quantum Optics: Photon counting experiments, Intentsity-intensity correlation - Hanbury-Brown and Twiss experiment. [8]

3. **Classical and Quantum Theories of Optical Coherence**: The concept of an analytic signal, elementary description of stochastic processes, correlation functions and coherence functions; Stationary and ergodic processes, Wiener-Khinchin relations etc. Young's double slit experiment to discuss the conditions on the classical coherence functions and quantum coherence functions for various orders of coherence; higher-order correlations functions etc. [8]

4. **Interaction Between Light and a Two-level Atom**: The Jaynes-Cummings model interaction and the corresponding Hamiltonian - its solution and the expression for the population inversion; the experimental developments; the classical and quantum signatures -collapses and revivals. [6]

5. **Quantum Theory of Laser**: Photon rate equations, threshold conditions, laser photon distribution, fluctuations in laser light and laser phase diffusion. [12]

   Special topics: Spontaneous emission, laser cooling, collective and cooperative effects in the light-atom(s) interaction, quantum beats, the role of quantum optics in the problem of quantum entanglement and quantum information.

Text Books:

1. L. Mandel and E. Wolf; Optical coherence and quantum optics, Cambridge, 1995.
2. M Fox; Quantum Optics, An Introduction, Oxford University Press, 2006.

Reference Books:

1. P. Meystre and M. Sargent; Elements Of Quantum Optics 3Ed, Springer (India) Pvt. Ltd., 2006.

PH 613 **Advance Condensed Matter Physics** **3 - 1 - 0 - 4**

1. **Plasmons, Polaritons and Polarons:** Dielectric function of the electron gas, Plasma optics, Dispersion relation for electromagnetic waves, Transverse optical modes in plasma, Longitudinal plasma oscillations, Plasmons, electrostatic screening, Mott metal-insulator transition, Screening and phonons in metals; Polaritons and LST relation, Electron-electron interaction; Electron –phonon interaction (Polarons). [9]

2. **Optical Properties and Raman Effect in Crystals:** Optical reflectance, Kramers-Kronig relations, Excitons, Frenkelexcitons, weakly bound excitons, Raman Effect in crystals, Electron spectroscopy with X-rays, Energy loss of particles in a solid. [8]

3. **Superconductivity:** Superconductors, Meissner effect, heat capacity, energy gap, isotope effect, London penetration depth, coherence length, BCS theory, Flux quantization in a superconducting ring, Josephson tunnelling. [5]

4. **Magnetic Properties of Solids and Magnetic Resonance:** Langevin diamagnetism, quantum theory of paramagnetism, paramagnetic susceptibility of conduction electrons, ferromagnetic, Curie point, temperature dependence and saturation magnetization at absolute zero, Magnons, Curie temperature and susceptibility of Ferrimagnets, Antiferromagnetics and susceptibility below Neel temperature, Ferromagnetic domains, Nuclear magnetic resonance, line width, hyperfine splitting, electron paramagnetic resonance [12]

5. **Imperfections in crystals and diffusion in solids:** Point, line and surface imperfections, Dislocations; Fick's law of diffusion, Fick's second law, Kirkendall effect, Temperature dependence of diffusion coefficient, determination of diffusion coefficient and activation energy [5]

Text Books:

1. Kittel C, Introduction to Solid State Physics, Willey 7th ed. 2005
2. Hayden W., Moffatt W. G. And Wulff J., Structure and properties of materials, Willey Vol. 3rd.
3. Dekker A., Solid State Physics, Prentice-Hall, 1967

Reference Books:

1. Azaroff L. V., Introduction to Solids, Mc-Graw Hills, 2010
2. Vijaya M. S. And Rangrajan G., Material Science, Tata McGraw Hills, 2006
3. J. R. Hook, H. E. Hall., Solid State Physics, Wiley; 2 edition, 1995.
4. Narula and Gupta, Material Science, Tata McGraw Hills, 2007

PH 623 **Soft Condensed Matter Physics** **3 - 1 - 0 - 4**

1. **Introduction and Review of Statistical Mechanics:** Examples of soft materials in industry and biology, Foams as a lead-off example of macro properties derived from micro, Atomic- and molecular-scale forces and bonds, Repulsion, entropy, hydrophobicity. Probabilities; Boltzmann distribution, Helmholtz energy, Equipartition theorem, Example of pulling RNA and measuring stiffness of a network (experiments). [8]

2. **Van der Waals Forces and Fluctuation-induced forces:** Keesom, Debye, and London contributions, Mean-field models of media, Measurements; list of Hamaker constants, relationship to surface tension, Derjaguin approximation; interaction between spherical particles. Osmotic pressure, Depletion attraction, Repulsion between membranes, Tension in a polymer. [7]

3. **Polymer :** Part A: Survey of types of polymers. Ideal-chain and Freely-jointed chain models.

   Part B: Worm-like chain (Kratky-Porod) model. The spectrum of fluctuations and the stiffness of a single polymer. [4]

4. **Friction in Fluids and The Diffusion Equation:** The Langevin Equation of motion of a particle in fluid. Viscosity and a simple model for its value; terminal velocity; sedimentation. The mean-square displacement, Fluctuation-dissipation theorem. A free particle; an ink spot; diffusion to capture, etc. Particle-hopping model; Fick's law; diffusion with drift. Experimental methods: Dynamic light scattering and the correlation function. Measuring interactions: terminal velocity; g(r); Boltzmann method. [10]

5. **Fluid Interfaces**, **Fluid Dynamics and Electrostatics in Solution (3D):** Surface tension, surfactants and Pickering emulsions. Consequences of a surface tension: LaPlace pressure, Jurin's Law, the Rayleigh instability, the Young-Dupre law and wetting, the shape of a meniscus: the equation of capillarity. Forces among interfacial inclusions (the 'Cheerios Effect'). Assembly of particles at liquid interfaces. [10]

   The Navier-Stokes equation for an isotropic fluid. Reynolds Number, laminar flow, Poiseuille flow, lubrication. Poisson-Boltzmann theory and Debye length Inter-particle forces,

Text Books:

1. Richard A.L Jones., Soft Condensed Matter, Oxford University Press, 1st Edition, 2002.
2. Chaikin P. M. and Lubensky T.C. , Principles of Condensed Matter Physics, Cambridge University Press, 1st Edition 2000

Reference Books:

1. Poon W.C.K. , David Andelman, Soft Condensed Matter Physics in Molecular and Cell Biology, CRC Press, Taylor and Francis Group, 2006

PH 662 **Material Science**

3-1-0-4

1. **Introduction**

   Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern Materials.

   [2]

2. **Phase Diagrams and Phase Transition in materials**

   Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system.

   Solid solutions, Phases, Thermodynamics of solutions, Phase rule, Binary phase diagrams, Binary isomorphous systems, Binary eutectic systems, ternary phase diagrams, kinetics of solid reactions. Order disorder phenomenon in binary alloys, long range order, super lattice, short range order.

   [14]

3. **Elastic,Anelastic and viscoelastic behaviour**: Atomic model of elastic behavior- Rubber like elasticity- Anelastic behavior- Viscoelastic behavior, Spring-Dashpot model.

   [5]

4. **Plastic deformation, Creep and Fracture**

   Plastic deformation - Slip - twinning - Critical resolved shear stress - theoretical shear strength of perfect crystal - role of dislocation in plastic deformation - methods of strengthening crystalline materials - strain hardening - grain size - solid solution strengthening - precipitation strengthening - fibre reinforced materials - whiskers - creep - creep curves - mechanism of creep - creep resistant materials, Ductile, Brittle fracture, Fracture toughness, Ductile-Brittle transition, fatigue fracture, Method of protection against fracture.

   [14]

5. **Oxidation and Corrosion**

   Mechanisms of oxidation, Oxidation resistant materials, Principles of corrosion, Protection against corrosion

   [4]

Text Books:

1. Dekker A J, "Solid State Physics", Macmillan and Co., (2000).
2. Raghavan V, “Materials Science and Engineering: A First Course", 5th Edition, Prentice Hall of India Pvt. Ltd., (2004).
3. Narula G K,Narula K S and Gupta V K,”Material Science”4th Ed.Tata McGraw Hill,(1993).

Reference Books:

1. Callister W D, "Materials Science and Engineering: An Introduction", 7th Edition, John Wiley & Sons, Inc., (2007).
2. James F Shackelford, "Introduction to Materials Science for Engineers", 7th Edition,Pearson Prentice Hall, (2009).
3. Van Vlack L H, "Elements of Materials Science and Engineering", 5th Edition, Addison Wesley, New York, (1989).

PH 672 Smart Materials 3 - 1 - 0 - 4

1. **Smart Materials: An Introduction:** States of matter, atomic structure, chemical bond, oxidation and reduction, aldehydesand ketones, amines and amino acids, lipids, carbohydrates, proteins and Enzymes, Biological Cell structure, Bacteria, Viruses, DNA and heredity , chromosomes, Genes, Study of Smart Materials and their integration into novel designs. Classifies according to their Response and Stimuli ability. Describes the effect of crystalline structures in the properties of piezoelectric materials, magnetostrictive materials, shape memory alloys. [10]

2. **Sensing Elements And Transducers:** Mechanical spring devices, Cantilever, Helical spring, Torsion bars or Shaft; Pressure Sensitive Devices, Bourdon tubes, bellows; Passive and active transducers, Theory of strain gauges, measurement of temperature, Thermocouples, RTDs, Thermistors, LVDT, Capacitive transducers, Hall effect transducers. [12]

3. **Chemical, Gas and optical Sensors:** pH, pH electrode, pH measurement, Humidity, Absolute and relative humidity, measurement of humidity, P-i-n and APD photodetectors, Fiber optic sensor, sensors using CNTs [6]

4. **MEMS and NEMS:** An elementary idea of MEMS, NEMSs, molecular and super molecular switches. [7]

5. **Biosensors:** Insulin therapy, Enzyme electrode, bio receptor molusles, Transduction mechanisms in biosensors. [4]

Text Books:

1. Jasprit Singh, Smart Electronic Materials, Cambridge University Press,2005.
2. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
3. Vinod Kumar Khanna, Nano Sensors, CRC Press, 2012.
4. Helmut Budzier, Gerald Gerlach; Thermal Infrared Sensors, John Wiley & Sons, Ltd, 2011.

Reference Books:

1. Jon S. Wilson, Sensor Technology Handbook, Elsevier, 2005.

2. Pavel Ripka, AloisTipek,Modern Sensors, ISTE, 2007.

Mody University of Science & Technology

Master's of Science (Biotechnology)

(Effective from Academic Year 2020-21)

The proposed programme shall be governed by the Department of - Biosciences, SLAS, MUST, Laxshmangarh.

Programme Level: Post Graduate **Duration:** Two Years (Four Semesters)

No. of Seats: 10

M.Sc. – Biotechnology

Vision

Biotechnology is a frontline area of science with immense potential for the benefit of the mankind. Therefore, the department of bioscience is committed to achieve high standards in teaching, and to become a sought-after destination for highly motivated students and faculty. The Programme aspires to lead in the areas of Molecular biology, cytogenetics, Biostatistics, Biophysical techniques, plant biotechnology, animal biotechnology, Bioinformatics & IPR, Immunology, genetic engineering, Bioprocess Engineering.

Mission

- To maintain high quality of education with latest techniques, inculcating in students, the ability to be lifelong learners, and continually upgrading the program curriculum to meet the requirement of industry.
- To provide a flexible curriculum that allows the students to study courses of her choice (through Elective courses) that will fulfill their aptitude and professional aspirations..
- To create opportunities and a supporting infrastructure for students – through laboratory courses, projects, dissertations.

Program Educational Objectives (PEOs)

PEO 1 : Post Graduates are prepared with analytical and critical thinking for finding the solution for the problems associated with the society in terms of human welfare.

PEO 2 : Post Graduates are provided with practical training, hands-on and project experience to meet the industrial needs.

PEO 3 : Post Graduates are motivated in career and entrepreneurial skill development to become global leaders.

Program Outcomes (POs)

At the end of the M.Sc Programme, Post-graduates will be able to

PO 1 Become well versed with the knowledge in interdisciplinary subjects to understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

PO 2 The student gets hands-on experience in basic biology/molecular biology and related techniques to venture into research world for a good career within country and abroad.

PO 3 Practical hands on exposure and the institutional academic program, student develops a sustainable approach in both academia and corporate sectors.

Scope

The MSc Biotechnology is a postgraduate degree with a focus in science, medicine, engineering with a combination of two of these disciplines, focusing on biology and chemistry along with principles of design and engineering. The field of biotechnology uses living organisms to generate controlled processes or their final products. Students pursuing this degree can learn about genetics, microbiology, cellular biology, process design and genetic engineering and their applications in healthcare or food production. This degree program prepares students for biotechnology careers by encompassing a broad range of subjects that many degree programs do not. Besides providing students with necessary knowledge, the degree coursework fosters problem solving and critical thinking skills that prepare students to take on various design and engineering challenges. Additionally, earning the degree can improve likelihood of employment as science and engineering employers often prefer candidates with post graduate degrees. MSc Biotechnology graduates can work in research or development in a variety of bioengineering fields. These include pharmaceutical or medical design, genetic engineering, biofuel production, and industrial biotechnology systems.

Input Qualification:

Candidates should possess a Bachelor degree offered by a recognized university in the following fields, viz., Agriculture, Pharmacy, Biological, Physical, Veterinary and Fishery Sciences, Engineering/Technology, Medicine (MBBS) or BDS or 4-years BSc (Physician Assistance Course).

Programmed and Teaching Methodology

The teaching methods include lectures, practical's, field visits, workshops, seminars, field visits, guest lectures etc.

Programmed and Teaching Methodology

The teaching methods include lectures, practical's, field visits, workshops, seminars, field visits, guest lectures etc.

Evaluation Procedure

All the Rules and Regulations as provided in the Ordinances and Regulations of the Mody University shall be followed. No student shall be admitted as a candidate for the examination for any of the Parts/Semesters after the lapse of [4] years from the date of admission to the Part-I/Semester-I of the Programme.

Minimum Credits (Excluding Proficiency credits) required for year up-gradation: Year up-gradation of the student will be as per the University ordinance.

Session 2020-2021 onwards										
Name of the Programme: M.Sc. Biotechnology							**Year: First**			
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW[$]	MTE	ETE
	Core Courses									
	BT20.501	Biochemistry	3	-	-	3	3	25	25	50
	BT20.503	Genetics	2	-	-	2	3	25	25	50
	BT20.505	Microbiology	2	-	-	2	3	25	25	50
	BT20.507	Cell and Molecular Biology	3	-	-	3	3	25	25	50
	BT20.509	Biochemistry and Instrumentation Laboratory	-	-	6	3	6	25	25	50
	BT20.511	Biotechnology Laboratory-I	-	-	6	3	6	25	25	50
	BT20.513	IPR, Biosafety and Bioethics	2	-	-	2	3	25	25	50
	RM20.501	Research Methodology and Scientific Communication Skills	2	-	-	2	3	25	25	50
	MS20.501	Math and Statistics for Biology	2	-	-	2	3	25	25	50
	FL-I	Foreign Language-I	3	-	-	3	3	25	25	50
		Sub Total	**19**		**12**	**25**				
Autumn Semester	SF 101	Personal Grooming, Fine Dining (Non credit)				1				

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$	MTE	ETE
	Core Courses									
	BT20.502	Bioinformatics	3	-	-	3	3	25	25	50
	BT20.504	Immunology	3	-	-	3	3	25	25	50
	BT20.506	Genetics Engineering	3	-	-	3	3	25	25	50
	BT20.508	Genomics and Proteomics	2	-	-	2	3	25	25	50
	BT20.510	Plant and Animal Biotechnology	3	-	-	3	3	25	25	50
	BT20.512	Elective Course	3	-	-	3	3	25	25	50
	BT20.516	Bioinformatics and Immunology Laboratory	-	-	6	3	6	25	25	50
	BT20.518	Biotechnology Laboratory-II	-	-	6	3	6	25	25	50
	FL-II	Foreign Language-I	3	-	-	3	3	25	25	50
		Sub Total	**20**		**12**	**26**				
Spring Semester	SF 102	Social Grooming, Home & Decor and Business Comm unication (Non credit)				1				

$CW (Course work) includes teacher assessment, assignments, class /quiz test.

Elective paper	BT20.512 Food Technology FS20.510 Introduction to Forensic Biotechnology

Session 2020-2021 onwards										
Name of the Programme: M.Sc. Biotechnology							**Year: Second**			
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$^{\$}$	MTE	ETE
Autumn Semester										
	BT20.601	Bioprocess Engineering and Technology	3	-	-	3	3	25	25	50
	BT20.603	Emerging Technologies	2	-	-	2	3	25	25	50
	BT20.605	Bioentrepreneurship	2	-	-	2	3	25	25	50
	BT20.607	Environmental Biotechnology	3	-	-	3	3	25	25	50
	BT20.609	Critical Analysis of Classical Papers	2	-	-	2	-	-	-	100
	BT20.611	Project Proposal	2	-	-	2	-	-	-	100
	BT20.613	Research Seminar	1	-	-	1	-	-	-	100
	BT20.615	Elective Course	3	-	-	3	3	25	25	50
	BT20.619	Biotechnology Laboratory-III	-	-	6	3	8	25	25	50
		Sub Total	**19**	**-**	**6**	**21**				
	SF 201	Personal Grooming, Fine Dining (Non-credit)				1				
	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration Hours	Weightage (%)		
			L	T	P			CW$^{\$}$	MTE	ETE
Spring Semester										
	BT20.602	Dissertation	-	-	40	20	-	25	-	75
		Sub Total				**20**				
	SF 202	Personal Grooming, Fine Dining (Non-credit)				1				
Total			**92**							

Elective paper	BT20.615 Biocatalysis and Biotransformation BT20.617. Molecular Diagnostics

BT20.501	**Biochemistry**	**3-0-0-3**
Course Objective	The objectives of this course are to build upon undergraduate level knowledge of biochemical principles with specific emphasis on different metabolic pathways. The course shall make the students aware of various disease pathologies within the context of each topic.	7
	Chemical basis of life: Miller-Urey experiment, abiotic formation of amino acid oligomers, composition of living matter; Water – properties of water, essential role of water for life on earth pH, buffer, maintenance of blood pH and pH of gastric juice, pH optima of different enzymes (pepsin, trypsin and alkaline phosphatase), ionization and hydrophobicity, emergent properties of biomolecules in water, biomolecular hierarchy, macromolecules, molecular assemblies; Structure-function relationships: amino acids – structure and functional group properties, peptides and covalent structure of proteins, elucidation of primary and higher order structures, Ramachandran plot, evolution of protein structure, protein degradation and introduction to molecular pathways controlling protein degradation, structure-function relationships in model proteins like ribonuclease A, myoglobin, hemoglobin, chymotrypsin etc.; basic principles of protein purification; tools to characterize expressed proteins; Protein folding: Anfinsen‟s Dogma, Levinthal paradox, cooperativity in protein folding, free energy landscape of protein folding and pathways of protein folding, molten globule state, chaperons, diseases associated with protein folding, introduction to molecular dynamics simulation.	7
	Enzyme catalysis – general principles of catalysis; quantitation of enzyme activity and efficiency; enzyme characterization and Michaelis-Menten kinetics; relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification; single substrate enzymes; concept of catalytic antibodies; catalytic strategies with specific examples of proteases, carbonic anhydrases, restriction enzymes and nucleoside monophosphate kinase; regulatory strategies with specific example of hemoglobin; isozymes; role of covalent modification in enzymatic activity; zymogens.	7
	Sugars - mono, di, and polysaccharides with specific reference to glycogen, amylose and cellulose, glycosylation of other biomolecules - glycoproteins and glycolipids; lipids - structure and properties of important members of storage and membrane lipids; lipoproteins. Self-assembly of lipids, micelle, biomembrane organization - sidedness and function; membrane bound proteins - structure, properties and function; transport phenomena; nucleosides, nucleotides, nucleic acids - structure, a historical perspective leading up to the proposition of DNA double helical structure; difference in RNA and DNA structure and their	7

	importance in evolution of DNA as the genetic material.	
	Bioenergetics-basic principles; equilibria and concept of free energy; coupled interconnecting reactions in metabolism; oxidation of carbon fuels; recurring motifs in metabolism; Introduction to GPCR, Inositol/DAG//PKC and Ca^{++} signaling pathways; glycolysis and gluconeogenesis; reciprocal regulations and non-carbohydrate sources of glucose; Citric acid cycle, entry to citric acid cycle, citric acid cycle as a source of biosynthetic precursors; Oxidative phosphorylation; importance of electron transfer in oxidative phosphorylation; F_1-F_0 ATP Synthase; shuttles across mitochondria; regulation of oxidative phosphorylation	7
	Photosynthesis – chloroplasts and two photosystems; proton gradient across thylakoid membrane; Calvin cycle and pentose phosphate pathway; glycogen metabolism, reciprocal control of glycogen synthesis and breakdown, roles of epinephrine and glucagon and insulin in glycogen metabolism; Fatty acid metabolism; protein turnover and amino acid catabolism; nucleotide biosynthesis; biosynthesis of membrane lipids and sterols with specific emphasis on cholesterol metabolism and mevalonate pathway; elucidation of metabolic pathways; logic and integration of central metabolism; entry/ exit of various biomolecules from central pathways; principles of metabolic regulation; steps for regulation.	11

Course Outcome

Students should be able to –

- Gain fundamental knowledge in biochemistry.
- Understand the molecular basis of various pathological conditions from the perspective of biochemical reactions.

Suggested Readings

Text Book:

1. Stryer, L. (1988). Biochemistry. New York: Freeman.
2. Lehninger, A. L. (1982). Principles of biochemistry (4th ed.). New York, NY: Worth.

References:

1. Voet, D., & Voet, J. G. (2004). Biochemistry (4th ed.). Hoboken, NJ: J. Wiley & Sons.
2. Dobson, C. M. (2003). Protein folding and misfolding. Nature, 426(6968), 884-890. doi:10.1038/nature02261.
3. Richards, F. M. (1991). The Protein Folding Problem. Scientific American, 264(1), 54-63. doi:10.1038/scientificamerican0191-54.

BT20.503	**Genetics**	**2-0-0-2**
Course Objective	The objectives of this course are to take the students through the basics of genetics and classical genetics encompassing prokaryotic/phage genetics to yeast and higher eukaryotic domains. On covering all classical concepts of Mendelian genetics across these life-forms, the students will be exposed to the concepts of population genetics, quantitative genetics encompassing complex traits,	
	Genetics of Bacteria and Bacteriophages: Concept of a gene in pre-DNA era; mapping of genes in bacterial and phage chromosomes by classical genetic crosses; genetic complementation and other genetic crosses using phenotypic markers; phenotype to genotype connectivity prior to DNA- based understanding of a gene.	8
	Yeast Genetics: Meiotic crosses, tetrad analyses, non-Mendelian and Mendelian ratios, gene conversion, models of genetic recombination, yeast mating type switch; dominant and recessive genes/mutations, suppressor or modifier screens, complementation groups, transposon mutagenesis, synthetic lethality, genetic epistasis.	6
	Drosophila Genetics as a model of higher Eukaryotes: Monohybrid & dihybrid crosses, back-crosses, test-crosses, analyses of autosomal and sex linkages, screening of mutations based on phenotypes and mapping the same, hypomorphy, genetic mosaics, genetic epistasis in the context of developmental mechanisms.	4
	Population Genetics & Genetics of Evolution:Introduction to the elements of population genetics: genetic variation, genetic drift, neutral evolution; mutation selection, balancing selection, Fishers theorem, Hardy-Weinberg equilibrium, linkage disequilibrium; in-breeding depression & mating systems; population bottlenecks, migrations, Bayesian statistics; adaptive landscape, spatial variation & genetic fitness.	4
	Quantitative Genetics of complex traits (QTLs):Complex traits, mapping QTLs, yeast genomics to understand biology of QTLs. Plant Genetics:Laws of segregation in plant crosses, inbreeding, selfing, heterosis, maintenance of genetic purity, gene pyramiding.	4
Course Outcome	On successful completion of this course, the student will be able to – • Describe the fundamental molecular principles of genetics. • Understand the relationship between phenotype and genotype in human genetic traits. • Describe the basics of genetic mapping. • Understand how gene expression is regulated.	
Suggested Readings	**Text Book:** Hartl, D. L., & Jones, E. W. (1998). Genetics: Principles and analysis. Sudbury, MA: Jones and Bartlett. **References:** Pierce, B. A. (2005). Genetics: A conceptual approach. New	

York: W.H. Freeman.
Tamarin, R. H., & Leavitt, R. W. (1991). Principles of genetics. Dubuque, IA: Wm. C. Brown.
Smith, J. M. (1989). Evolutionary genetics. Oxford: Oxford University Press.

BT20.505	**Microbiology**	**2-0-0-2**
Course Objective	The objectives of this course are to introduce the students to the field of microbiology with special emphasis on microbial diversity, morphology, physiology and nutrition; methods for control of microbes and host-microbe interactions.	
	Microbial Characteristics Introduction to microbiology and microbes, history & scope of microbiology, morphology, structure, growth and nutrition of bacteria, bacterial growth curve, bacterial culture methods; bacterial genetics: mutation and recombination in bacteria, plasmids, transformation, transduction and conjugation; antimicrobial resistance.	6
	Microbial Diversity Microbial taxonomy and the evolution of diversity, classification of microorganisms, criteria for classification; classification of bacteria; Cyanobacteria, acetic acid bacteria, Pseudomonads, lactic and propionic acid bacteria, endospore forming bacteria, Mycobacteria and Mycoplasma. Archaea: Halophiles, Methanogens, Hyperthermophilic archae, Thermoplasm; eukarya: algae, fungi, slime molds and protozoa; extremophiles and unculturable microbes.	8
	Control of Microorganisms Sterilization, disinfection and antisepsis: physical and chemical methods for control of microorganisms, antibiotics, antiviral and antifungal drugs, biological control of microorganisms.	3
	Virology Virus and bacteriophages, general properties of viruses, viral structure, taxonomy of virus, viral replication, cultivation and identification of viruses; sub-viral particles – viroids and prions.	4
	Host-Microbes Interaction Host-pathogen interaction, ecological impacts of microbes; symbiosis (Nitrogen fixation and ruminant symbiosis); microbes and nutrient cycles; microbial communication system; bacterial quorum sensing; microbial fuel cells; prebiotics and probiotics.	5
Course Outcome	Students should be able to –	

- Identify the major categories of microorganisms and analyze their classification, diversity, and ubiquity.
- Identify and demonstrate the structural, physiological, and genetic similarities and differences of the major categories of microorganisms.
- Identify and demonstrate how to control microbial growth.
- Demonstrate and evaluate the interactions between

microbes, hosts and environment.

Suggested Readings

Text Book:

Pelczar, M. J., Reid, R. D., & Chan, E. C. (1977). Microbiology (5th ed.). New York: McGraw-Hill.

References:

Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. (2011). Prescott's microbiology. New York: McGraw-Hill.

Matthai, W., Berg, C. Y., & Black, J. G. (1999). Microbiology, principles and explorations. Boston, MA: John Wiley & Sons.

BT20.507 Cell and Molecular Biology **3-0-0-3**

Course Objective

The objectives of this course are to sensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules, the understanding of various biological processes becomes deeper and inclusive.

Dynamic Organization of Cell: Universal features of cells; cell chemistry and biosynthesis: chemical organization of cells; internal organization of the cell - cell membranes: structure of cell membranes and concepts related to compartmentalization in eukaryotic cells; intracellular organelles: endoplasmic reticulum and Golgi apparatus, lysosomes and peroxisomes, ribosomes, cellular cytoskeleton, mitochondria, chloroplasts and cell energetics; nuclear compartment: nucleus, nucleolus and chromosomes.	6
Chromatin Structure and Dynamics: Chromatin organization - histone and DNA interactome: structure and assembly of eukaryotic and prokaryotic DNA polymerases, DNA-replication, repair and recombination; chromatin control: gene transcription and silencing by chromatin-Writers,-Readers and –Erasers; Transcriptional control: Structure and assembly of eukaryotic and prokaryotic RNA Polymerases, promoters and enhancers, transcription factors as activators and repressors, trancriptional initiation, elongation and termination; post-transcriptional control: splicing and addition of cap and tail, mRNA flow through nuclear envelope into cytoplasm, breakdown of selective and specific mRNAs through interference by small non-coding RNAs (miRNAs and siRNAs), protein translation machinery, ribosomes-composition and assembly; universal genetic codes, degeneracy of codons, Wobble hypothesis; Iso-accepting tRNA; mechanism of initiation, elongation and termination; co- and post-translational modifications, mitochondrial genetic code translation product cleavage, modification and activation.	12
Cellular Signalling: Transport and Trafficking Molecular mechanisms of membrane transport, nuclear transport, transport across mitochondria and chloroplasts; intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to	6

	lysosomes/cell exterior.	
	Manipulating and Studying Cells, Isolation of cells and basics of cell culture; observing cells under a microscope, different types of microscopy; analyzing and manipulating DNA, RNA and proteins.	
	Cellular Processes: Cell cycle and its regulation; cell division: mitosis, meiosis and cytokinesis; cell differentiation: stem cells, their differentiation into different cell types and organization into specialized tissues; cell-ECM and cell-cell interactions; cell receptors and trans-membrane signalling; cell motility and migration; cell death: different modes of cell death and their regulation.	8
	Genome Instability and Cell Transformation: Mutations, proto-oncogenes, oncogenes and tumour suppressor genes, physical, chemical and biological mutagens; types of mutations; intra-genic and inter-genic suppression; transpositions- transposable genetic elements in prokaryotes and eukaryotes, role of transposons in genome; viral and cellular oncogenes; tumor suppressor genes; structure, function and mechanism of action; oncogenes as transcriptional activators.	7
Course Outcome	Student should be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek; c) why to seek?	
Suggested Readings	**Text Book:** Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular biology of the cell. New York: Garland Science. Lodish, H. F. (2000). Molecular cell biology. New York: W.H. Freeman. **References:** Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). Lewin's genes XI. Burlington, MA: Jones & Bartlett Learning. Cooper, G. M., & Hausman, R. E. (2009). The cell: A molecular approach. Washington: ASM ; Sunderland. Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). Becker's world of the cell. Boston: Benjamin Cummings. Watson, J. D. (1987). Molecular biology of the gene (7th ed.). Menlo Park, CA: Benjamin/Cummings.	
BT20.509	**Biochemistry and Instrumentation Laboratory**	**0-0-6-3**
Course Objective	The objective of this laboratory course is to introduce students to experiments in biochemistry. The course is designed to teach students the utility of set of experimental methods in biochemistry in a problem oriented manner.	

- Preparing various stock solutions and working solutions that will be needed for the course.
- To prepare an Acetic-Na Acetate Buffer and validate the Henderson-Hasselbach equation.
- To determine an unknown protein concentration by plotting a standard graph of BSA using UV-Vis Spectrophotometer and validating the Beer- Lambert‟s Law.
- Titration of Amino Acids and separation of aliphatic, aromatic and polar amino acids by thin layer chromatography.
- Purification and characterization of an enzyme from a recombinant source (such as Alkaline Phosphatase or Lactate Dehydrogenase or any enzyme).
- Experimental verification that absorption at OD_{260} is more for denatured DNA as compared to native double stranded DNA.
- Identification of an unknown sample as DNA, RNA or protein using available laboratory tools. (Optional Experiments)
- Biophysical methods (Circular Dichroism Spectroscopy, Fluorescence Spectroscopy).
- Determination of mass of small molecules and fragmentation patterns by Mass Spectrometry.
- Protein characterization using different gel-based proteomic tools
- Agarose gel electrophoresis

Course Outcome

Students would be able to -

- To elaborate concepts of biochemistry with easy to run experiments.
- To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.

BT20.511 **Biotechnology Laboratory-I** **0-0-6-3**

Course Objective

The objective of this laboratory course is to provide the students practical skills on basic microbiological and biotechnological techniques.

- Sterilization, disinfection and safety in microbiological laboratory.
- Preparation of media for cultivation of bacteria.

- Isolation of bacteria in pure culture by streak plate method.
- Study of colony and growth characteristics of some common bacteria: Bacillus, E. coli, Staphylococcus, Streptococcus, etc.
- Preparation of bacterial smear and Gram‟s staining.
- Enumeration of bacteria: standard plate count.
- Antimicrobial sensitivity test and demonstration of drug resistance.
- Maintenance of stock cultures: slants, stabs and glycerol stock cultures
- Determination of phenol co-efficient of antimicrobial agents.
- Determination of Minimum Inhibitory Concentration (MIC)
- Isolation and identification of bacteria from soil/water samples.
- Isolation of genomic DNA, Qualitative and quantitative analyses of the DNA
- Polymerase Chain Reaction, Isolation of plant RNA, cDNA synthesis and RT-PCR expression profiling of genes using RT-PCR
- Study of divisional stages in Mitosis and Meiosis.
- Genetics exercises based on Mendel' s Experiments

Course Outcome

Students should be able to

- Ability to isolate, characterize and identify common bacterial organisms.
- Determine bacterial load of different samples.
- Perform antimicrobial sensitivity test.
- Preserve bacterial cultures.

BT20.513 **IPR , Biosafety and Bioethics** **2-0-0-2**

Course Objective

- To provide basic knowledge on intellectual property rights and their implications in biological research and product development.
- To learn biosafety and risk assessment of products derived from biotechnology and regulation of such products.
- To understand ethical issues in biological research.

Introduction to IPR Introduction to intellectual property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, protection of new GMOs; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to biotechnology and few case studies; introduction to history of GATT, WTO, WIPO and TRIPS; plant variety protection and farmers rights act; concept of „prior 5

art": invention in context of "prior art"; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.	
Patenting: Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure/non-disclosure - patent application- forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies, fee structure, time frames; types of patent applications: provisional and complete specifications; PCT and conventional patent applications; international patenting-requirement, procedures and costs; financial assistance for patenting-introduction to existing schemes; publication of patents- gazette of India, status in Europe and US; patent infringement- meaning, scope, litigation, case studies and examples; commercialization of patented innovations; licensing – outright sale, licensing, royalty; patenting by research students and scientists-university/organizational rules in India and abroad, collaborative research - backward and forward IP; benefit/credit sharing among parties/community, commercial (financial) and non-commercial incentives.	5
Biosafety and Biosecurity - introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs & LMOs; principles of safety assessment of transgenic plants – sequential steps in risk assessment; concepts of familiarity and substantial equivalence; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan; risk assessment of transgenic crops vs cisgenic plants or products derived from RNAi, genome editing tools.	5
National and International Regulations: International regulations – Cartagena protocol, OECD consensus documents and Codex Alimentarius; Indian regulations – EPA act and rules, guidance documents, regulatory framework – RCGM, GEAC, IBSC and other regulatory bodies; Draft bill of Biotechnology Regulatory authority of India - containments – biosafety levels and category of rDNA experiments; field trails – biosafety research trials – standard operating procedures - guidelines of state governments; GM labeling – Food Safety and Standards Authority of India (FSSAI).	5
Bioethics Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive	6

technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, Human and animal experimentation, animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk, labeling and public opinion. Sharing benefits and protecting future generations - Protection of environment and biodiversity – biopiracy.

Course Outcome

Students will be able to –

- Understand different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents.
- Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations
- Understand ethical aspects related to biological, biomedical, health care and biotechnology research.

Suggested Readings

Text Book:

- Ganguli, P. (2001). Intellectual property rights: Unleashing the knowledge economy. New Delhi: Tata McGraw-Hill Pub.
- Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication Oct.

References:

- Kuhse, H. (2010). Bioethics: An anthology. Malden, MA: Blackwell.
- Office of the Controler General of Patents, Design & Trademarks; Department of Industrial Policy & Promotion; Ministry of Commerce & Industry; Government of India. http://www.ipindia.nic.in/
- World Trade Organisation. http://www.wto.org
- World Intellectual Property Organisation. http://www.wipo.int
- International Union for the Protection of New Varieties of Plants. http://www.upov.int
- National Portal of India. http://www.archive.india.gov.in
- National Biodiversity Authority. http://www.nbaindia.org
- Recombinant DNA Safety Guidelines, 1990 Department of Biotechnology, Ministry of Science and Technology, Govt. of India. Retrieved from http://www.envfor.nic.in/divisions/csurv/geac/annex-5.pdf

- Wolt, J. D., Keese, P., Raybould, A., Fitzpatrick, J. W., Burachik, M., Gray, A., Wu, F. (2009). Problem formulation in the environmental risk assessment for genetically modified plants. Transgenic Research, 19(3), 425-436. doi:10.1007/s11248-009-9321-9

RM20.501 **Research Methodology and Scientific Communication Skills** **2-0-0-2**

Course Objectives

- To give a background on the history of science, emphasizing the methodologies used to do research
- To use the framework of these methodologies for understanding effective lab practices and scientific communication
- To use the framework of these methodologies to understand and appreciate scientific ethics

History of Science and Science Methodologies **5**

Empirical science; The scientific method; Interrogative perturbation experiments and controls; Deductive and inductive reasoning; Descriptive science; Reductionist vs holistic biology. Preparation for Research

Choosing a mentor, lab and research question; Maintaining a lab notebook with date-wise entry.

Sampling, Scale and Analysis: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale **10**

Scientific Communication **11**

Technical Writing Skills - Types of reports; Layout of a formal report; Scientific writing skills - Importance of communicating science; Problems while writing a scientific document; Plagiarism; Scientific publication writing: Elements of a scientific paper including Abstract, Introduction,

Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts; Publishing scientific papers - the peer review process and problems, recent developments such as open access and non-blind review; Plagiarism; Characteristics of effective technical communication; Scientific presentations; Ethical issues; Scientific misconduct.

Student Learning Outcomes

- Understanding of the history and methodologies of scientific research, applying these to recent published papers
- Understanding and practicing scientific reading, writing, presentations
- Appreciating scientific ethics through case studies.

Suggested Readings:

1. Valiela, I. (2001). Doing science: Design, analysis, and communication of scientific research. Oxford: Oxford University Press.
2. On being a scientist: A guide to responsible conduct in research. (2009). Washington, D.C.: National Academies Press.
3. Gopen, G. D., & Smith, J. A. (n.d.). The Science of Scientific Writing. American Scientist, 78(Nov-Dec 1990), 550-558.
4. Mohan, K., & Singh, N. P. (2010). Speaking English effectively. Delhi: Macmillan India.
5. Movie: Naturally Obsessed, The Making of a Scientist.

MS20.501 Math and Statistics for Biology 2-0-0-2

Objective: To acquire fundamental knowledge of bio statistics.

1.	**Introduction:** Collection of primary and secondary data, Classification and tabulation of data, Graphs of frequency distribution and Curves, Measures of central tendency — mean, median and mode, Mathematical properties of arithmetic mean, Geometric and harmonic Mean	**05**
2.	**Measures of Dispersion:** Absolute and Relative Measures of Dispersion, Range, Mean deviation, Standard deviation, Mathematical properties of standard deviation, Coefficient of variation, Variance, Skewness and its measures, Kurtosis and its measures	**05**
3.	**Correlation and Regression Analysis:** Meaning, significance and types, Scatter diagram method, Correlation graph, Karl Pearson's correlation coefficient, Coefficient of determination, Spearman's Rank correlation coefficient, Lines of Regression, Regression equations, Difference between correlation and regression analysis	**05**
4.	**Tests of Significance:** Student's t-test, Chi-square tests, Yate's correction factor, ANOVA– One and two way classification with examples	**05**
5.	**Probability and Probability Distributions:** Elements of probability-definition, addition and multiplication, Probability distribution function-Binomial, Poisson and normal, Area under normal probability distribution curve	**06**

Course Outcome: After completion of the course, students would be able to apply the knowledge of bio statistics in sciences and applied sciences with solve curriculum problems.

Text Books:

1. Fundamental of Mathematical Statistics by Gupta and Kapoor, SCS Publisher, 2002.
2. Bailey; Statistical Methods in Biology; Cambridge Publications, UK.

Reference Books:

1. Prasad S.; Elements of Biostatistics; Rastogi Publication, Meerut.
2. Probability, Random Variables and Stochastic Processes by Papoulis, TMH.

BT20.502	**Bioinformatics**	**3-0-0-3**
Course Objective	The objectives of this course are to provide students with the theory and practical experience of the use of common computational tools and databases which facilitate investigation of molecular biology and evolution-related concepts.	
	Bioinformatics basics: Computers in biology and medicine; Importance of Unix and Linux systems and its basic commands; Database concepts; Protein and nucleic acid databases; Structural databases; databases and search tools: biological background for sequence analysis; Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; resources at EBI; resources on the web; database mining tools.	7
	DNA sequence analysis: gene bank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; motif discovery and gene prediction; local structural variants of DNA, their relevance in molecular level processes, and their identification; assembly of data from genome sequencing.	7
	Multiple sequence analysis; multiple sequence alignment; flexible sequence similarity searching with the FASTA3 program package; use of CLUSTAL W and CLUSTAL X for multiple sequence alignment; submitting DNA protein sequence to databases: where and how to submit, SEQUIN, genome centres; submitting aligned set of sequences, updates and internet resources; methods of phylogenetic analysis.	7
	Protein modelling: introduction; force field methods; energy, buried and exposed residues; side chains and neighbours; fixed regions; hydrogen bonds; mapping properties onto surfaces; fitting monomers; RMS fit of conformers; assigning secondary structures	8
	Protein structure prediction: protein folding and model generation; secondary structure prediction; analyzing secondary structures; protein loop searching; loop generating methods; loop analysis; homology modelling: potential applications, description, methodology, homologous sequence identification; align structures, align model sequence; construction of variable and conserved regions; threading techniques; topology fingerprint approach for prediction; evaluation of alternate models; structure prediction on a mystery sequence; structure aided sequence techniques of structure prediction; structural profiles, alignment algorithms, mutation tables, prediction, validation, sequence based methods of structure prediction, prediction using inverse folding, fold prediction; significance analysis, scoring techniques, sequence-sequence scoring; protein function prediction; elements of insilico drug design.	10
Course Outcome	Student should be able to – • Develop an understanding of the basic theory of these	

computational tools.

- Gain working knowledge of these computational tools and methods.
- Appreciate their relevance for investigating specific contemporary biological questions.
- Critically analyse and interpret the results of their study.

Suggested Readings

Text Book:

- Lesk, A. M. (2002). Introduction to bioinformatics. Oxford: Oxford University Press.
- Mount, D. W. (2001). Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

References:

- Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: A practical guide to the analysis of genes and proteins. New York: Wiley-Interscience.
- Pevsner, J. (2015). Bioinformatics and functional genomics. Hoboken, NJ.: Wiley- Blackwell.
- Bourne, P. E., & Gu, J. (2009). Structural bioinformatics. Hoboken, NJ: Wiley-Liss.
- Lesk, A. M. (2004). Introduction to protein science: Architecture, function, and genomics. Oxford: Oxford University Press.

BT20.504 **Immunology** **3-0-0-3**

Course Objective

The objectives of this course are to make students learn about the structural features of the components of the immune system as well as their function. The major emphasis of this course will be on the development of the immune system and mechanisms by which our body elicit the immune response. This will be imperative for the students as it will help them to think like an immunologist and predict about the nature of immune response that develops against bacterial, viral or parasitic infection, and prove it by designing new experiments.

Immunology fundamental concepts and anatomy of the immune system Components of innate and acquired immunity; phagocytosis; complement and inflammatory responses; pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP); innate immune response; mucosal immunity; antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and 6

	disease susceptibility.	
	Immune responses generated by B and T lymphocytes Immunoglobulins - basic structure, classes & subclasses of immunoglobulins, antigenic determinants; multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; principles of cell signaling; basis of self & non-self discrimination; kinetics of immune response, memory; B cell maturation, activation and differentiation; generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; functional T Cell subsets; cell-mediated immune responses, ADCC; cytokines-properties, receptors and therapeutic uses; antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; cell-cell co-operation, Hapten-carrier system.	9
	Antigen-antibody interactions Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; surface plasmon resonance, biosenor assays for assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock outs.	7
	Vaccinology Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology- role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; antibody genes and antibody engineering- chimeric, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries, idiotypic vaccines and marker vaccines, viral-like particles (VLPs), dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, edible vaccine and therapeutic vaccine.	8
	Clinical Immunology Immunity to infection : bacteria, viral, fungal and parasitic infections (with examples from each group); hypersensitivity – Type I-IV; autoimmunity; types of autoimmune diseases; mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; treatment of autoimmune diseases; transplantation – immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; tumor immunology – tumor antigens; immune response to tumors and tumor evasion of the immune system, cancer immunotherapy; immunodeficiency - primary immunodeficiencies, acquired or secondary immunodeficiencies, autoimmune disorder, anaphylactic shock, immunesenescence, immune exhaustion in chronic viral infection, immune tolerance, NK cells in chronic viral infection and malignancy.	9
Course	Students should be able to –	

Outcome

- Evaluate the usefulness of immunology in different pharmaceutical companies.
- Identify the proper research lab working in the area of their own interests.
- Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.

Suggested Readings

Text Book:

- Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2006). Kuby immunology. New York: W.H. Freeman.
- Brostoff, J., Seaddin, J. K., Male, D., & Roitt, I. M. (2002). Clinical immunology. London: Gower Medical Pub.

References:

- Murphy, K., Travers, P., Walport, M., & Janeway, C. (2012). Janeway's immunobiology. New York: Garland Science.
- Paul, W. E. (1993). Fundamental immunology. New York: Raven Press.
- Goding, J. W. (1986). Monoclonal antibodies: Principles and practice: Production and application of monoclonal antibodies in cell biology, biochemistry, and immunology. London: Academic Press.
- Parham, P. (2005). The Immune System. New York: Garland Science.

BT20.506 **Genetic Engineering** **3-0-0-3**

Course Objective

The objectives of this course are to teach students with various approaches to conducting genetic engineering that they can apply to their future career in biological research as well as in biotechnology industries. Genetic engineering is a technology that has been developed based on our fundamental understanding of the principles of molecular biology and this is reflected in the contents of this course. This technology has revolutionized the way modern biological research is done and has impacted mankind with a number of biological products and processes.

Impact of genetic engineering in modern society; general requirements for performing a genetic engineering experiment; restriction endonucleases and methylases; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline 6

	phosphatase; cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; labelling of DNA: nick translation, random priming, radioactive and non-radioactive probes, hybridization techniques: northern, southern, south-western and far-western and colony hybridization, fluorescence in situ hybridization.	
	Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, hagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Principles for maximizing gene expression expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Inclusion bodies; methodologies to reduce formation of inclusion bodies; mammalian expression and replicating vectors; Baculovirus and pichia vectors system, plant based vectors, Ti and Ri as vectors, yeast vectors, shuttle vectors.	7
	Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR – multiplex, nested; real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; proof reading enzymes; PCR based site specific mutagenesis; PCR in molecular diagnostics; viral and bacterial detection; sequencing methods; enzymatic DNA sequencing; chemical sequencing of DNA; automated DNA sequencing; RNA sequencing; chemical synthesis of oligonucleotides; mutation detection: SSCP, DGGE, RFLP.	7
	Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; isolation of mRNA and total RNA; reverse transcriptase and cDNA synthesis; cDNA and genomic libraries; construction of microarrays – genomic arrays, cDNA arrays and oligo arrays; study of protein-DNA interactions: electrophoretic mobility shift assay; DNaseI footprinting; methyl interference assay, chromatin immunoprecipitation; protein-protein interactions using yeast two-hybrid system; phage display.	7
	Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; gene knockouts and gene therapy; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems e.g. fruit flies (drosophila), worms (C. elegans), frogs (xenopus), fish (zebra fish) and chick; Transgenics - gene replacement; gene targeting; creation of transgenic and knock-out mice; disease model; introduction to genome editing by CRISPR- CAS with specific emphasis on Chinese and American clinical trials.	12
Course Outcome	Given the impact of genetic engineering in modern society, the students should be endowed with strong theoretical knowledge of this technology. In conjunction with the practicals in molecular biology & genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech	

industry.

Suggested Readings

Text Book:

- Old, R. W., Primrose, S. B., & Twyman, R. M. (2001). Principles of gene manipulation: An introduction to genetic engineering. Oxford: Blackwell Scientific Publications.
- Green, M. R., & Sambrook, J. (2012). Molecular cloning: A laboratory manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

References:

- Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.
- Selected papers from scientific journals, particularly Nature & Science.
- Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.

BT20.508 Genomics and Proteomics **2-0-0-2**

Course Objective

The objectives of this course are to provide introductory knowledge concerning genomics & proteomics and their applications.

Basics of Genomics and Proteomics Brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast.	3
Genome Mapping Genetic and physical maps; markers for genetic mapping; physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, in situ hybridization, comparative gene mapping.	4
Genome Sequencing Projects Human Genome Project, genome sequencing projects for microbes, plants and animals, accessing and retrieving genome project information from the web.	4
Proteomics Aims, strategies and challenges in proteomics; proteomics technologies: 2D-PAGE, isoelectric focusing, mass spectrometry, MALDI-TOF, yeast 2-hybrid system, proteome databases.	6
Functional Genomics and Proteomics Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking and characterization of chromosomes, mining functional genes in the genome, gene function- forward and reverse genetics, gene ethics; protein-protein and protein- DNA interactions; protein chips and functional proteomics; clinical and biomedical applications of proteomics; introduction to metabolomics, lipidomics, metagenomics and systems biology.	9

Course Outcome

Students should be able to acquire knowledge and understanding of the fundamentals of genomics and proteomics, transcriptomics and metabolomics and their applications in various applied areas of

biology.

Suggested Readings

Text Book:

- Primrose, S. B., Twyman, R. M., Primrose, S. B., & Primrose, S. B. (2006). Principles of gene manipulation and genomics. Malden, MA: Blackwell Pub.

References:

- Liebler, D. C. (2002). Introduction to proteomics: Tools for the new biology. Totowa, NJ: Humana Press.
- Campbell, A. M., & Heyer, L. J. (2003). Discovering genomics, proteomics, and bioinformatics. San Francisco: Benjamin Cummings.

BT20.510 **Plant and Animal Biotechnology** **3-0-0-3**

Course Objective

The objectives of this course is to introduce students to the principles, practices and application of animal biotechnology, plant tissue culture, plant and animal genomics, genetic transformation and molecular breeding of plants and animals.

Plant Tissue Culture and Animal Cell Culture Plant tissue culture: historical perspective; totipotency; organogenesis; Somatic embryogenesis; establishment of cultures – callus culture, cell suspension culture, media preparation – nutrients and plant hormones; sterilization techniques; applications of tissue culture - micropropagation; somaclonal variation; androgenesis and its applications in genetics and plant breeding; germplasm conservation and cryopreservation; synthetic seed production; protoplast culture and somatic hybridization - protoplast isolation; culture and usage; somatic hybridization - methods and applications; cybrids and somatic cell genetics; plant cell cultures for secondary metabolite production. Animal cell culture: brief history of animal cell culture; cell culture media and reagents; culture of mammalian cells, tissues and organs; primary culture, secondary culture, continuous cell lines, suspension cultures; application of animal cell culture for virus isolation and in vitro testing of drugs, testing of toxicity of environmental pollutants in cell culture, application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.	10
Plant Genetic Manipulation Genetic engineering: Agrobacterium-plant interaction; virulence; Ti and Ri plasmids; opines and their significance; T-DNA transfer; disarmed Ti plasmid; Genetic transformation - Agrobacterium-mediated gene delivery; cointegrate and binary vectors and their utility; direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; screenable and selectable markers; characterization of transgenics; chloroplast transformation; marker-free methodologies;	9

	advanced methodologies - cisgenesis, intragenesis and genome editing; molecular pharming - concept of plants as biofactories, production of industrial enzymes and pharmaceutically important compounds.	
	Animal Reproductive Biotechnology and Vaccinology Animal reproductive biotechnology: structure of sperms and ovum; cryopreservation of sperms and ova of livestock; artificial insemination; super ovulation, embryo recovery and in vitro fertilization; culture of embryos; cryopreservation of embryos; embryo transfer technology; transgenic manipulation of animal embryos; applications of transgenic animal technology; animal cloning - basic concept, cloning for conservation for conservation endangered species. Vaccinology: history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, modern vaccines.	8
	Plant and Animal Genomics Overview of genomics – definition, complexity and classification; need for genomics level analysis; methods of analyzing genome at various levels – DNA, RNA, protein, metabolites and phenotype; genome projects and bioinformatics resources for genome research – databases; overview of forward and reverse genetics for assigning function for genes.	4
	Molecular Mapping & Marker Assisted Selection Molecular markers - hybridization and PCR based markers RFLP, RAPD, STS, SSR, AFLP, SNP markers; DNA fingerprinting-principles and applications; introduction to mapping of genes/QTLs; marker-assisted selection - strategies for Introducing genes of biotic and abiotic stress resistance in plants: genetic basis for disease resistance in animals; molecular diagnostics of pathogens in plants and animals; detection of meat adulteration using DNA based methods.	8
Course Outcome	Students should be able to gain fundamental knowledge in animal and plant biotechnology and their applications.	
Suggested Readings	**Text Book:** • Chawla, H. S. (2000). Introduction to plant biotechnology. Enfield, NH: Science. • Razdan, M. K. (2003). Introduction to plant tissue culture. Enfield, NH: Science. **References:** • Slater, A., Scott, N. W., & Fowler, M. R. (2008). Plant biotechnology: An Introduction to Genetic Engineering. Oxford: Oxford University Press. • Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). Biochemistry & molecular biology of plants. Chichester, West Sussex: John Wiley & Sons.	

- Umesha, S. (2013). Plant biotechnology. The Energy And Resources.
- Glick, B. R., & Pasternak, J. J. (1994). Molecular biotechnology: Principles and applications of recombinant DNA. Washington, D.C.: ASM Press.
- Brown, T. A. (2006). Gene cloning and DNA analysis: An introduction. Oxford: Blackwell Pub.
- Primrose, S. B., & Twyman, R. M. (2006). Principles of gene manipulation and genomics. Malden, MA: Blackwell Pub.
- Slater, A., Scott, N. W., & Fowler, M. R. (2003). Plant biotechnology: The genetic manipulation of plants. Oxford: Oxford University Press.
- Gordon, I. (2005). Reproductive Techniques in Farm Animals. Oxford: CAB International. 11. Levine, M. M. (1997). New generation vaccines. New York: M. Dekker.

BT20.516 **Bioinformatics and Immunology Laboratory** **0-0-6-3**

Course Objective The objectives of this laboratory course are to make students develop an understanding about practical aspects of the components of the immune system as well as their function. Basic as well as advanced methods will be taught to detect different antigen and antibody interactions, isolation of different lymphocyte cells etc. and how they can be used in respective research work.

- Selection of animals, Preparation of antigens, Immunization and methods of bleeding, serum separation and storage.
- Antibody titre by ELISA method.
- Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
- Complement fixation test.
- SDS-PAGE, Immunoblotting, Dot blot assays.
- Biological Databases: Sequence databases, Structure databases
- ORF Finder
- Pairwise sequence alignment using BLAST
- MSA using Clustal Omega and MEGA
- Phylogenetic analysis using MEGA software
- Primer Design
- 3-D structure Prediction

Course Outcome Students should be able to –

- Evaluate the usefulness of immunology and Bioinformatics in different pharmaceutical companies.

- Identify proper research lab working in the area of their own interests.
- Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.
- Apply the bioinformatics tools for evolutionary analysis and drug designing

BT20.518 **Biotechnology laboratory II** **0-0-6-3**

Course Objective The objectives of this course are to provide students with the experimental knowledge of molecular biology & genetic engineering.

- Plasmid DNA isolation and DNA quantitation.
- Restriction Enzyme digestion of plasmid DNA.
- Agarose gel electrophoresis.
- Polymerase Chain reaction.
- DNA Ligation.
- Preparation of competent cells.
- Transformation of E.coli with standard plasmids, Calculation of transformation efficiency.
- Confirmation of the insert, Miniprep of recombinant plasmid DNA, Restriction mapping.
- Vector mediated gene transfer in plants
- Surface sterilization of explants
- Plant tissue culture using leaf/ stem/seeds
- Effect of different pH, Temp, Moisture, and Salt Concentration on plant growth
- PGPRs and their activity analysis
- Primary and Secondary culture of Animal cell lines
- Maintenance and storage of animal cell lines

Course Outcome Students should be able to gain hands-on experience on gene cloning, protein expression and purification. This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.

BT20.601	**Bioprocess Engineering and Technology**	**3-0-0-3**
Course Objective	The objectives of this course are to educate students about the fundamental concepts of bioprocess technology and its related applications, thus preparing them to meet the challenges of the new and emerging areas of biotechnology industry.	
	Basic principles of Biochemical engineering Isolation, screening and maintenance of industrially important microbes; microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); strain improvement for increased yield and other desirable characteristics.	5
	Stoichiometry and Models of Microbial Growth Elemental balance equations; metabolic coupling – ATP and NAD+; yield coefficients; unstructured models of microbial growth; structured models of microbial growth.	5
	Bioreactor Design and Analysis Batch and continuous fermenters; modifying batch and continuous reactors: chemostat with recycle, multistage chemostat systems, fed-batch operations; conventional fermentation v/s biotransformations; immobilized cell systems; large scale animal and plant cell cultivation; fermentation economics; upstream processing: media formulation and optimization; sterilization; aeration, agitation and heat transfer in bioprocess; scale up and scale down; measurement and control of bioprocess parameters.	10
	Downstream Processing and Product Recovery Separation of insoluble products - filtration, centrifugation, sedimentation, flocculation; Cell disruption; separation of soluble products: liquid-liquid extraction, precipitation, chromatographic techniques, reverse osmosis, ultra and micro filtration, electrophoresis; final purification: drying; crystallization; storage and packaging.	10
	Fermentation Economics Isolation of micro-organisms of potential industrial interest; strain improvement; market analysis; equipment and plant costs; media; sterilization, heating and cooling; aeration and agitation; bath-process cycle times and continuous cultures; recovery costs; water usage and recycling; effluent treatment and disposal. Applications of enzyme technology in food processing Mechanism of enzyme function and reactions in process techniques; enzymatic bioconversions e.g. starch and sugar conversion processes; high-fructose corn syrup; interesterified fat; hydrolyzed protein etc. and their downstream processing; baking by amylases, deoxygenation and desugaring by glucoses oxidase, beer mashing and chill proofing; cheese making by proteases and various other enzyme catalytic actions in food processing.	9
Course Outcome	Students should be able to – • Appreciate relevance of microorganisms from industrial context. • Carry out stoichiometric calculations and specify models of	

their growth.

- Give an account of design and operations of various fermenters.
- Present unit operations together with the fundamental principles for basic methods in production technique for bio-based products.
- Calculate yield and production rates in a biological production process, and also interpret data.
- Calculate the need for oxygen and oxygen transfer in a bioproduction process.
- Critically analyze any bioprocess from an economics/market point of view.
- Give an account of important microbial/enzymatic industrial processes in food and fuel industry.

Suggested Readings

Text Book:

- Shuler, M. L., & Kargi, F. (2002). Bioprocess engineering: Basic concepts. Upper Saddle River, NJ: Prentice Hall.
- Stanbury, P. F., & Whitaker, A. (1997). Principles of fermentation technology. Oxford: Pergamon Press.

References:

- Blanch, H. W., & Clark, D. S. (1997). Biochemical engineering. New York: M. Dekker.
- Bailey, J. E., & Ollis, D. F. (1986). Biochemical engineering fundamentals. New York: McGraw-Hill.
- El-Mansi, M., & Bryce, C. F. (2007). Fermentation microbiology and biotechnology. Boca Raton: CRC/Taylor & Francis.

BT20.603 **Emerging Technologies** **2-0-0-2**

Course Objective

This course is broad-based in nature encompassing several new technologies that current experimental researchers are employing to probe complex system biology questions in life- sciences. The objectives of this course are to teach the basic principles of the new principles to the students and make them appreciate the current-day research tool-kit better.

Optical Microscopy Methods The Light Microscopy: lenses and microscopes, resolution: Rayleigh‟s Approach, Darkfield; Phase Contrast; Differential Interference Contrast; fluorescence and fluorescence microscopy: confocal microscope: scanning optical 8

	microscope, advanced fluorescence techniques: FLIM, FRET, and FCS, Fluorescence Lifetime, Fluorescence Resonant Energy Transfer (FRET), Fluorescence Correlation Spectroscopy (FCS), Evanescent Wave Microscopy; Near-Field and Evanescent Waves, Total Internal Reflection Microscopy; Near-Field Microscopy; Beyond the Diffraction Limit: Stimulated Emission Depletion (STED), Super-Resolution Summary, Super-Resolution Imaging with Stochastic Optical Reconstruction Microscopy (STORM) and Photoactivated Localization Microscopy (PALM).	
	Mass Spectroscopy Ionization techniques; mass analyzers/overview MS; FT-ICR and Orbitrap, fragmentation of peptides; proteomics, nano LC-MS; Phospho proteomics; interaction proteomics, mass spectroscopy in structural biology; imaging mass spectrometry.	4
	Systems Biology and Structural Biology: High throughput screens in cellular systems, target identification, validation of experimental methods to generate the omics data, bioinformatics analyses, mathematical modeling and designing testable predictions. X-ray diffraction methods, solution & solid-state NMR.	6
	CRISPR-CAS History of its discovery, elucidation of the mechanism including introduction to all the molecular players, development of applications for in vivo genome engineering for genetic studies, promise of the technology as a next generation therapeutic method.	4
	Nanobodies Introduction to Nanobodies, combining nanobody with phage-display method for development of antibody against native proteins, nanobody as a tool for protein structure-function studies, use of nanobodies for molecular imaging, catabolic antibodies using nanobodies.	4
Course Outcome	Students should be to learn the history, theoretical basis and basic understanding of some of the latest technologies in the area of biotechnology. They should also be able to learn about various applications of these technologies. They may learn one application in depth through an assignment and/or seminar.	
Suggested Readings	**Text Book:** • Campbell, I. D. (2012). Biophysical techniques. Oxford: Oxford University Press. • Serdyuk, I. N., Zaccai, N. R., & Zaccai, G. (2007). Methods in molecular biophysics: Structure, dynamics, function. Cambridge: Cambridge University Press.	

References:

- Phillips, R., Kondev, J., & Theriot, J. (2009). Physical biology of the cell. New York: Garland Science.
- Biological physics: Energy, information, life. New York: W.H. Freeman.
- Huang, B., Bates, M., & Zhuang, X. (2009). Super-Resolution Fluorescence Microscopy. Annu. Rev. Biochem. Annual Review of Biochemistry, 78(1), 993-1016. doi:10.1146/annurev.biochem.77.061906.092014.
- Mohanraju, P., Makarova, K. S., Zetsche, B., Zhang, F., Koonin, E. V., & Oost, J. V. (2016). Diverse evolutionary roots and mechanistic variations of the CRISPR-Cas systems. Science, 353(6299). doi:10.1126/science.aad5147.

BT20.605	**Bioentrepreneurship**	**2-0-0-2**
Course Objective	The objectives of this course are to teach students about concepts of entrepreneurship including identifying a winning business opportunity, gathering funding and launching a business, growing and nurturing the organization and harvesting the rewards.	
	Basics of Bioentrepreneurship Importance of entrepreneurship; advantages of being entrepreneur - freedom to operate; introduction to bioentrepreneurship – biotechnology in a global scale; Scope in bioentrepreneurship; types of bio-industries – biopharma, bioagri, bioservices and bioindustrial; innovation – types, out of box thinking; skills for successful entrepreneur – creativity, leadership, managerial, team building, decision making; opportunities for bioentrepreneurship- entreprenuership development programs of public and private agencies (MSME, DBT, BIRAC, Startup & Make in India); patent landscape, IP protection & commercialization strategies.	5
	Accounting and Finance Business plan preparation; business feasibility analysis by SWOT, socio-economic costs benefit analysis; funds/support from Government agencies like MSME/banks and private agencies like venture capitalists:/angel investors for bioentrepreneurship; business plan proposal for „virtual startup company"; statutory and legal requirements for starting a company/venture; basics in accounting practices: concepts of balance sheet, profit and loss statement, double entry bookkeeping; collaborations & partnerships; information technology for business administration and expansion.	5
	Business Strategy Entry and exit strategy; pricing strategy; negotiations with financiers, bankers, government and law enforcement authorities; dispute resolution skills; external environment/ changes; avoiding/managing crisis.	5

	Marketing Market conditions, segments, prediction of market changes; identifying needs of customers; Market linkages, branding issues; developing distribution channels - franchising; policies, promotion, advertising; branding and market linkages for „virtual startup company".	5
	Knowledge Centre and R&D Knowledge centres e.g., in universities, innovation centres, research institutions (public & private) and business incubators; R&D for technology development and upgradation; assessment of technology development; managing technology transfer; industry visits to successful bio-enterprises, regulations for transfer of foreign technologies; quality control.	6
Course Outcome	Students should be able to gain entrepreneurial skills, understand the various operations involved in venture creation, identify scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies.	
Suggested Readings	**Text Book**: • Adams, D. J., & Sparrow, J. C. (2008). Enterprise for life scientists: Developing innovation and entrepreneurship in the biosciences. Bloxham: Scion. • Shimasaki, C. D. (2014). Biotechnology entrepreneurship: Starting, managing, and leading biotech companies. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier. **References:** • Onetti, A., & Zucchella, A. (n.d.). Business modeling for life science and biotech companies: Creating value and competitive advantage with the milestone bridge. Routledge. • Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press. • Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.	

BT20.607	**Environmental Biotechnology**	**3-0-0-3**
Course Objective	To introduce the students to various regional and global concerns regarding the environment, including the natural challenges, various types of environmental pollutants and their effects, the changing environment, and the developments of diverse technologies to detect, study and address these concerns. The subject aims to introduce specific examples and cases, and explain how chemical, biological and molecular sciences can be applied to identify and	

address issues of environmental concerns.

Sources, generation, classification & composition of pollutants; effect on living organism; Persistence and bio-magnification of xenobiotic molecules. Biological and Chemical methods for detection of Wastes; Need for management of resources.	8
Biodegradation. Acclimation, detoxification activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Methods in determining biodegradability; Contaminant availability for biodegradation.	8
Microbial degradation of aliphatic and aromatic compounds; Microbial degradation of halogenated and sulfonated compounds; Biodegradation of pesticides.	6
Bioremediation, Constraints, advantages and applications; Types of bioremediation, Bioaugmentation and biostimulation; factors affecting bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol.	9
Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, bioreactors; Phytoremediation.	
Sources of heavy metal pollution; Microbial interactions with inorganic pollutants - Microbial metal resistance; Microbial transformation; Accumulation and concentration of metals; Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills.	8

Course Outcome

By the end of the course, the student should be able to

- Recognise the various global and regional environmental concerns due to natural causes and/or human activities, and the impact of these on various forms of life including native biodiversity.
- Investigate some examples of different types of environmental pollution and their impacts Describe the applications of various fields including chemistry, biochemistry, molecular biology and/or microbiology, in understanding and addressing the above issues, as well as exploring environmental resources for new technologies.
- Demonstrate an awareness of emerging concerns such as climate change, waste management or reductions in fossil fuels, and new technologies for addressing these.

Suggested Readings

Text Book:

- Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition,

McGraw-Hill, 2000.
- Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999.

References:

- K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999.
- Martin Alexander, Biodegradation and Bioremediation, 2nd edition, Academic Press, 1999.
- M.N.V. Prasad, Kazimierz Strzalka, Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, Kluwer Academic Publishers, Dordrecht Hardbound, 2002.
- Baker, K.H and Herson, D.S.BioremediationMcGraw Hill, Inc. New York, 1994.
- M.V.Levin&Gealt, M.A., Biotreatment of Industrial & Hazardous Waste McGraw Hill. Inc. 1993.
- Martin Alexander, Biodegradation and Bioremediation (2^{nd}editon). Elsevier Science & Technology. 1999.
- Raina M. Maier, Ian L. Pepper, Environmental Microbiology. Academic Press. 2001.

BT20.609 Critical Analysis of Classical Papers 2-0-0-2

Course Objective The objectives of this course are to familiarize the students with classic literature to make them appreciate how ground-breaking discoveries were made without, necessarily, use of high-end technologies.

Execution: There are sixteen classical papers. Each students will be taking one paper for analysis. Each week there may be a 1.5-hour presentation cum discussion for each of the papers. At the end of the semester each student will be asked to write a mini-review (2-3 pages long) on any of the sixteen papers, other than the one he/she presented/discussed.

Course Outcome Students should be able to train in the exercise of hypothesis building and methods of addressing the hypothesis with readily available technology.

Molecular Biology

1 Studies on the chemical nature of the substance inducing transformation of Pneumococcal types: Induction of transformation by a desoxyribonucleic acid fraction isolated from Pneumococcus type III.
Avery OT, Macleod CM, McCarty M.; J Exp Med. 1944 Feb 1;79(2):137-58.

Note: This paper demonstrates that DNA is the transforming Principle originally described by Fredrick Griffith.

2 Independent functions of viral protein and nucleic acid in growth of bacteriophage
Hershey AD and Chase M.; J Gen Physiol. 1952 May;36(1):39-56.

Note: This paper demonstrates that DNA, and not protein, component of phages enter bacterial cells.

3 Molecular structure of nucleic acids; a structure for deoxyribose nucleic acid
Watson JD and Crick FH; Nature. 1953 Apr 25;171(4356):737-8

Note: In this one page paper Watson and Crick first described the structure of DNA double helix
Study help - Watson_Crick_Nature_1953_annotated

4 Transposable mating type genes in Saccharomyces cerevisiae
James Hicks, Jeffrey N. Strathern & Amar J.S. Klar; Nature 282, 478-483,1979
Note: This paper provided evidence for „cassette hypothesis" of yeast mating type switches i.e. interconversion of mating types in yeast (S. cerevisiae)

occurs by DNA rearrangement.

5 Messelson and Stahl experiment demonstrating semi-conservative replication of DNA
Meselson M and Stahl FW.; Proc Natl Acad Sci U S A. 1958 Jul 15;44(7):671-82
Note: The experiment demonstrating semi-conservative mode of DNA replication is referred to as "the most beautiful experiment in biology"

6 In vivo alteration of telomere sequences and senescence caused by mutated Tetrahymena telomerase RNAs
Guo-Liang Yu, John D. Bradley, Laura D. Attardi & Elizabeth H. Blackburn; Nature 344, 126-132, 1990
Note: This paper demonstrates that the telomerase contains the template for telomere synthesis

Cell Biology

1 A protein-conducting channel in the endoplasmic reticulum
Simon SM AND Blobel G.; Cell. 1991 May 3;65(3):371-80

Note: This paper demonstrates the existence of a protein conducting channel
Study help - A brief history of Signal Hypothesis

2 Identification of 23 complementation groups required for post-translational events in the yeast secretory pathway
Novick P, Field C, Schekman R.; Cell. 1980 Aug;21(1):205-15

Note: In this groundbreaking paper Randy Schekman's group used a mutagenesis screen for fast sedimenting yeast mutants to identify genes involved in cell secretion

3 A yeast mutant defective at an early stage in import of secretory protein precursors into the endoplasmic reticulum
Deshaies RJ and Schekman R.; J Cell Biol. 1987 Aug;105(2):633-45

Note: Using another yeast mutation screen Schekman lab identifies Sec61, a component of ER protein Conducting Channel (PCC)
Suggested reference paper - A biochemical assay for identification of PCC.

4 Reconstitution of the Transport of Protein between Successive Compartments of the Golgi

Balch WE, Dunphy WG, Braell WA, Rothman JE.; Cell. 1984 Dec;39(2 Pt 1):405-16

Note: This paper describes setting up of an in vitro reconstituted system for transport between golgi stacks which eventually paved the way for identification of most of the molecular players involved in these steps including NSF, SNAP etc.

5 A complete immunoglobulin gene is created by somatic recombination

Brack C, Hirama M, Lenhard-Schuller R, Tonegawa S.; Cell. 1978 Sep;15(1):1-14

Note: This study demonstrates DNA level molecular details of somatic rearrangement of immunoglobulin gene sequences leading to the generation of functionally competent antibody generating gene following recombination.

6 A novel multigene family may encode odorant receptors: a molecular basis for odor recognition

Buck L and Axel R; Cell. 1991 Apr 5;65(1):175-87

Note: This paper suggests that different chemical odorants associate with different cell-specific expression of a transmembrane receptor in Drosophila olfactory epithelium where a large family of odorat receptors is expressed.

7 Kinesin walks hand-over-hand

Yildiz A, Tomishige M, Vale RD, Selvin PR.; Science. 2004 Jan 30;303(5658):676-8

Note: This paper shows that kinesin motor works as a two-headed dimeric motor walking hand-over-hand rather than like an inchworm on microtubule tract using the energy of ATP hydrolysis.

Developmental Biology/ Genetics

1 Mutations affecting segment number and polarity in Drosophila

Christiane Nusslein-Volhard and Eric Weischaus; Nature 287, 795-801, 1980

Note: This single mutagenesis screen identified majority of the developmentally important genes not only in flies but in other metazoans as well.

2 Information for the dorsal--ventral pattern of the Drosophila embryo is stored as maternal mRNA

Anderson KV and Nüsslein-Volhard C; Nature. 1984 Sep 20-26;311(5983):223-7

Note: This landmark paper demonstrated that early dorsal-ventral pattern information is stored as maternal mRNA in flies and devised the method of identifying genes encoding such genes

3 Hedgehog signalling in the mouse requires intraflagellar transport proteins

Huangfu D, Liu A, Rakeman AS, Murcia NS, Niswander L, Anderson KV.; Nature. 2003 Nov 6;426(6962):83-7

Note: One of the architects of original fly mutagenesis screens conducted a mouse mutagenes screen which identified a gene Kif3a as a major component of hedgehog signaling pathway. Eventually this discovery revolutionizes our understanding of mechanisms of action of signaling pathways by demonstrating central role of cilia in it.

Suggested Reference paper - Design and execution of a embryonic lethal mutation screen in mouse

BT20.611 **Project Proposal** **2-0-0-2**

Course Objective

The objectives of this course are to prepare the students to present their topic of research and explain its importance to their fellow classmates and teachers.

Poster Presentation: Students will have to present the topic of their project proposal after few months of their selection of the topic. They should be able to explain the novelty and importance of their research topic.

Oral Presentation: At the end of their project, presentation will have to be given by the students to explain in detail the work done by them. Along with summarizing their findings they should also be able to discuss the future outcomes of their work.

Course Outcome

Students should be able to learn how to present and explain their research findings to the audience affectively.

BT20.613 **Research Seminar** **1-0-0-1**

Course Objective

The objectives of this course are to train the students to evaluate research papers, to assess quality of the papers and how the papers are refereed and published as well as learn how to get the papers published.

Student presentations: Each student will need to present one paper during the term. They should select research papers, which deal with upcoming or most recent scientific findings/breakthrough and technologies developed.

Class evaluations and discussions: Every week, each student will be asked to write a short review and evaluations of the paper presented in the class and then indulge in discussion with flaws of the paper, important questions and impact of the overall paper. Recent technologies, can be discussed, where it can be applied.

Course Outcome

Students should be able to –

- Critically analyse the research papers from different upcoming topics.
- Understand the weaknesses and strengths of the paper and what additional experiments could have been done to strengthen the research study.
- Understand the context of the paper and identify important questions.
- Acquire the skills in paper writing and getting it published.

BT20.619 **Biotechnology Laboratory-III** **0-0-6-3**

Course Objective

To learn - microbial process fundamentals, enzyme catalysis. Bioreactor design and analysis.

- Kinetics of growth in batch cultivation- estimation of Monod kinetic parameters
- Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.
- Development of enzyme assays and quantification of enzyme activity and specific activity
- Enzyme kinetics
- Effect of pH and temperature on enzyme activity
- Use of surfactants to enhance biodegradation of hydrophobic substrates
- Analysis of water quality/BOD/DO
- Tools for reference management like Mendeley, Zotero, EndNote
- Plagiarism Analysis using Urkund or TurnItIn softwares
- Research paper writing and citation analysis

Course Outcome

1. The student understands about biological and kinetic concepts underlying bioprocesses engineering.
2. The student able to learn procedures for the design and control of industrial scale fermentation and biological waste treatment processes.

BT20.602 **Dissertation** **0-0-40-20**

Course Objective

The objectives of this course are to prepare the students to adapt to the research environment and understand how projects are executed in a research laboratory. It will also enable students to learn practical aspects of research and train students in the art of analysis and thesis writing.

Planning & performing of experiments: Based on the project proposal submitted in earlier semester, students should be able to plan, and engage in, an independent and sustained critical investigation and evaluate a chosen research topic relevant to biological sciences and society. They should be able to systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions. Senior researchers should be able to train the students such that they can work independently and are able to understand the aim of each experiment performed by them. They should also be able to understand the possible outcomes of each experiment. Thesis writing: At the end of their project, thesis has to be written giving all the details such as aim, methodology, results, discussion and future work related to their project. Students may

aim to get their research findings published in a peer-reviewed journal. If the research findings have application-oriented outcomes, the students may file patent application.

Course Outcome

Students should be able to learn how to select and defend a topic of their research, how to effectively plan, execute, evaluate and discuss their experiments. Students should be able to demonstration considerable improvement in the following areas:

- In-depth knowledge of the chosen area of research.
- Capability to critically and systematically integrate knowledge to identify the issues that must be addressed within the framework of the specific thesis.
- Competence in research design and planning.
- Capability to create, analyse and critically evaluate different technical solutions.
- Ability to conduct research independently.
- Ability to perform analytical techniques/experimental methods. Project management skills.
- Report writing skills.
- Problem solving skills.
- Communication and interpersonal skills.

BT20.615 Biocatalysis and Biotransformation **3-0-0-3**

Course Objective

To introduce the students about importance of biocatalysts in industry and role of biotransformation for product developments

Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes	8
Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system	8
Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation	8
Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds	
Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc.	8
Stresses related defense enzymes in plants and animals, Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc.	8

Course Outcome

After successful completion of this course, students will be able to reflect a broad knowledge about enzymes and their applications in academia and industry and have an overview of relevant bio-transformations

Suggested Readings

Text Book:

- Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press
- Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press

References:

- Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford
- Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.

FS20.510	**Introduction to Forensic Biotechnology**	**3-0-0-3**

Course Objective:

To give insight of biotechnology applicable in forensic area

Serology and Immunology **6**

Cell structure and functions. Structure and function of carbohydrates, fats and proteins, serum proteins, haemoglobin and its variants, haptoglobins, HLA, polymorphic enzymes, blood groups-history, biochemistry and genetics of ABO, Rh, Mn and other systems, Methods of ABO blood grouping from fresh blood and biological stains, body fluids, determination of secretor status, polymorphic enzyme typing, serogenetic markers, determination of origin of species, immunology, immune response, antigens, haptens and antibodies, function and rising of antisera, lectins.Bloodstains investigations: Blood pattern analysis, ageing of bloodstains, difference between human and animal bloodstains, spectroscopic analysis.

Forensic Biology **8**

General plant classification schemes. Sub specialisation of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology.Wood and timber analysis.Diatoms and their forensic importance.Study and identification of various diatoms.Paper and pulp identification.

Hair examination **8**

Collection and preservation of hair samples.Morphological and microscopic examination of human and animal hair. Hair growth and development, determination of origin, race, sex, site from hair. Comparison between human and non-human hair.Macroscopic and microscopic features of hair.

Wildlife Forensics **8**

Introduction and importance of wild life. Protected and endangered species of animals and plants.Sanctuaries and their importance.Introduction to Wildlife (Protection) Act 1972 and CITES, Relevant provision of wild life and environmental act. Types of wildlife crimes, different methods of killing and poaching of wildlife animals

DNA Profiling **9**

Double helical structure of DNA, alternate forms of DNA double helix, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA.Nature and structure of human genome and its diversity.mt-DNA, Y-Chromosomes and the peopling, migration, of modern humans, Forensic DNA profiling and its application in criminal and civil investigations.

Text Books

Butler, J; Advanced Topics in Forensic DNA Typing: Methodology, 1st Ed., Academic Press, London, 2009.

Easteal, S. McLeod, N. & Reed, K; DNA Profiling: Principles, Pitfalls and Potential, Harwood Academic Publishers, New Jersey, 1991.

Reference Books

Rudin, N. & Inman, K; An Introduction to Forensic DNA Analysis, Second Ed.,CRC press, New York, 2001.

Spencer, C; Genetic testimony: a guide to forensic DNA profiling, Pearson, New Delhi, 2004.

Brown, T; Gene cloning and DNA analysis: An Introduction , 5th ed. Blackwellpublishing, London, 2006

BT20.512	**Food Technology**	**3-0-0-3**
Course Objective	To impart knowledge of various areas related to Food Science and Technology, To enable the students to understand food composition and its physicochemical, nutritional, and microbiological aspects,	
	Food and Fermentation Technology: Origin, Scope and development of fermented food products, Microbial starters for food fermentations.	10
	Fermented Foods- Bread, Vinegar, Beer, Wine, polysaccharides, low calorie sweeteners, Vitamins, Fermented vegetables, Nutraceuticals, Prebiotic and Probiotic foods, Genetically modified foods, Nano foods.	
	Fermented dairy products- Milk and Curd, Yoghurt, Buttermilk, Cheese, Oriental fermented foods,	
	Single cell protein, Mushroom cultivation **Spoilage and Preservation**:	9
	Factors affecting microbial growth in foods- extrinsic and intrinsic,	
	Contamination of foods (cereals, Vegetables and Fruits, Meat and Meat products and Fish, Milk and milk products, canned foods) and their involvement in disease outbreaks,	
	Spoilage detection and characterization.	
	Methods of food preservation (thermal processing, refrigeration, dehydration, irradiation, microfiltration, chemical preservatives).	
	Food Borne Infections and Intoxications: Microbial toxins in food- Chemical Structure and Types, Food borne illnesses caused by- *Brucella, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio and Yersinia,* Diseases caused by Fungi, Emerging pathogens, *E.coli*O157:H7, *Listeria monocytogens, Campylobacter jejuni, Helicobacter pylori*	9
	Packaging and Quality Control:	5
	Need and method of packaging (glass, metal, plastics, moulded pulp and aluminium foil), Controlled atmosphere packaging, Tetra pack, Nano capsule, Nano membrane.	
	Detection of food pathogens- Culture methods, Rapid detection using PCR	6
	Food standards- Standards for Milk, Poultry, Food control agencies- BIS, Codex commission,	

Food laws and current concepts in food safety (HACCP, quantitative risk assessment and prediction based systems)

Disposal and treatment of food industry waste

Course Outcome

The students will have knowledge about different processing and preservation methods and principals involved.
Students will have learnt about packaging materials, methods and their applications in food industry.

Suggested Readings

Text Book

- Frazier and Westhoff, Food Microbiology, Tata McGraw Hill Publishing Company, Ltd, New Delhi
- Banwart,GJ: Basis of Food Microbiology, CBS Publishers and Distributors, New, Delhi

References

- Adams and Moss, Food Microbiology, Royal Society of Chemistry Publication, Cambridge

BT20.617 Molecular Diagnostics **3-0-0-3**

Course Objective

The objectives of this course are to sensitize the students about the recent advances in molecular biology and various facets of molecular medicine which has the potential to profoundly alter many aspects of modern medicine including the pre- or post-natal analysis of genetic diseases and identification of individuals predisposed to disease ranging from common cold to cancer.

Genome Biology in Health & Disease DNA, RNA, Protein: An overview; chromosomal structure & mutations; DNA polymorphism: human identity; clinical variability and genetically determined adverse reactions to drugs. 5

Genome: Resolution, Detection & Analysis PCR: Real-time; ARMS; Multiplex; ISH; FISH; ISA; RFLP; DHPLC; DGGE; CSCE; SSCP; Nucleic acid sequencing: new generations of automated sequencers; Microarray chips; EST; SAGE; microarray data normalization & analysis; molecular markers: 16S rRNA typing; Diagnostic proteomics: SELDI-TOF MS; Bioinformatics data acquisition & analysis. 6

6

Diagnostic Metabolomics Metabolite profile for biomarker detection in the body fluids/tissues under various metabolic disorders by making

use of LCMS & NMR technological platforms.

Detection & Identity of Microbial Diseases Direct detection & identification of pathogenic-organisms that are slow growing or currently lacking a system of invitro cultivation as well as genotypic markers of microbial resistance to specific antibiotics.

Detection of Inherited Diseases Exemplified by two inherited diseases for which molecular diagnosis has provided a dramatic improvement of quality of medical care: - Fragile X Syndrome: Paradigm of the new mutational mechanism of the unstable triplet repeats, von-Hippel Lindau disease: recent acquisition in the growing number of familial cancer syndromes. 4

Molecular Oncology Detection of recognized genetic aberrations in clinical samples from cancer patients; types of cancer-causing alterations revealed by next-generation sequencing of clinical isolates; predictive biomarkers for personalized onco-therapy of human diseases such as chronic myeloid leukemia, colon, breast, lung cancer and melanoma as well as matching targeted therapies with patients and preventing toxicity of standard systemic therapies. 5

Course Outcome

Students should be able to understand the various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in the early diagnosis and prognosis of human diseases.

Suggested Readings

Text Book:

- Campbell, A. M., & Heyer, L. J. (2006). Discovering genomics, proteomics, and bioinformatics. San Francisco: Benjamin Cummings.

References

- Brooker, R. J. (2009). Genetics: Analysis & principles. New York, NY: McGraw-Hill.
- Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). Molecular biotechnology: Principles and applications of recombinant DNA. Washington, DC: ASM Press.
- Coleman, W. B., & Tsongalis, G. J. (1997). Molecular diagnostics: For the clinical laboratorian. Totowa, NJ: Humana Press.

Mody University of Science & Technology

Ph.D.

(Effective from Academic Year 2020-21)

MODY UNIVERSITY
OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH • RAJASTHAN
A Leading Women's University

RM20.711 **Research Methodology** **3-0-2-4**

Course Objectives:

1. To equip students with knowledge, abilities and insight in research methodology and related interdisciplinary fields.
2. To plan and design research using scientific and statistical methods.

1. Introduction to Research: Meaning, nature, purpose and motivation; Types of research – exploratory, descriptive, causal, and analytical; Research process; Definition of construct and variables and types of variables; Bases for choosing a topic; Problem definition; Literature review, Identification of research gap; Formulation of objectives; Signification and relevance of research objectives. **[06]**

2. Research Design and Sampling: Research Design - Meaning, need, features, types, important concepts, developing a research plan. **[06]**
Sampling: Census and Sample Survey, implications and types of sampling, process of sample selection, criteria and characteristics of selecting a good sample.

3. Scaling and Methods of Data Collection: Definition and types of scales, construction of measurement scale, errors, test of sound measurement scale. **[06]**
Methods of data collection: Types, sources and methods (Qualitative and Quantitative).

4. Statistical Tools for Data Analysis*: Measures of central tendency – Mean, Median, Mode, Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness, Correlation – Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests – Chi-Square test. **[09]**

5. Application of Computer in Research*: MS office and its application in Research, Use of Internet in Research – Websites, Search Engines, E-journal and E-Library – INFLIBNET. **MS-Excel:** Data representation, application of inbuilt formulas, formulation of equation using BODMAS rule in MS-Excel. **[06]**

6. Foundation of Research and Report Writing*: Significance and technique of interpretation, importance of report writing, types of reports, structure and components, writing research proposal and synopsis, planning phase of report writing (cauterization), Bibliography, Appendices, referencing, Style Manuals – APA style, MLA style, ASA style, Harvard/IEEE etc), plagiarism, journals, citations and indexing, funding agencies, ethics in research, characteristics of a good research report. **[06]**

Remark: 39 Hours for Lecture and 26 Hours for Practical*.

Course Outcome:

1. Develop the ability to understand and analyse the problems and able to connect the problem with practical and present scenario.
2. Develop the ability to think independently as well as scientifically towards for continuous lifelong learning process.
3. Analyse the situation, convert into problem and find its solution.

Suggested Readings

1. Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill.India.
2. Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics.Cengage Learning. India
3. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
4. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House(Pvt.) Limited, (2), New Delhi.
5. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
6. Krishnaswami, O. R., Ranganatham M. (2011). Methodology of Research in SocialSciences. Himalaya Publishing House. India
7. Kothari C. R. (2004). Research Methodology: Methods and Techniques. New AgeInternational (P) Publisher. New Delhi
8. Lambert, Joan , Frye, Curtis D. (2016). Microsoft Office 2016 Step By Step. PHI
9. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd. India
10. Sekaran Uma (2003). Research Methods for Business. Wiley India.
11. Zikmund, Babin, Carr, Griffin (2003). Business Research Methods. Cengage Learning,India.

https://www.proschoolonline.com/blog/top-10-data-analytics-tools

BT 761	Forensic Biotechnology	3-0-0-3
Forensic Serology: General Introduction, Collection, preservation and packing of Biological fluids. Forensic applications of Isozymes and Polymorphic proteins. Introduction to Human Leucocyte Antigen, classification and typing		**[6]**
DNA profiling: Nuclear DNA and Mitochondrial DNA Techniques involved: PCR, Sequencing, RFLP analysis, analysis of STR, SNP Significance of DNA profiling DNA extraction/isolation from different samples, FTA cards, Ethical issues		**[7]**
Forensic Toxicology: Brief Idea of Toxins and Drugs, Extraction, separation and Identification		**[4]**
Wild Life Forensics: Collection, Processing and Examination of forensic artefacts: Pug marks, Horn, Skin, Fur, Hair, Nail and Teeth. Extraction of species specific antigens. Introduction to forensic entomology and forensic microbiology, Wild Life Protection Act		**[9]**
Analytical techniques for forensic applications: Spectroscopy: UV-Visible, NMR and Mass Chromatography: Normal and Reverse Phase, Paper and Column (Gel filteration, Ion exchange and Affinity) Electrophoresis: Agarose, PAGE-1D and 2D, IEF Antigens- Antibody reactions. ELISA, Immuno-electrophoresis, RIA, single diffusion, double diffusion, and rocket electrophoresis Microscopy: Simple and Compound microscope, Phase contrast Microscope, Fluorescent Microscopy, Scanning Electron Microscope (SEM) & Transmission Electron Microscope (TEM) Centrifugation: Density gradient centrifugation, Preparative centrifugation, Analysis of sub-cellular fractions, Ultra-centrifuge- Refrigerated Centrifuges		**[13]**
Suggested Readings **Text Book** 1. H.H Willard etal; Instrumental Methods of Analysis CBS Pub. and Distributors, Delhi (1986). 2. Wilson K and Walker J; Principle and Techniques of Biochemistry and Molecular Biology and Practical Biochemistry, Cambridge University Press **Reference Book** 1. Clark, E.G.C. Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986 2. Brown TA; Gene cloning; Willey-Liss Publications, Singapore. 3. Old & Primrose; Principle of Gene Manipulation; Panima Publications, New Delhi 4. Goldsby et al; Kuby Immunology; Freeman and Company, New York.		

Evaluation Pattern

Course Code	Course Title	Contact Hours per Week	Credits	ETE Duration	Weightage (%)

		L	T	P		Hours	CW	MTE	ETE
BT 761	**Forensic Biotechnology**	3	-	-	3	3	100		

Annexure-VIII

Ph.D. Syllabus

BT 711	**Animal Toxicology**	**3-0-0-3**
	Introduction to the subject, History, Terminology, Disciplines. Basic Principles, Dose, Dose Response, Toxic Effects and Testing methods, Risk Assessment, Exposure Standards and Guidelines. Toxicokinetics: Absorption, Distribution, Biotransformation and elimination of toxic agents Environmental Toxicology, Classification of toxicants, Routes of Exposure, Duration and frequency, category of toxic effects, bio-magnification Cellular Toxicology, Introduction, Effects of toxicant on cell structures, DNA damage Cellular Toxicology, Biochemical disturbance, cellular response and repair Mechanism of Toxicity: Introduction, Dose-response Relationship, Receptor Concept Natural Protection Mechanism: Role of cell organelles, Glutathione Metabolism, Antioxidants Antidotal Therapy: Types and Procedures, free radicals Nanotoxicology: Introduction and Interdisciplinary aspects **Suggested Readings:** 1. Landis WG, Sofield RM, Yu MH. Introduction to Environmental Toxicology, Molecular Substructures to Ecological Landscapes, CRC Press 2. Reviews of Environmental Contamination and Toxicology Springer 3. Worth DJH, Howard G J. Fundamental Toxicology Springer	
Course instructor : Dr. R.S.Chundawat		
Evaluation pattern: End Term Examination of 100 marks		

BT 721	**Plant Microbe Interaction**	**3-0-0-3**
	Introduction: Plant and microbe interaction, Plants as a host environment, The effects of microbes on plant physiology such as effects on photosynthesis, respiration, and the translocation of water and nutrients. Plants defense including structural defenses, biochemical defenses, and the hypersensitive response, Biotechnological perspectives of plant-microbe interaction Plant-Bacteria Interaction: Introduction, Abundance and distribution of bacteria in plants, Epiphytic/Endophytic bacteria, Rhizobacteria, Plant growth-	

	promoting rhizobacteria/bacteria (PGPR/PGPB), Pseudomonads *Bacillus* and as PGPR, Bacteria and plant health, Root nodule formation on legumes by *Rhizobium*spp for nitrogen fixation; other nitrogen fixing systems such as in alder/ *Frankia* and *Azolla*/*Anabaena*, Molecular mechanism of plant growth-promotion and biocontrol by bacteria, Microbial response to plants under habitat-imposed stresses (abiotic and biotic), Pathogenic interactions of bacteria with plants Plant-fungal Interaction: Introduction to fungal biology, Abundance and distribution of fungus in plants (Epiphytic/Endophytic), Mycorrhiza: Ecto, endo and VAM, Survey of fungal diseases important in plant pathology, Diagnostics and preventive measures Plant-virus Interaction: Diversity of plant viruses, Plant diseases caused by virus, Life cycles of plant viruses, Diagnostics and preventive measures Plant-nematode Interaction: Root-knot nematode, role of *Meloidogyne*, Plant health and nematode, Diagnostics and preventive measures **Suggested Readings:** 1. Burns and Slater. Experimental Microbial Ecology, Blackwell Scientific Publications, Oxford 2. Alexander M. Microbial Ecology, John Wiley and Sons 3. Atlas RM and Bartha R. Microbial Ecology: Fundamentals and Principles, Benjamin Cummins, USA	
Course instructor : Dr. D.K.Choudhary		
Evaluation pattern: End Term Examination of 100 marks		

BT 731	**Plant Transgenic Biology**	**3-0-0-3**
	Agrobiology: *Agrobacterium*-plant interaction, T-DNA transfer mechanism, *Agrobacterium* based vectors, Binary and shuttle vectors. Genetic Transformation: *Agrobacterium*-mediated gene delivery, Co -integrate and binary vectors and their utility, Direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods, Screenable and selectable markers, Characterization of transgenics, Marker-free Methodologies, Gene silencing, Chloroplast transformation Application of Plant Transformation: Herbicide resistance, Bacterial resistance, Viral resistance, Fungal resistance, Insects and pathogens resistance, Drought, Salinity, Thermal stress, Flooding and submergence tolerance, Plants as Bio-factories, Metabolic engineering of plant secondary metabolites pathways of metabolism Molecular Marker-aided Breeding: Conventional plant breeding, Non PCR and PCR based molecular markers- RFLP, RAPD Markers, STS, microsatellites, SCAR, SSCP, AFLP, QTL, map based cloning, molecular marker assisted selection.	

	Transgenic animal production, Methods of transgene delivery, Integration of foreign genes and their validation, Gene targeting methods and strategies, Expression of mammalian genes into prokaryotic and eukaryotic cell **Suggested Readings:** 1. Henry RJ. Practical Application of Plant Molecular Biology, Chapman and Hall Publishers 2. Glick and Pasternak.Molecular Biotechnology: Principles and application of Recombinant DNA, ASM Press 3. P.K.Gupta: Elements of Biotechnology, Rastogi and Co. Publishers 4. Freshney I. Culture of Animal Cells, Wiley-Liss. 5. Hafez B, Hafez ESE. Reproduction in Farm Animals, Wiley-Blackwell. 6. Houdebine LM. Transgenic Animals: Generation and Use, CRC Press. 7. Decker J and Reischl U. Molecular Diagnosis of infectious diseases, 2nd Edition, Humana Press	
Course instructor: R.K. Gaur		
Evaluation pattern : End Term Examination of 100 marks		
BT 741	**Biocatalysis and Biotransformation**	**3-0-0-3**
	Introduction: Importance of catalyst, Catalyst vs Biocatalyst, Kinetics, Mechanisms of action, Mode of Regulation, Allosteric enzymes, Investigation of active sites and catalytic mechanism, Enzyme Engineering, Non protein enzymes Sources of a Biocatalyst, Isolation strategies, Assay Methods, Strain Improvement, Extracellular and Intracellular enzymes, Properties, Mechanisms of secretion, regulation of enzyme synthesis, Recovery and Purification of fermentation product, Enzymes in non-aqueous system Industrial Application of Enzymes: Immobilization Kinetics, Batch and Continuous Mode of Fermentation Application of enzymes in Diagnosis and Treatment, Research Sector, Biotransformation Industry and Biodegradation of Xenobiotic compounds Enzymes in soil nutrients recycling, Green House gases sequestration, Nitrogen Fixation etc. Stresses related defense enzymes in plants and animals Enzymes in energy production: Bioethanol, Biogas, Biohydrogen etc. **Suggested Readings:** 1. Comprehensive Biotechnology, 2004. Murray M Y (ed). Pergamon Press 2. Enzyme Technology, 1990. Chaplin M F and Bucke C. Cambridge University Press 3. Biotol- Technological Applications of Biocatalysts, 1993. Barker R D J (ed). Butterworth Heinemann Ltd. Oxford	

	4. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2007. Palmer T. and Bonner P L R. Harwood Publication, London.	
Course instructor: Dr. K.P.Sharma		
Evaluation pattern: End Term Examination of 100 marks		

BT 751	**Environmental Biotechnology**	**3-0-0-3**
	Sources, generation, classification & composition of pollutants;effect on living organism;Persistence and biomagnification of xenobiotic molecules. Biological and Chemical methods for detection ofWastes; Need for management of resources. Biodegradation. Acclimation, detoxification activation, bio-availability, effect of chemical structure on biodegradation, recalcitrance, predicting products of biodegradation, co-metabolism and biotransformation. Methods in determining biodegradability; Contaminant availability for biodegradation. Microbial degradation of aliphatic and aromatic compounds; Microbial degradation of halogenated and sulfonated compounds; Biodegradation of pesticides. Bioremediation, Constraints, advantages and applications; Types of bioremediation, Bioaugmentation and biostimulation; factors affecting	

	bioremediation, treatability studies for bioremediation- purpose, experimental design and example protocol. Advantages and disadvantages of specific bioremediation technologies- land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands, bioreactors; Phytoremediation. Sources of heavy metal pollution; Microbial interactions with inorganic pollutants - Microbial metal resistance; Microbial transformation; Accumulation and concentration of metals; Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills. **Suggested Readings:** 1. Bruce Rittman, Perry L. McCarty, Environmental Biotechnology: Principles and Applications, 2nd edition,McGraw-Hill, 2000. 2. Milton Wainwright, An Introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston. Hardbound, 1999. 3. K.G. Mukerji, B.P. Chamola, Rajeev K. Upadhyay, Biotechnological Approaches in Biocontrol of Plant Pathogens, Kluwer Academic/Plenum Publishers. Hardbound, 1999. 4. Martin Alexander, Biodegradation and Bioremediation, 2nd edition, Academic Press, 1999. 5. M.N.V. Prasad, Kazimierz Strzalka, Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants, Kluwer Academic Publishers, Dordrecht Hardbound, 2002. 6. Baker, K.H and Herson, D.S.BioremediationMcGraw Hill, Inc. New York, 1994. 7. M.V.Levin&Gealt, M.A., Biotreatment of Industrial & Hazardous Waste McGraw Hill. Inc. 1993. 8. Martin Alexander, Biodegradation and Bioremediation (2nd editon). Elsevier Science & Technology. 1999. 9. Raina M. Maier, Ian L. Pepper, Environmental Microbiology. Academic Press. 2001.	
Course instructor: Dr. Pankaj Kumar Jain		
Evaluation pattern: End Term Examination of 100 marks		

MS 711 Advanced Computational Methods and MATLAB 3-1-0-4

Algebraic and Transcendental Equations: General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graeffe's root squaring method, Muller's method, Bairstow iterative method. **[7]**

System of Linear Equations and Boundary Value Problems: Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, relaxation method, convergence of iteration methods. Finite difference scheme for linear and non linear boundary value problems, shooting method, finite difference method **[8]**

Partial Differential Equations: Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations. **[8]**

Elements of MATLAB-I: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. **[8]**

Elements of MATLAB-II: Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs. **[8]**

Text Books:

1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd.
2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press.

Reference Books:

1. Balagurusamy E. (2008), Numerical Methods, 25th reprint, McGraw-Hill Education (India) Ltd.
2. Shastry S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd.
3. Srimanta Pal (2009), Numerical Methods, 1st ed., Oxford University Press, Oxford.
4. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)		
		L	T	P		Hours	CW	MTE	ETE

MS 711	Advanced Computational Methods and MATLAB	3	1	-	4	3	---	---	100

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
1.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
2.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
3.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
4.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**
5.	**Elements of MATLAB:** Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 1. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 2. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 3. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 4. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.		
Reference Books: 1. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 2. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited.		

3. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education.
4. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

MS 20.701	**Advances In Mathematics**	**4-0-0-4**
6.	**Mathematical Modeling and Simulation:** System concepts and theories, attributes and types of systems, system dynamics- system flow, flow diagrams, notations and conventions, feedback systems and casual loops diagrams, Random number generation, properties of random numbers, generation of pseudo random numbers, techniques for generating random numbers test for randomness, random variates, inverse transform methods (exponential, uniform, weibull), convolution methods and acceptance-rejection methods.	**[10]**
7.	**Graph Theory (Modeling, Applications, and Algorithms):** Basics of graphs and directed graphs, degree vectors of simple graphs, basics of trees, cut–sets, planar and dual graphs, basics of coloring, matrix representation of graphs, signal-flow graphs, and graphs in Markov processes.	**[10]**
8.	**Numerical Solution of Equations and System of Linear Equations:** General iterative methods and their convergence (Bisection, Newton-Raphson and method of false position), Graffe's root squaring method, Muller's method, Bairstow iterative method; Existence of solution, ill-conditioned system, Jacobi iteration method, Gauss-Seidel method, convergence of iteration methods, Finite difference scheme for linear and nonlinear boundary value problems, shooting method, finite difference method.	**[10]**
9.	**Numerical Solution of ODE and PDE:** Picard's method, Taylor's series method, Modified Euler's method, Predictor-corrector method, Runge-Kutta method of order four, Numerical solution of partial differential equations, finite difference approximation to partial derivatives, solution of Laplace and Poisson equations, solutions of one and two dimensional heat and wave equations, Crank-Nicolson method for parabolic partial differential equations.	**[10]**

10. Elements of MATLAB: Interactive sessions, menus and the toolbar, arrays, files, and plots, script files and the editor, numeric, cell and structure arrays. Elementary mathematical functions, user defined functions, additional functions, working with data files. Relational operators and logical variables, logical operators and functions, conditional statements, loops, the switch structure, debugging MATLAB programs.	**[12]**
Text Books: 5. Jain M.K. and Iyenger S.R.K. (2003), Numerical Methods for Scientists and Engineering Computations, 4th ed., Wiley Eastern Ltd. 6. Rudra Pratap (2003), Getting Started with MATLAB, Oxford University Press. 7. Banks Jerry, Carson II John S., Nelson Barry L. and Nicol David M. (2013) Discrete- Event System Simulation, Fifth Edition, Pearson,. 8. Deo N. (2001) Graph Theory with Applications to Engineering and Computer Science, PHI.	
Reference Books: 5. Shastri S.S. (2006), Introductory Methods of Numerical Analysis, 4th ed., PHI Pvt. Ltd. 6. Chapra (Edition 3), Applied Numerical Methods with MATLAB, McGraw Hill Education (India) Private Limited. 7. Rosen Kenneth H. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Seventh Edition, TMH Education. 8. Singh V.P. (2009) System Modeling and Simulation, New Age International Publishers.	

Evaluation Scheme:

Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weight age (%)		
		L	T	P		Hours	CW	MTE	ETE
MS20.701	Advances In Mathematics	4	-	-	4	3	25	25	50

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Session 2016-2017

BA Honours English 2016-17
B. A. (Hons.) in English

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]

W S Maugham: The Verger [4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct) [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative) [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most) [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation [4]

Reading Comprehension: Efficient reading and note taking [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers [13]

V.S. Naipaul: A House for Mr. Biswas [13]

Khushwant Singh: A Train to Pakistan [13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry	[9]
Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists	[7]
Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening	[9]
Sylvia Plath: Morning Song, Death and Company	[5]
R.W. Emerson: Brahma	[4]
Edgar Allan Poe: The Fall of the House of Usher	[5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree	[4]
Sarojini Naidu: Indian Weaver, The Song of Radha.	[4]
Rabindranath Tagore: Where the Mind is Without Fear	[4]
Sri Aurobindo: Transformation	[3]
Kamala Das: An Introduction as a Writer	[4]
Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S.	[4]
A K Ramanujan: Love Poem for a Wife	[4]
Arun Kolatkar: Chaitanya	[4]
Chinua Achebe: Refugee Mother and Child	[4]
Wole Soyinka: Agbor Dancer	[4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.

5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 331 Modern English Language and Phonetics-I 3-0-0-3

Basic Sentence Types – Subject, Verb, Object, Complement, Adverbials [5]

Coordination and Subordination Clauses [5]

Different Notions and Concepts (Request, Order, Purpose, Wish, Suggestion, Obligation, Concession, Condition) [5]

Morphology and Phonology (Various morphs and phonemes) [4]

Word Substitutions and Idioms [3]

Synonyms and Antonyms [3]

Theme Writing [4]

Literary Appreciation [4]

Advanced Comprehension [5]

Suggested Books:

7. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
8. Leech Geoffery: English Grammar for today, Longman, Delhi.
9. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
10. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
11. Quirk & Greenbaum: University English Grammar, Longman Publications.
12. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 341 English Literature : Pre and Post Elizabethans 3-0-0-3

Geoffrey Chaucer : General Prologue to Canterbury Tales (Line1-100) [6]

John Milton : Paradise Lost BK – I (Line 1-49, 94- 124) [10]

John Dryden : Absalom and Achitophel (Line 1-70) [10]

Alexander Pope : Rape of the Lock (Canto I & V) [13]

Suggested Books:

1. Chaucer, Geoffrey, The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.
2. Daiches, David, A Critical History of English Literature (vol. I), Delhi, Allied Publishers.
3. Grose, M. W.: Chaucer: Literature in Perspective.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Tragedy.
5. Rudram, Alan: A Critical Commentary on Milton's Paradise Lost.
6. Pope, Alexander: Rape of the Lock.
7. Dryden, John: Absalom and Achitophel.

EL 351 English Literature: Pre- romantics & Romantics-I 3-0-0-3

Thomas Gray : Elegy Written in a Country Churchyard	[6]
William Collins : Ode to Evening	[6]
William Wordsworth : Ode on the Intimation of Immortality	[5]
John Keats : Ode to Grecian Urn, Ode to Autumn, La Belle Dam Sans Merci	[7]
William Hazlitt : On the Ignorance of the Learned	[7]
Jane Austen : Mansfield Park (Non-detailed)	[8]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Ausen, Jane: Mansfield Park.
6. Hazlitt, William: On the Ignorance of the Learned.

EL 361 Twentieth Century English Literature-I 3-0-0-3

W B Yeats : When you are Old, The Second Coming, Byzantium, Lapis Lazuli	[9]
W H Auden : In Memory of W B Yeats	[4]
T S Eliot : The Wasteland	[13]
Samuel Backett : Waiting for Godot (detailed)	[13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).
4. Beckett, Samuel: Waiting for Godot.
5. Eliot, T S : The Wasteland
6. Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers.
7. Smith, Grover: T. S. Eliot's Poetry and Plays.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

Suggested Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press.
2. Hutcheun, Linda, Theorizing the Postmodern in K. M. Newton edited Twentieth Century Literary Theory, London, Macmillan,
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press.
4. Chandra, Naresh, New Criticism: An Appraisal, New Delhi, Doaba Publishing House.
5. Aristotle, Poetics, translated by S. H. Butcher.
6. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press.
7. Wright, Elizabeth, Psychoanalytic Criticism: Theory in Practice, Metheun,
8. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Oxford University Press.
9. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan.

EL 332 Modern English Language and Phonetics-II 3-0-0-3

Question Tags	[4]
Transformation : Active-Passive voice, Direct-Indirect Narration, Assertive into Negatives and Interrogatives	[5]
Punctuations	[4]
Translations (English to Hindi, Hindi to English)	[6]
Phonemic Symbols for Sounds of English, practice of Phonetic transcription	[5]
Word Structure and word Stress	[5]
Fallacies (Hasty Generalisation, *Petipio Principi*, Non-Sequitur, Composition, Division, *Post Hoc Ergo Propter Hoc*)	[5]
Common Errors in English	[3]
Word Power and Vocabulary	[2]

Suggested Books:

1. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
2. Leech Geoffery: English Grammar for today, Longman, Delhi.
3. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
5. Quirk & Greenbaum: University English Grammar, Longman Publications.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 342 English Literature: Pre- romantics & Romantics-II 3-0-0-3

S T Coleridge : Kubla Khan [6]

P B Shelley : Ode to Skylark, To Night [6]

A. Tennyson : The Lotus Eaters [5]

Charles Lamb : Imperfect Sympathies, All Fools' Day [9]

Charles Dickens : A Tale of Two Cities (non-detailed) [13]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Dickins, Charles: A Tale of Two Cities.

Lamb, Charles: Imperfect Sympathies and All Fools

EL 352 Victorian Literature 3-0-0-3

Robert Browning : My Last Duchess, Porphyria's Lover, Andrea Del Sarto [10]

G M Hopkins : Spring and Fall, Windhover, Felix Randal [10]

Emily Bronte : Wuthering Heights (non- detailed) [10]

Thomas Hardy : Far From the Madding Crowd (non- detailed) [9]

Suggested Books:

1. Pick, John: Gerard Manley Hopkins: Priest and Poet, Delhi, Oxford University Press
2. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books
3. Rhys, E.: Robert Browning and His Poetry.
4. De Vane, W. C.: A Browning Handbook.
5. Bronte, Emily: Wuthering Heights.
6. Hardy, Thomas. Far From the Madding Crowd.

EL 362 Twentieth Century English Literature-II 3-0-0-3

Ted Hughes : Pike, View of a Pig, Thought Fox [7]

Philip Larkin : Toad, Coming, At Grass [6]

James Joyce : A Portrait of the Artist as a Youngman (non- detailed) [13]

Virginia Woolf : To the Lighthouse (non- detailed) [13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).

BA Honours Psychology 2016-2017
B. A. (Hons.) in Psychology

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology.	[8]
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services.	[7]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling.	[6]
Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.	[9]
Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.	[9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PL 311	**Social Psychology - I**	**3-0-0-3**
	Social Psychology: Nature and Subject Matter; Relationship with other social sciences.	[3]
	Methods: Experimental, Observation, and Sociometry.	[5]
	Socialization: Nature, Process and Agents of Socialization.	[4]
	Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.	[8]
	Social Norms: Meaning, Characteristics and Formation	[5]
	Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants	[6]
	Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional	[8]

PL 321	**Biological Basis of Behaviour**	**3-0-0-3**
	Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical.	[6]
	Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters.	[7]
	Nervous System: Central nervous system and Peripheral nervous system –Structure and Functions. Endocrine system and its behavioral implications.	[9]
	Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention.	[6]
	Motivation: Neural mechanism of Hunger, Thirst and Sex	[5]
	Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory.	[6]

PL 331 Systems of Psychology 3-0-0-3

Nature and scope of Psychology: Psychology as science; Historical Origins: Preexperimental period- Science Among Greeks, British Empiricism, German Nativism.	[4]
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status	[5]
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner.	[7]
Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.	[6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).	[6]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.	[5]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.	[6]

PL 341 Psychopathology-I **3-0-0-3**

Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.	[3]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.	[7]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.	[3]
Diagnostic Assessment: Case History, Interview, Projective Techniques	[5]
Anxiety Based Disorders: Nature, Symptoms and Etiology- Generalized Anxiety Disorders, Phobia, O.C.D, Somatoform and Dissociative Disorders	[12]
Psycho physiological Disorders: Nature, Symptoms and Etiology –Asthma, Peptic Ulcer, CHD, Hypertension	[5]
Mental Retardation: Nature, Types, Causes and its Management	[4]

PL 351	**Industrial and Organizational Psychology-I**	**3-0-0-3**
	Industrial/Organizational Psychology: Nature, historical development and scope.	[5]
	Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.	[9]
	Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme	[9]
	Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal	[10]
	Work environment: Noise, atmospheric conditions. Illumination and performance	[6]

PL 361 Psychological Testing-I 3-0-0-3

Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.	[9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.	[9]
Validity: meaning, validation procedures, and special problems.	[9]
Construction and Standardization of Psychological Tests General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.	[12]

PL 312	**Social Psychology-II**	**3-0-0-3**
	Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.	[6]
	Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects. .	[6]
	Attribution process Nature and theories: Kelly and Weiner.	[6]
	Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies	[5]
	Propaganda: Nature, Tools and Techniques	[5]
	Aggression and Violence: Nature, Determinants and Management.	[5]
	Social Change: Nature, Factors and Theories.	[6]

PL 322 Guidance and Counseling 3-0-0-3

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational.	[5]
Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.	[5]
Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.	[9]
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.	[9]
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling.	[7]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.	[4]

PL 332	Experimental Psychology	3-0-0-3
	Experimental Psychology: Nature and History, Experimental Method	[4]
	Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. **Perception:** Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.	[9]
	Psychophysics: Problems and Methods of Classical Psychophysics.	[8]
	Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.	[6]
	Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning	[5]
	Verbal Learning: Methods, Materials, Organizational Processes.	[3]
	Discrimination Learning: Phenomena, Procedures and paradigms	[4]

PL 342 Psychopathology-II **3-0-0-3**

Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation.	[6]
Mood Disorders: Unipolar and Bipolar Symptoms and Etiology	[10]
Schizophrenia: Nature , Symptoms , Types and Etiology	[11]
Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT	[12]

PL 352	**Industrial and Organizational Psychology-II**	**3-0-0-3**
	Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory.	[7]
	Job Satisfaction: Concept, determinants and measurement.	[5]
	Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.	[6]
	Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.	[6]
	Human engineering: Man-machine system. Designs, displays, controls and action.	[6]
	Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions.	[9]

PL 362	**Psychological Testing-II**	**3-0-0-3**
	Personality Tests: Purpose and Types, **Inventories**-Cattell's 16 PF, MMPI and Neo-five factors.	[9]
	Projective- Rorschach and TAT.	[9]
	Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.	[8]
	Measurement of aptitude and Interest	[6]
	Measurement of Creativity- Torrance Test	[7]
	Anxiety and Depression,	

BA Pass Course 2016-2017

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]
W S Maugham: The Verger	[4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct)	[4]
Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	[4]
Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most)	[6]
Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing	[4]
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	[4]
Reading Comprehension: Efficient reading and note taking	[4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

SO 111 Introduction to Sociology-I 3-0-0-3

Sociology: The Meaning of Sociology, Nature of Sociology, Scope of Sociology-Formalistic and Synthetic School, Sociology and other Social Sciences [10]

Basic Concepts: Society, Community, Social Group, Status and Role [10]

Socialisation: Meaning of Socialisation, Agencies of Socialisation, Theories of Socialisation [9]

Culture: Meaning and Characteristics of Culture, Theory of Cultural Lag, Civilisation, Interrelationship and distinction between Culture and Civilisation [10]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 121 Social Thinkers-I 3-0-0-3

Auguste Comte: Positivism, Law of Three Stages, Social Statics and Social Dynamics [14]

Herbert Spencer: The Evolutionary Doctrine, The Organic Theory [10]

Talcott Parsons: Social Action, AGIL, Pattern Variables [15]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 111 Textile Science and Care 3-0-0-3

Introduction to Textile: basic terminology and classification of textile fibres	[2]
General Properties of Textile Fibres: physical, chemical and other properties of textile fibres	[2]
Properties of different textile fibres and their importance: Cotton, Wool, Silk and other natural fibres Rayon, Acetate, Nylon, Polyester, Acrylic, Glass and other manmade fibres	[4]
Preparation and manufacturing of different textile fibres: Cotton, wool and silk, rayon, acetate, nylon, polyester and acrylic	[10]
Yarn and fabric construction: Spinning methods- mechanical and chemical, yarn classification, methods of fabric construction	[7]
Laundry agents: water, detergents, soaps and other agents	[6]
Stain removal: classification and methods of stain removal	[4]
Care and storage of textiles-care of textiles with reference to service, appearance and economy	[4]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Dantyagi, S.: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
4. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
5. Mullick, P.: Textbook of Home science, Kalyani Publication.
6. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
7. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.

GM 121 Textile Science and care Laboratory 0-0-4-2

Suggested Experiments: Identification of textile fibres- burning, microscopic and solubility tests; Removal of stains from fabrics; Washing, ironing and finishing of textile articles

Suggested Books:

1. Dantyagi, S: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
2. Deulkar, D: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
3. Hollen, N. and Saddler, J: Textiles, New York, Mac millan company.
4. Tortora, P.G: Understanding Textiles, New York, Mac millan company.

GM 131 Apparel Industrial Management 2-0-0-2

Textile Industry: Overview of textile industry, globalization and its impact on textile industry [6]

Status of garment industry in India: Production, marketing, distribution, consumption and export trends over the last five years [4]

Organization and association related to garment industry:

Problems of apparel industry and remedial measures, government role in promoting the growth of garment industry [13]

Sales promotion techniques [3]

Suggested Books:

1. Soundarapandian, M: Textile Industry Under Globalization, New Delhi, Vedams Books (P) Ltd.
2. Gurumurthy, G: A book on Textile Industry's 6-decade Journey, Coimbatore, The Hindu Business Line.
3. The Textile Industry and Trade Journal, Baroda, Comput –Media Services.
4. The Indian Textile Journal. Chennai, IPFonline limited.
5. Textile Trends. Kolkata, Eastland Publications Pvt. Ltd.
6. Textile Research Journal. New Jersey, Textile Research Institute.
7. Textile magazine, Chennai, Gopali and CO.

Note: The Students are advised to refer recent Journals of textiles.

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

Suggested Books:

1. Approach to Life, Kolkata, Orient Longman Ltd.
2. Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press.
3. Lascelles, Abercrombie, Thomas Hardy: A Critical Study, New York, Russel & Russel.
4. Cecil, David, Hardy, the Novelist, London, Constable & Co.
5. Kettle, Arnold (ed), Hardy, the Novelist: A reconsideration in the Nineteenth Century Novel, London, Heinemann.
6. Walker, Hugh: The English Essay and the Essayists.

SO 112 Introduction to Sociology-II 3-0-0-3

Family: Meaning and Characteristics of Family, Functions, Types of Family, Changing Family Patterns	[10]
Marriage: Meaning and Functions of Marriage, Types of Marriage	[6]
Social Change: Meaning and Characteristics of Social Change, Causes of Social Change	[7]
Social Stratification: Meaning and Characteristics of Social Stratification, Caste and Class	[8]
Social Control: Meaning and Nature of Social Control, Process and Means of Social Control	[8]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 122 Social Thinkers - II 3-0-0-3

Karl Marx: Historical Materialism, Class and Theory of Class Struggle	[10]
Max Weber: Social Action, Ideal Type, Protestant Ethics and Spirit of Capitalism	[15]
Emile Durkheim: Social Fact, Suicide, Division of Labour	[14]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 112 Fundamentals of Textile Designing 2-0-0-2

Types of designs: structural and decorative	[2]
Elements of design: line, form, shape, colour and texture	[3]
Principles of design: proportion, rhythm, balance, emphasis and harmony	[3]
Weaving: history of weaving, looms and its parts, different types of weaves	[5]
Knitting: terminology, principles of knitting	[2]
Dyeing: types of dyes, different techniques of dyeing	[6]
Printing: styles and techniques of printing	[5]

Suggested Books:

1. Vastala, R.: Textbook of Clothing and Textiles, Indian Council of Agriculture and Research Publication.
2. Yadla,Vijay Lakshmi and Jasrai, Sucheta: UGC Guide to Home Science.
3. Smith, J. L.: Textiles Processing Printing Dyeing Finishing, Chandigarh, Abhishek Publications.
4. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
5. Tortora, P.G. : Understanding Textiles, New York, Mac millan company.

GM 122 Clothing Construction-I 1-0-0-1

Sewing equipment: Tools required for clothing construction	[3]
Sewing machine: parts of machine their use and care, common machine problems	[3]
Fabric terms and definition	[1]
Preparation of fabric before cutting, placing, marking and cutting patterns	[2]
Taking body measurements	[1]
Simple stitches, seam and seam finish, Disposal of fullness in a garment	[3]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction, Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.

GM 132 Fundamentals of Textile Designing Laboratory 0-0-4-2

Suggested Experiments: Preparation of different types of weave; Preparation of samples of knitting; Dyeing-tie and dye technique; Printing- direct, discharge and resist style

Suggested Books:

1. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.
2. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.

GM 142 Clothing Construction-I Laboratory 0-0-4-2

Suggested Experiments: Sewing tools and handling of sewing machine; Taking body measurements; Construction of following samples: stitches, seams, disposal of fullness, plackets, fasteners and binding

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. The Complete Guide to Sewing: Readers Digest, DK publishing.

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

SO 211 Methodology of Social Research-I 3-0-0-3

Social Research: Meaning, Scope and Significance of Social Research, Scientific Method, Difference between Social Research and Social Survey [12]

Research Design: Meaning and Purpose of Research Design, Types – Exploratory, Descriptive and Experimental Research Design [10]

Sampling: Meaning and Characteristics of Sampling, Steps in Sampling Design, Types of Sampling - Random, Stratified, Cluster and Multi-stage Sampling [12]

Hypothesis: Meaning and Procedure of Hypothesis, Types of Hypothesis. [5]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 221 Sociological Theories-I 3-0-0-3

Structure-functionalism: Radcliffe-Brown – The idea of Social Structure, Malinowski - Functional Analysis [12]

Empirical Functionalism: Merton – Theory of Middle Range, Merton's critique and reformulation of Functional analysis [11]

Conflict Theory: Marx – Conflict Theory, Coser – Functional Analysis of Conflict [11]

Sociology of Knowledge: Karl Mannheim [5]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

GM 211 Textile Finishes 2-0-0-2

Finishes: meaning and its classification	[3]
Basic finishes: singeing, stiffening, mercerization and others	[6]
Surface finishes: delustering, flocking, napping, calendaring and others	[7]
Functional finishes: fireproof, water proof, wrinkle resistance, mothproof and other finishes	[7]
Consumer problems and care labels	[3]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill International Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
4. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
5. Tortora, P.G.: Understanding Textiles, New York, Mac millan publishing company.

GM 221 Clothing Construction-II 1-0-0-1

Importance of clothing	[2]
Application of elements and principles of design for clothing construction	[3]
Factors affecting clothing: Social, psychological and economic	[3]
Wardrobe planning: Principles of wardrobe planning and wardrobe planning for different age groups	[3]
Consumer rights and responsibilities	[2]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Carson, B.: How You Look and Dress, Webster Division, Mc Graw-Hill Book company.
3. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
4. Erwin, M.D and Kinchen, A.L.: Clothing for Moderns, Mac millan Publishing, New York.
5. The Complete Guide to Sewing-Readers Digest, DK publishing.
6. Brocknam, H.L. The Theory of Fashion Design, John Wiley and Sons Inc., New York.

GM 231 Textile Finishes Laboratory 0-0-2-1

Suggested Experiments: Study and identification of finishes; Market survey for collection of fabric samples of different types of weaves; Laboratory tests for different fabric finish; Collection of care labels

GM 241 Clothing Construction-II Laboratory 0-0-4-2

Suggested Experiments: Construction of garments for different age groups

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers	[13]
V.S. Naipaul: A House for Mr. Biswas	[13]
Khushwant Singh: A Train to Pakistan	[13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

SO 212 Methodology of Social Research-II 3-0-0-3

Observation Method: Meaning and Characteristics of Observation Method, Types- Participant, Non- participant and Quasi- participant Observation [10]

Interview Method: Meaning, Objectives and Techniques of Interview Method, Types- Structured, Unstructured and Focused Interview [10]

Questionnaire and Schedule: Meaning, Construction and Application [08]

Analysis of Data and Report Writing: Tabulation, Interpretation of Data and Steps in writing Report [11]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 222 Sociological Theories-II 3-0-0-3

Phenomenology and Ethnomethodology: A. Schutz- Phenomenological Sociology, H.Ganfinkel- Ethnomethodology [11]

Interactionalist Perspective: G.H. Mead and H. Blumer- Symbolic Interactionism [11]

***Verstehen* Approach:** Max Weber [6]

Exchange Theory: Homans - Psychological Exchange Perspective, Blau - Structural Exchange Theory [11]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

CA 111 Fundamentals of Computers and Information Technology 3-0-0-3

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing: Data, Information, Knowledge and Wisdom [8]

Data representation: Representation of Data, Bits and Bytes, Number System; Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Number, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language; Machine Language, Assembly Language, High Level Language, Generation of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 212 Clothing Construction-III 1-0-0-1

Basic pattern: definition and methods of making pattern [2]

Pattern making: Principles of pattern making and process of designing by flat pattern method [4]

Figure irregularities: Types and methods of changing garment according to it [2]

Pattern making: different types of collars, sleeves and skirts [5]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.
4. Hollen, Norma R. and Carolyn J. Kundel: Pattern Making by the Flat Pattern Method. Prentice Hall
5. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

CA 141 Application Software Laboratory 0-0-4-2

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 222 Clothing Construction-III Laboratory 0-0-4-2

Suggested Experiments: Construction of different types of collars, sleeves and skirts by flat pattern method

Suggested Books:

1. The Complete Guide to Sewing.: Readers Digest, DK publishing.
2. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry [9]

Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists [7]

Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening [9]

Sylvia Plath: Morning Song, Death and Company [5]

R.W. Emerson: Brahma [4]

Edgar Allan Poe: The Fall of the House of Usher [5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree	[4]
Sarojini Naidu: Indian Weaver, The Song of Radha.	[4]
Rabindranath Tagore: Where the Mind is Without Fear	[4]
Sri Aurobindo: Transformation	[3]
Kamala Das: An Introduction as a Writer	[4]
Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S.	[4]
A K Ramanujan: Love Poem for a Wife	[4]
Arun Kolatkar: Chaitanya	[4]
Chinua Achebe: Refugee Mother and Child	[4]
Wole Soyinka: Agbor Dancer	[4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.
5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

Suggested Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press.
2. Hutcheun, Linda, Theorizing the Postmodern in K. M. Newton edited Twentieth Century Literary Theory, London, Macmillan,
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press.
4. Chandra, Naresh, New Criticism: An Appraisal, New Delhi, Doaba Publishing House.
5. Aristotle, Poetics, translated by S. H. Butcher.
6. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press.
7. Wright, Elizabeth, Psychoanalytic Criticism: Theory in Practice, Metheun,
8. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Oxford University Press.
9. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan.

SO 311 Gender and Society-I 3-0-0-3

Social Construction of Gender: Gender vs. Biology, Equality vs. Difference, Women in the Family, Gender roles, Development and Women's Empowerment. [9]

Emergence of Feminist Thought: Socio-historical perspective, Mapping various Women's movements. [11]

Gender and Sociological Analysis: Feminist critiques of Sociological Theories, Emergence of Women's Studies. [11]

Gender based Division of Labour: Production vs. Reproduction, Household work, Invisible work, Women's work and technology. [8]

SO 321 Society in India-I 3-0-0-3

Social Change in India: Sanskritisation, Westernisation and Modernisation.	[10]
Marriage in India: *Hindu Marriage- a sacrament, Types and changing patterns; Muslim Marriage- a contact, Types and changing patterns, Divorce among Muslims, Differences between Hindu and Muslim Marriages.*	[9]
Kinship in India: Meaning and Types of Kinship, Kinship Behaviour and Usages, Classificatory Terminology of Kinship.	[7]
Varna and Jati: Origin and changing dimensions.	[7]
Jajmani System: Functions, Roles and Changes in Jajmani System.	[6]

SO 312 Gender and Society-II 3-0-0-3

Women in India: Changing profile, The changing status of women in India—pre-colonial, colonial and post-colonial. [8]

Demographic profile: Sex ratio, Child Sex ratio. [8]

Gender and Society in India: Economy: Marginalisation of Women and Sexual Division of Labour, Polity — Reservation for Women, Religion and Culture, Marriage, Dowry and Property. [15]

Issues affecting the Quality of Life of Women: Health, Education, and Domestic Violence. [8]

SO 322 Society in India-II 3-0-0-3

Indian Society: *Hindu View of Life- Ashramas and Purusharthas*	[9]
India as a Plural Society: *Religion, Language and Region.*	[6]
Challenges of Unity in Diversity: Problems of Communalism, Religionalism, Casteism, Regionalism.	[10]
Tribal Life in India: Religious beliefs and practices, Tribal problems in India.	[5]
Population Problems and Society in India: Population explosion, causes and its remedies, Population Policy, Population and Sustainable Development.	[9]

FR 111 Grammar and Composition-I 3-0-0-3

Articles (definite, indefinite and partitive, contracted)-le,la,les,un,une des and du,de la,des,de l',au,a la,a l',aux.	[6]
Gender: The formation of feminine, The Formation of the Plural, Collective noun. Numbers (coordinal and ordinal).	
Conjugation of different regular and irregular verbs.	[5]
Verb: Regular conjugation, standard spelling irregularities, reflexive verbs, impersonal verbs.	[8]
The sentence, word order, negative expression, direct questions, answers.	[6]
Introduction of Adjectives and their uses in different sentences, Agreement of adjectives, position of adjectives. Affirmative, Interrogative and Negative Sentences.	[5]
Adjectives: demonstrative and possessive	[5]
Plural of adjectives, comparatives and superlatives of adjectives.	[4]
Audio Visual Programme	

FR 121 Written Expression-I 3-0-0-3

Greeting someone in formal and informal situation, Knowledge of etiquettes through telephonic conversation.	[4]
Introducing oneself / speaking of oneself, Giving the time/ giving one's telephone number.	[4]
Introducing someone/ describing a person (indicating one's nationality, saying where one lives, revealing one's profession, saying what one likes or does not like).	[4]
Fixing an appointment over the phone, Expressing one's agreement and disagreement.	[4]
Describing about one's daily activities, Seeking clarification on something.	[3]
Asking and giving information, Describing an action.	[4]
Making hypotheses**,** Solution to problem.	[2]
Study of monuments and different public places	[6]
Study of different geographical/historical/political regions of France.	[8]

Audio Visual Programme

FR 211 Comprehension, Grammar and Translation-I 3-0-0-3

Adverbs: Adverbs of manner, Adverbs of time. Adverbs of place, Adverbs of intensity and quantity.	[7]
Pronoun relative, interrogative, demonstrative, possessive.	[4]
Pronoun: (emphatic, disjunctive, indefinite pronouns, personal pronoun).	[4]
Present indicative and recent past.	[5]
Questions based on seen or unseen passages	[9]
Passive form, subjunctive, impersonal form, translation from English to French	[6]
Possessive adjectives and pronouns.	[4]
Audio Visual Programme	

FR 221 Letter Writing, Composition, Culture and Civilization-I 3-0-0-3

Current important French personalities and events after World War Second in France	[8]
Function of national and regional institution of France.	[7]
History of France (Medieval era & 16th to 18th century)	[8]
Writing of paragraphs and Dialogues, Letter writing (Formal Letters)	[8]

[8]

FR 222 Letter Writing, Composition, Culture and Civilization-II 3-0-0-3

Simple translation, applied translation, skills and techniques in translation.	[8]
Writing resume, application.	[8]
Report writing (formal and informal).	[7]
Translation of passage from French to English and English to French.	[10]
History of France (19th & 20th century).	[6]
Audio Visual Programme	

FR 311 **History of French literature-I** **3-0-0-3**

History of French Literature: Middle age to 17th century.	[5]
Renaissance in France, its origin and significance.	[5]
French revolution: its impact on social and religious philosophy, politics & literature.	[6]
Writer and poets: life & work.	[7]
Classical Literature in 17th century	[8]
General idea of 16th, & 17th century	[8]

FR 312	**History of French literature-II**	**3-0-0-3**

L’histoire de la littérature française : moyen âge au 17ème siècle.	[5]
La renaissance en France, son origine et signification.	[5]
La révolution française : son impact sur philosophie sociale et religieuse, politique et littérature.	[6]
Les écrivains et les poètes : leurs vies et leurs travails.	[7]
La littérature Classique au 17e siècle	[8]
L’idée générale de 16e et le 17e siècle	[8]

FR 312	**History of French literature-III**	**3-0-0-3**

History of French Literature: 18th century.	[5]
History of French Literature: 19th century.	[5]
History of French Literature: 20th century.	[6]
Romantic movement.	[7]
Realism, realistic, symbolisms periods in France.	[8]
Music cinema, theater in 20th century.	[8]

FR 322	**History of French literature-IV**	**3-0-0-3**

L’histoire de la littérature française : le 18ème siècle.	[5]
L’histoire de la littérature française : le 19ème siècle.	[5]
L’histoire de la littérature française : le 20ème siècle.	[6]
Le mouvement romantique	[7]
Les périodes de réalisme, réaliste et symbolismes en France.	[8]
La musique, le cinéma, et le théâtre au 20ème siècle.	[8]

SN 131 Origin and Development of Sanskrit 3-0-0-3

Evolution of Sanskrit: Nomenclature of Sanskrit, Vedic Sanskrit and Classical Sanskrit, Prakrita, Pali, Apabhransha, Modern Indian Languages [9]

Vedic Sanskrit: Origin of the word veda, Vedic hymns, division of Vedic hymns, branches, content of the Samhitas, women vedic seers [11]

Post Vedic Literature: Brahmana, Aranyaka, Upanishad [8]

Classical Sanskrit: Epics, Mahabharata, Ramayana, Gita, Purana, Poetry, Prose, Champoo, Modern Sanskrit Literature [11]

Suggested Books:

1. Keith, A.B.; History of Sanskrit Literature, MLBD, Delhi
2. Krishnamachariar; History of Classical Sanskrit Literature, MLBD, Delhi
3. Macdonell, A.A.; History of Sanskrit Literature, MLBD, Delhi
4. Shastri, Gaurinath; A Concise History of Sanskrit Literature, MLBD, Delhi
5. Winternitz, Maurice; History of Indian Literature (Vol. I & II), MLBD, Delhi
6. Warder, A.K.; Indian Kavya Literature, MLBD, Delhi
7. Gairola, Vachaspati; Sanskrit Sahitya Ka Itihas, Chaukhamba Vidyabhawan, Varanasi
8. Tripathi, Radhavallabha; Sanskrit Sahitya Ka Abhinav Itihas, Vishvavidyalaya Prakashan, Varanasi
9. Dasgupta, S.N.; A History of Sanskrit Literature: Classical Period, University of Calcutta
10. Burrow, T.; Sanskrit Language (also Trans. into Hindi by Bholashankar Vyas), Chaukhamba Vidya Bhawan, Varanasi
11. Altekar,A.S.; Education in Ancient India, Delhi
12. Altekar,A.S.; Position of Women in Hindu Civilization, MLBD, Delhi
13. Basham, A.L.,; The Wonder that was India, London
14. Dandekar, R.N.; Vedic Religion & Mythology: A Survey of the Works of Some Western Scholars, University of Poona, Poona
15. Vaidya,C.V.; Epic India, Delhi

SN 141 Self Management in the Bhagavad Gita 3-0-0-3

Mind and its Functions- Nature of Mind-7.4-6,15.7,15.9,3.42,10.20,10.22, Mental Conflict-1.1, 2.60, 67,3.36-38,40,16.21, Factors responsible for Mental Conflict-16.21, 2.62-63, Factors responsible for *Karma* & *Swabhava*- 18.13-16	[9]
Infirmity of Mind and Quandary of Intelligence- Sense control and Importance of Intellect- 2.3,2.49,52,55,62,65,67, 4.38,39,42, 18.63,18.3.-32, Versatility of Mind and restraint- 6.11-14, 25-26,34,36, Factors for Perfection in Yoga- 3.8, 6.3, 16-17, 17.8-10, 3.12-13, 17.14-19, 6.36	[7]
Importance of Karma-Nature of soul and its difference from the material world- 2.19-26 , *Karma-yoga* :as a means to attain the knowledge – 2.40-44, 47-50, *Bhakti-yoga*: as a means to facilitate *Nishkaam karmayoga*- 12.19-20, Concept of *Lokasangraha*- 3.18-25	[16]
Relationship between consciousness and divine-13.31-32, 10.41, 7.12, 10.4,18.51-66,78	[7]

SN 132 Grammar and Composition-I 3-0-0-3

Inititialising Sanskrit Language through conversation -Diclension (Shabdaroopa), Conjugation (Dhaturoopa), Avayay with their applications in simple sentences	[10]
Laghusiddhanta Kaumudi- Maheshvara Sutra and concept of Pratyahara, Sanjna and Sandhi (Only essential rules based on application in the texts to be taught)	[12]
Elementary Knowledge of Case (Karaka) – Meaning, Numbers, Vibhakti	[5]
Translation -From English into Sanskrit, From Sanskrit into English	[12]

SN 142 Classical Sanskrit Literature-I 3-0-0-3

Panchatantram of Vishnu Sharman- Fifth Episode- Aparikshitakarakam	[15]
NitiShatakam of Bhartrihari (selected verses only) - Mangalacharan, Moorkhapaddhati, Vidwatpaddhati, Manshauryapaddhati	[9]
Raghuvansham of Kalidasa- 1st Canto (Verse 1-35)	[15]

SN 231 भारतीय-वैज्ञानिक-निधिः (Indian Scientific Heritage) 3-0-0-3

13. D. D. Kosambi; Bhartrihari's Shatakatrayam (with the Oldest Commentary of Jain Scholar Dhanasaragani) , Bharatiya Vidya Bhavan, Mumbai

Text Books:

संस्कृत साहित्ये प्रतिबिम्बित-वैज्ञानिक-भिज्ञता (Scientific Awareness reflected in Sanskrit Literature),वैदिकसाहित्ये ऋतुविज्ञानम्(Rituvigyana in Vedic Literature),संवत्सरचक्रम्(Samvatsarchakra),वृष्टिविज्ञानम्(Vristhivigyana),वराहमिहिरमते प्राचीनभारते जलवायुविज्ञानस्यावधारणा (Concept of Climatology in Ancient India-according to Varahmihira), बृहत्-संहिता 21.1-2,28.1-5(Brihatsamhita-21.1-2,28.1-5), भद्रबाहुसंहिता-9.1-15(Bhadrabahusamhita-9.1-15) ,प्राचीनभारते जलसंसाधनप्रबन्धस्य इतिहासः (History of Water Resource Management in Ancient India)-ऋग्वेद-10.9 (Rigveda-10.9),अर्थशास्त्रम्(Arthashastra(2.1.20-24,3.9.29-38,7.12.4-5), बृहत्संहिता(Brihatsamhita-54.1-10),महाभारत-आदिपर्वः(Mahabharata -Adi Parva-96) [10]

पातञ्जलयोगसूत्रसंदर्भे तनाव-प्रबन्धनम् (Stress Management: In context of PatanjaliYogasutra)समाधिपादः(Samadhipad 1.1,1.2,1.5,1.12,1.13,1.15,1.23, 1.30,1.30-37),साधनपादः(Sadhanapada (2.1, 2.3 ,2.11, 2.16, 2.27, 2.29) [20]

वैदिकजीवनचर्या आसनं प्राणायामः च –सिद्धान्तमात्रं (Vedic Life Style- Aasana and Pranayama (theory only), यौगिक-षट्कर्मः(Yogic Satkarma), ऋतुचर्या (Ritucharya),आहार: विहार:(Ahaara-Vihaara),आयुर्वेदतः प्राकृतिकचिकित्सा (Naturopathy from Ayurveda) [09]

SN 241 व्याकरणं रचना च- द्वितीयः भागः (Grammar and Composition-II) 3-0-0-3

सिद्धान्तकौमुद्यानुसारं कारकम् **(Case)-** Based on Siddhantakaumudi) [15]

लघुसिद्धान्तकौमुद्यानुसारं समासः**(Compound)-**Based on Laghusiddhantakaumudi) [14]

वाच्यम् (Voice) [10]

Text Books:

1. Kale, M.R. (2011). *Higher Sanskrit Grammar*. Delhi: MLBD.
2. Apte, V.S. (1996). *The Students' Guide to Sanskrit Composition*. Varanasi Chowkhambha Sanskrit Series.

Reference Books:

3. Kanshiram (2009). *Laghusiddhantakaumudi (Vol. 1-2)*. Delhi: MLBD.
4. Shastri, B. (2008). *Laghusiddhantakaumudi- Bhaimivyakhya* (Vol. 3-6). Delhi: Bhaimi Prakashan.
5. Shastri, C. (1960).*Vyakaranchandrodaya* (Vol. 1-3). Delhi: MLBD.

SN 232 लौकिकसंस्कृतसाहित्यम्- द्वितीयः भागः (Classical Sanskrit Literature-II) 3-0-0-3

कालिदासविरचितम् अभिज्ञानशाकुन्तलम् –चतुर्थाङ्कः पञ्चमाङ्कः च (Abhigyana-Shakuntalam of Kalidasa- 4th & 5th Act) [24]

बाणभटविरचितम् कादंबरी(शुकनासोपदेशः)- (Shukanasopadesha –Kadambari- of Banabhatta) [15]

Text Books:

1. Kale, M.R. (2010). *Abhigyana-Shakuntalam of Kalidasa*. Delhi:MLBD.
2. Kumar, P. (1974). *Shukanasopadesha (Kadambari).* Delhi: Meharchand Lachchmandas.

Reference Books:

3. Pant, S.C. (1992). *Abhigyana-Shakuntalam*. Delhi: MLBD.
4. Dwivedi, K. (1989). *Abhigyana-Shakuntalam*. Allahabad: Ramnarayan Lal Benimadhav Press.
5. Tiwari, R. (2005). *Natakakar Kalidasa aur Kavyakar Kalidas*. Delhi: Parimal Publication.
6. Macdonell, A.A. (1970). *History of Sanskrit Literature*. Delhi: MLBD.
7. Saxena, R. (1990). *Shukanasopadesha (Banabhatta).* Indore: Bharati Publication.
8. Karmarkar, R.D. (1980). *Bana*. Dharwar: Karnataka University.
9. Dwivedi, H. (1976). *Kalidas ki Lalitya Yojana*. Delhi: Rajkamal Prakashan.

SN 242 राष्ट्रवादः भारतीय-राजशास्त्रं च (Nationalism and Indian Polity) 3-0-0-3

संस्कृतसाहित्यम् राष्ट्रवादः च (**Sanskrit Literature and Nationalism**)- शुक्लयजुर्वेदः 22.22(Shuklayajurveda (22.22),अथर्ववेदः-12.1.1-2(Atharvaveda (12.1.1-2), रामायण कृ.कि. काण्डम् .46-48 (Ramayana (KK 46-48), विष्णुपुराणम्2.3 (Vishnupurana (2.3), अम्बिकादत्तव्यासः, Ambikadutt Vyas, प.क्षमारावः Pt. Kshama Rao,मथुराप्रसाददीक्षितः (Mathura Prasad Dixit), चारुदेवशास्त्री (Charudev Shashtri)	[24]
भारतीयराजशास्त्रम्- स्वरूपम्,महत्त्वम्,सैद्धान्तिकविकासः च Indian Polity: Nature, Importance and Development- कौटिल्यः(Kautilya),भीष्मः(Bhishma),मनुः (Manu), शुक्राचार्यः (Shukracharya),सोमदेवसूरी(Somdev Suri),कमंदकः(Kamandaka)	[7]
भारतीयराजशास्त्रस्य प्रमुखग्रन्थानि (Important Texts on Indian Polity)-ऋग्वेदः-10.173,10.174 (Rigveda -10.173,10.174), अथर्ववेदः-6.87,7.13 (Atharvaveda 6.87,7.13),शतपथब्राह्मण 5.1.1.8-13,9.4.1.1-5(Shatapath Brahmana -5.1.1.8-13, 9.4.1.1-5),अर्थशास्त्रम् -1.4.1-19 (Arthashastra 1.4.1-19), महाभारत-शान्तिपर्वः-120.1-35(Mahabharata- Shantiparva 120.1-35),मनुस्मृतिः-7.1-35(Manusmriti 7.1-35),गान्धीगीता-सत्याग्रहनिरुपणम् 5.1-25 (Gandhigita- Satyagraha Nirupana - 5.1-25)	[8]

SN 311 वैदिकसाहित्यम् (Vedic Literature) 3-0-0-3

ऋग्वेद: - अग्नि: 1.1 (**Rigveda-** Agni-1.1), इन्द्र:-1.18(Indra-1.18), उषस् 3.61 (Ushas- 3.61), विष्णु: -1.154 (Vishnu- 1.154), हिरण्यगर्भ: 10.121(Hiranyagarbha-10.121),संज्ञानम्(Sangyana-10.191),**यजुर्वेद**:-शिवसङ्कल्प: -34.१-6 (**Yajurveda-** Shivasankalpa- 34.1-6), **अथर्ववेद**: -सामनस्य 3.30 (**Atharvaveda-** Sammanasya-3.30),भूमि: -12.1-12 (Bhoomi- 12.1-12) [20]

उपनिषद् -कठोपनिषद्, **1-2** (**Upanishad-** Kathopanishad (1st and 2nd Chapter) [19]

Text Books:

1. Velankar, H.D. (1965). *Riksuktashati*. Pune: Vaidika Samshodhana Mandal.
2. Bandhu, V. (1960). *Atharvaveda (Shaunakiya)* Hoshiyarpur: VVRI.

Reference Books:

3. Upadhyay, G.P. (2001). *Shatapatha Brahmana.* Delhi: S.L.B.S.Rastriya SanskritVidyapeetha.
4. Shashtri, J. L. (1978).*Shuklayajurveda-Samhita(Vajasneyi-Madhyandina).* Delhi: MLBD.
5. Trivedi, R. (1996). *Rigveda Samhita*. Delhi: Chaukhambha Sanskrit Pratishthan.
6. Shashtri, S. D. (1986). *Kathopanishad(Shankarbhashya*). Delhi: Chaukhambha Sanskrit Pratishthana.
7. Krishnalal (1998).*Vaidiksangraha.* Delhi:Eastern Book Linkers.
8. Tripathi,V.N. (1986).*Vedachayanam.*Varanasi:Vishwavidyalaya Prakashan.
9. Velankar, H.D. (1970). *Riksuktavaijayani.* Mumbai:Bharatiya Vidya Bhawana.

SN 321 सौन्दर्यशास्त्रम् भारतीयनाट्यशाला च (Aesthetics and Indian Theatre) 3-0-0-3

सौन्दर्यशास्त्रम्(**Aesthetics**)-काव्यप्रकाशः-4.27-28 (Kavyaprakasha-4.27-28), सहित्यदर्पणः-दशमपरिच्छेदः (Sahityadarpana -Dashamparichcheda)	[12]
छन्दशास्त्रम्-(**Chhandashastr**a)- अनुष्टुपः(Anushtupa), आर्या(Arya), इन्द्रवज्रा(Indravajra), उपेन्द्रवज्रा(Upendravajra), उपजातिः(Upajati), वन्शस्थ:(Vanshastha), द्रुतविलंबित:(Drutavilambita), पुष्पिताग्रा(Pushpitagra), वसन्ततिलका(Vasantatilaka), मालिनी(Malini), मन्दाक्रान्ता(Mandakranta), शिखरिणी(Shikharini), शार्दूलविक्रिडीतं (Shardulavikridita),स्रग्धरा(Sragdhara)	[15]
नाट्यशास्त्रम्- द्वितीय अध्यायः (**Natyashastra (2nd Chapter)**परम्परागतभारतीय आधुनिकनाट्यशाला च (Traditional Indian and Modern Theatre), नाट्यमण्डपम् (Natyamandapa),रङ्गशीर्ष(Rangashirsha),रङ्गपीठम् (Rangapeetha), रङ्गमञ्चः (Rangamancha) स्वरूपम् विकासश्च (Features and Developments)	[12]

Text Books:

1. Nagendra (1996). *Kavyaprakash of Mammata with Vishveshwar Vyakhya*. Varanasi: Gyanmandal Ltd.
2. Nagar, R. (1994). Natyashashtra of Bharata. Delhi: Parimal Publication.

Reference Books:

1. Shastri, S. (1978). *Sahityadarpana*. Delhi: MLBD.
2. Bakshi, M.C. (1971). *The Concept of Ancient Theatre*. Delhi: Munsiram Manoharlal.

3. Ghosh, M.M. (2007). *Natyashastra of Bharat,* Delhi: Chaukhambha Publication.
4. Gupta, C.B. (1987). *Indian Theatre*. Delhi: Munshiram Manoharlal.
5. Mankad, D.R. (1996). *Ancient Indian Theatre*. Delhi: MLBD
6. Warder, A.K. (2004). *Indian Kavya Literature*. Delhi: MLBD

SN 312 संस्कृतव्याकरणम् भारतीयतर्कपद्धतिः च **3-0-0-3**
Sanskrit Grammar and Indian System of Reasoning

वरदराजाचार्यविरचितलघुसिद्धान्तकौमुदी- अच्-सन्धिःसूत्रबोधसहितः- - 6.1.47,1.1.65,1.149,6.1.75,1.3.10,1.1.2,1.1.69,6.1.84,1.3.2,1.1.50,1.1.1,6.1.85,6.1.91,6.1.97 (**Laghusiddhantakaumudi of Varadaraja** (Achsandhi with sutrabodha)- 6.1.47, 1.1.65, 1.149, 6.1.75, 1.3.10, 1.1.2, 1.1.69, 6.1.84, 1.3.2, 1.1.50, 1.1.1, 6.1.85, 6.1.91, 6.1.97 [20]

अन्नम्भट्टप्रणीतः तर्कसंग्रहः (**Tarkasangraha of Annambhatta**) [19]

SN 322 **वैदिकगणितम् खगोलविद्या च** **3-0-0-3**

(Vedic Mathematics and Astronomy)

Text Books:

भारतीयगणितस्य खगोलविद्यायाः च संक्षिप्त-इतिहासः (A Brief History of Vedic Mathematics & Astronomy- वेदाङ्ग-ज्योतिषम्(Vedanga Jyotisha), शुल्बसूत्रं (Shulbasutra),पञ्चसिद्धान्तिका(Panchasiddhantika),सूर्यसिद्धान्तः Suryasiddhanta, आर्यभट्टः-I(Aryabhatta-I),गणेशदैवज्ञः(Ganesh Daivagya),कमलाकरः Kamalakara, जयसिंहः Jay Singh, सुधाकरद्विवेदी (Sudhakar Dwivedi)	[8]
वैदिकगणितम्-लगध्-ज्योतिषम्(4&42) **Vedic Mathematics-** Selected section of LagadhJyotish(4&42),लीलावती(21श्लोकाः)),Lilawati(21Verses),श्रीभारतीकृष्णतीर्थः(5 सूत्राणि), Shri Bharati Krishna Teertha(5 Aphorism)	[12]
खगोलविद्या (लगधज्योतिषं -1-3&43)**Astronomy-** Selected section of Lagadh Jyotisha(1-3&43),सूर्यसिद्धान्तः(चतुर्दश-अध्यायः)Suryasiddhanta(14thChapter), आर्यभटीयम(गोलपद-1-22)Aryabhatiyam (Golapada- 1-22)	[12]
वेधशाला अथ च खगोलीयगणनार्थं प्रमुखप्राचीनयन्त्राणि (Observatories and Important Ancient Instruments for Astronomical Calculations)	[7]

GY 111 **Physical Geography-I** **3-0-0-3**

Solar System and origin of planets: Introduction to Solar system, Theories regarding origin of planets- hypothesis by Kant, Nebular hypothesis by Laplace, Planetesimal hypothesis of Chamberlin, Tidal hypothesis of James Jeans, Binary Star hypothesis of Russell and Big-bang.	**[15]**
Earth & Its components: Rotation, revolution of the earth and its consequences, Axis of the earth, Longitude and Latitude of the earth, Shape of the earth, Local time and standard time, Time zone and International Date line, Internal structure of the earth, Distribution of land and water on the earth.	**[7]**
Rocks, Earth movements, Volcanoes & Earth quake: Mode of occurrences of rocks: Igneous, Metamorphic and Sedimentary, Earth movements-folding and faulting of rocks, Earth quake: causes and consequences, Volcanoes: causes and consequences.	**[8]**
Work of different agents and resulted landforms: Weathering: Physical, Chemical and Biological, Work of River, Wind, Glacier, Sea wave and Karst: erosion, transportation, deposition and resulted landforms, Groundwater, springs and artesian wells.	**[9]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 121 **Bio-Geography-1** **3-0-0-3**

Biogeography: Introduction: Biogeography: Meaning, Definitions, Concept, importance and relevance, Ecology and Ecosystem: Definitions and principles, Dimensions in Ecology: Definition of Ecotope, Ecotone and Habitat, Biosphere, food chain, food web and ecological pyramid.	**[14]**
Biogeochemical Cycles and Soil: Biogeochemical cycles- Carbon cycle, Nitrogen cycle, Oxygen cycle and Phosphorus cycle, Soil: forming processes, factors responsible. Soil profile.	**[7]**
Distribution of Flora and fauna: Distribution of flora and fauna over geographical space, Factors affecting plant ecology: light, temperature, moisture etc.	**[5]**
Introduction to Biome, Biodiversity and Issues: Biome: meaning, concept and importance, Introduction to Bio-diversity-meaning and concept, Major bio-diversity hotspots in India, Issues related to the bio-diversity with special reference to India, Human induced changes in the ecosystem: causes and consequences.	**[13]**

Text Books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998) Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones, G.R. (eds) (1966) Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.

GY 112 **Physical Geography-II** **3-0-0-3**

Isostasy, Processes and Mountain building: Theories of Isostasy: Models of Pratt & Airy, Brief understanding of Geological time, Endogenetic and Exogenetic processes, Concept of geosynclines and orogenic processes, Mountains: types and their formations, Mountain building theories: theories by Kober, Joly, Holmes, Daly **[18]**

Concept of Scale, Cycles and landform evolution: Concept of scale in physical geography: spatial and temporal, Cyclic and non-cyclic concept of erosion, Normal cycle of erosion by W.M. Davis, Landscape evolution theory by W. Penk **[14]**

Evolution of drainage network on different topography: Development of drainage network on uniclinal structure, Development of drainage network on folded structure, Development of drainage network on faulted structure **[7]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 122 **Bio-Geography-2** **3-0-0-3**

Introduction to Community: Concept of community, Factors affecting community: Succession, vegetation climax, Effects of human interventions in the community (with special reference to India), Effects of industrial effluents on the community with special reference to India, management practices **[10]**

Spatial distribution of Biomes: Description of major biomes of the world in reference to the location, extension, climate, soil, flora, fauna, succession and human activates **[12]**

Soil formation, erosion and management: Mechanism of formation of podzol, laterite, chernozem and saline alkaline soils, Soil erosion and land degradation: Types and factors, their impacts on soil fertility and their management, Major ecological regions of India: Tropical rain forest, Desert, Mountain, aquatic ecosystem, mangrove and deciduous forest **[17]**

Text books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998): Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography: An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones G.R. (eds) (1966): Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.
4. Barry C. (1993) Biogeography, Blackwell Scientific Publication, Oxford, London.
5. Huggett R.J. (2004) Fundamentals of Biogeography, Psychology Press.

GY 132 **Practical Geography-1** **0-0-4-2**

Scale and Maps: Introduction and Types: Introduction of Practical Geography, Concept of Maps and their importance in Geography, Concept of Scales and their importance in Geography, Type of Scales: Construction of Linear, Diagonal and Vernier scales **[16]**

Projections and Contours, Types and representation: Concept of projection in their importance, types and uses in Geography, Construction of projection in graphical method: polar, conical and cylindrical cases, Contours: Concept and representation **[14]**

Text Books:

1. Singh R. L., Singh R. P. B. (1999) Elements of Practical Geography, Kalyani Publishers.
2. Sarkar A. (1997) Practical Geography, A systematic Approach, Orient Longman Ltd.

Reference Books:

1. Anson R., Ormelling F. J. (1994) International Cartographic Association: Basic Cartographic Vol. Pregmen Press.
2. Gupta K.K., Tyagi, V. C. (1992) Working with Map, Survey of India, DST, New Delhi.
3. Loxton J. (1980) Practical Map Production, John Wiley.
4. Mishra R.P., Ramesh A. (1989) Fundamentals of Cartography, Concept, New
5. Delhi.
6. Monkhouse F. J., Wilkinson H. R., (1973) Maps and Diagrams, Methuen, London.
7. Rhind D. W., Taylor D. R. F. (eds.) (1989) Cartography: Past, Present and Future, Elsevier, International Cartographic Association.
8. Robinson A. H. (2009) Elements of Cartography, John Wiley and Sons, New York.
9. Sharma J. P. (2010) Prayogic Bhugol, Rastogi Publishers, Meerut.
10. Steers J. A. (1965) An Introduction to the Study of Map Projections, London.

GY 211 Geography of India 3-0-0-3

Physiography and brief Geology of India: India: location, shape, size, boundaries and extent; Major physiographic divisions of India: Northern Hills, Northern plains, Peninsular Plateau, Coastal plains, Indian deserts and the islands, Brief understanding of major Geological structures of India. **[8]**

Drainage and Climate of India: Drainage of India: Himalayan drainage and Peninsular drainage, National Water grid., Characteristics of Indian climate and seasons (Temperature, Humidity and Precipitation), Indian Monsoon: mechanism and consequences and its relation to Indian agriculture. **[8]**

Soils and Vegetation of India: Distribution of Soils of India, Distribution of Vegetation of India, Problem of flood and drought in India. **[4]**

Demographic Aspects of India:
Population distribution, density, sex ratio and literacy pattern of India. **[8]**

Cultural and Social Aspects of India:
Schedule tribes and scheduled tribes, Religious diversity in India, Linguistic diversity in India, Distribution of different races in India, Contemporary Issues: Poverty, Population explosion, globalization and its impact on the environment, regional disparity. **[11]**

GY 221 Human Geography 3-0-0-3

Basic concepts and Theory of Population: Introduction to the Human Geography: meaning, definitions and concept, Relation of Human geography with other fields of sciences, Population resource relationship: concept of over population, optimum population and under population, Population transition theory. **[15]**

Adaptation and Distribution of Population: Human adaptation in different parts of the world: Equatorial, Tropical, Temperate, and Polar area; Settlements: meaning and concept; Rural and Urban settlements: types and pattern, Elements of the environment and their impact on the Habitat, economy and Society of Eskimos, Pygmies, Bushman, Distribution of Population - World patterns, Factors influencing spatial patterns of population distribution – physical, economic and social aspects. **[15]**

Migration, Urbanization and Globalization: Migration of population: causes and consequences, brain drain, World population problems and policies, Urbanization, problems of urbanization, Globalization: causes and its impact, Concept of a region: types of regions. [9]

GY 212 **Economic Geography** **3-0-0-3**

Introduction to Different Economic Sectors: Introduction to economic geography: definition, meaning and concept, Economic geography and its relation to human geography, Classification of economic activities of the world: Primary, Secondary and tertiary activities (Hunting and food gathering, agriculture, industries and market economy). **[11]**

Agricultural Resources: an Introduction to Primary activities: Agriculture systems: Intensive subsistence agriculture (Rice) and plantation agriculture (Tea), Commercial grain farming (Wheat), Horticulture and mixed farming. **[8]**

Industrial locations and Manufacturing Industries: Industrial activities: an introduction, Factors Affecting location of Economic Activity with special reference to Industry; Secondary Activities: Manufacturing (Cotton Textile, Iron and Steel) (World pattern). **[10]**

Manufacturing Regions: Concept of Manufacturing Regions, Special Economic Zones and Technology Parks., Tertiary activities: Transport, Trade and Services. **[10]**

Text books:

1. Bagchi-Sen, S. & Smith, H.L. (2006). *Economic Geography: Past, Present and Future*. U.K., Taylor and Francis.
2. Sharma, T.C. & Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Publication.

Reference Books:

1. Alexander, J. W. (1963). *Economic Geography*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
2. Clark Gordon, L., Feldman, M.P. & Gertler, M.S., (eds.) (2000). *The Oxford Handbook of Economic Geography*. N.Y., Oxford University Press.
3. Coe, N. M., Kelly, P. F. & Yeung, H. W. (2007). *Economic Geography: A Contemporary Introduction*. U.K., Wiley-Blackwell.
4. Combes, P., Mayer, T. and Thisse, J. F. (2008). *Economic Geography: The Integration of Regions and Nations*. U.S., Princeton University Press.
5. Hodder, B.W. & Lee, R. (1974). *Economic Geography*. U.K., Taylor and Francis.
6. Leong, G.C. & Morgan, G.C. (1979). *Human & Economic Geography*. N.Y., Oxford University Press, Oxford.
7. Wheeler, J. O. (1998). *Economic Geography*. U.S., Wiley.
8. Willington, D. E. (2008). *Economic Geography*. U.K., Husband Press.

GY 222 **Geography of Resources** **3-0-0-3**

Distribution of Mineral Resources: Resources: meaning, concept and Definitions; Mineral resources: Uses and distribution: Iron ore, Coal, Bauxite, Zinc, Gold, Silver, Mica. **[8]**

Energy Resources: Renewable energy resource: Wind energy and Solar energy, Non-renewable energy resource: Petroleum, Natural Gas. **[5]**

Distribution of Agricultural Resources and Agricultural Infrastructure: Rice, wheat, Millet, Cotton, Sugarcane, Tea and Coffee; HYV seeds, Irrigation, Fertilizers and Pesticides. **[13]**

Concept of Industry, industrial resources and Industrial Regions: Iron and steel industry, Cotton textile industry, Aluminum industry, Cement Industry; Free trade zones and Special Economic Zones, Concept of Human Resource. **[13]**

Text books:

1. Roy, P. (2007). *Economic Geography, A Study of Resources.* New Delhi, New Central Book Agency Pvt. Ltd.

Reference Books:

1. Gautam, A. (2009). *Advanced Geography of India*. Allahabad, Sharda Pustak Bha.
2. Khullar, D.R. (2000). *India: A Comprehensive Geography*. New Delhi, Kalyani Publishers.
3. Krishnaswamy, K. (1972). *India's Mineral Resources*. New Delhi, Oxford IBM.
4. Rao, K.L. (1975). *India's Water Wealth*. New Delhi, Orient Longman.
5. Sharma, T.C. and Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Pub.
6. Singh, G. (1988). *Geography of India*. New Delhi, Atmaram & Sons.

GY 232 **Practical Geography-II** **0-0-4-2**

Cartographic techniques and Introduction to the topographical Maps: Construction of one dimensional, two dimensional and three dimensional graphs and diagrams, Topographical maps and their interpretation.

Basics of Field Survey and Chain and Tape Survey: Introduction to the field survey, Chain and tape surveying and plotting.

Introduction of Remote Sensing: Mechanism of remote sensing, Different platforms of Remote sensing, Spectral signature and its application in remote sensing, Introduction to GPS and GIS, Applications of GIS.

Text books:

1. Joseph, G. (2005). *Fundamentals of Remote Sensing*. India, United Press India.
2. King, L.S. (1969). *Statistical Analysis in Geography*. U.S., Prentice-Hall.
3. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2004). *Remote Sensing and Image Interpretation*. U.S., Wiley. (Wiley Student Edition).
4. Mishra, R.P. and Ramesh, A. (1989). *Fundamentals of Cartography.* New Delhi, Concept.
5. Monkhouse, F.J. and Wilkinson H.R. (1973). *Maps and Diagrams*. London, Methuen.

Reference Books:

1. Gupta, K.K. and Tyagi, V.C. (1992). *Working with Map*. Survey of India, New Delhi, DST.
2. Hammond, P. and Mc. Cullagh, P.S. (1978). *Quantitative Techniques in Geography: An Introduction*. U.K., Oxford University Press.
3. Loxton, J. (1980). *Practical Map Production*. U.K., John Wiley.
4. Rhino, D.W. and Taylor, D.R.F. (eds.) (1989). *Cartography: Past, Present and Future*. Elsevier, Amsterdam, International Cartographic Association.
5. Robinson, A. H. (2009). *Elements of Cartography*. New York, John Wiley and Sons.
6. Sharma, J. P. (2010). *Prayogic Bhugol.* Meerut, Rastogi Publishers.

GY 311 Climatology and Oceanography 3-0-0-3

Basic Components of atmosphere: Atmosphere, Climate and Seasons: concept and meaning; Structure and composition of atmosphere, Humidity; Distribution of Temperature. **[6]**

Circulation of atmosphere: Pressure and wind and their broad pattern, General circulation of atmosphere, jet streams. **[5]**

Atmospheric Disturbances and Winds: Different types of atmospheric disturbances: Tropical cyclone, Extra-tropical cyclone and Hurricane, Winds: planetary, seasonal and local, Climatic classification, climate change: causes and consequences. **[8]**

Geography of Ocean Basins: Ocean basin relief (Indian ocean, Atlantic ocean and pacific ocean). **[4]**

Salinity and Temperature of ocean water: Salinity: causes, determinants and distribution, Distribution of temperature and salinity. **[5]**

Dynamics of Ocean water:
Waves, Currents and Tide: formation and types. **[6]**

Coral Reefs and Ocean Deposits:
Coral reefs: types and theories; Ocean deposits. **[5]**

Text books:

1. Lal, D.S. (2011). *Climatology*. India, Sharda Pustak Bhawan.
2. Sharma, R.C. and Vatal, M.(1980). *Oceanography for Geographers*. Allahabad, Chaitanya Publishing House.

Reference Books:

1. Anthes, R.A., Panofsky, H.A., Cahir, J.J. & Rango, A. (1978). *The Atmosphere*. SRA, Columbus.
2. Barry, R.G. & Carleton, A.M. (2001). *Synoptic and Dynamic Climatology*. U.K., Routledge.
3. Barry, R.G. & Corley, R.J. (1998). *Atmosphere, Weather and Climate*. N.Y., Routledge.
4. Batten, L.J. (1979). *Fundamentals of Meteorology*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
5. Pinet, P.R. (2008). *Invitation to Oceanography (Fifth Edition)*. USA, UK and Canada, Jones and Barlett Publishers.
6. Stowe, K. (1987). *Essentials of Ocean Science*. New York, John Wiley &Sons.
7. Sverdrup, K.A. & Armbrust. E.V. (2008). *An Introduction to the World Ocean*. Boston, McGraw Hill,
8. Thurman, H.V. (1996). *Essentials of Oceanography*. New Jersey, Prentice-Hall.
9. Tikka, R.N. (1989). *Physical Geography*. Meerut, Kedarnath Ramnath & Co.

GY 321 **Man and Environment** **3-0-0-3**

Basics of Environment: Environment: meaning, concept, definitions and types; Components of physical and cultural environment.

Relationship between Man and Environment:
Man and environmental relationship of time and space; Approaches in understanding the man and environment relation-Deterministic approach, Possibilistic approach and neo determinism, Geography and geographers: association with man and environment.

Changing relationship of Man and Environment and Issues:
Population explosion, technology and environment: changing relationship.

Environmental Issues: Environmental issues in Tropical, Temperate and Polar areas; Environmental hazards: natural and manmade.

Environmental Management: Environmental policies, Management, Concept of Sustainability.

Text Book:

1. Singh, S. (2015): *Environmental Geography*. Allahabad, Pravalika Publications.

Reference Books:

1. Chandna, R.C. (2002). *Environmental Geography*. Ludhiana, Kalyani.
2. Cunninghum, W.P. and Cunninghum M.A. (2004). *Principals of Environmental Science: Inquiry and Applications*. New Delhi, Tata Macgraw Hill.
3. Goudie, A. (2001). *The Nature of the Environment*. U.K., Blackwell, Oxford.
4. Miller, G.T. (2004). *Environmental Science: Working with the Earth*. Singapore, Thomson Brooks Cole,

GY 312 **Geography of Settlement** **3-0-0-3**

Basics of Settlement: Introduction: Nature and Scope; Basic Concepts: Rural and Urban Settlements, Hamlet, Village, Town, City, Metropolis, Megalopolis, Conurbation, Rural-Urban Fringe. **[9]**

Rural Settlements: Types and Patterns, Determinants. **[4]**

Theories of Settlement: Regional Settlement Hierarchy: Central Place Theory, Rank-Size Rule, Primate City. **[10]**

Urban Land use: Models; Types – Residential, Commercial, Industrial, Institutional, Recreational, Heritage, Public and Green Spaces, and Transport. **[9]**

Site and situation: Concept of Site and Situation, and Landuse, Services and Infrastructure; Problems and their prospects. **[7]**

Text Books:

1. Ghosh, S. (1999). A Geography of Settlements. Kolkata, Orient Longman.
2. Singh, R.Y. (1994). The Geography of Settlement. New Delhi, Rawat Publication.

Reference Books:

1. Chishlom, M. (2007). Rural Settlement and Land Use. U.S., Transaction Publishers.
2. Daniel, P. (2002). Geography of Settlement. Jaipur & New Delhi, Rawat publication.
3. Kaplan, D.H., Wheeler J.O. & Holloway S.R. (2008). Urban Geography. John U.S., Wiley.
4.Misra, R.P. and Misra, K. eds. (1998). Million Cities of India. New Delhi, Sustainable Development Foundation.
5. Pacione, M. (2009). Urban Geography: A Global Perspective. U.K., Taylor and Francis.
6. Ramachandran, R. (1989). Urbanisation and Urban Systems in India. India, Oxford University Press, India.
7. Ramachandran, R. (1992). The Study of Urbanisation. New Delhi, Oxford University Press.

GY 322 Spatial Dimensions of Development 3-0-0-3

Introduction to Development: Concept of Development; Measures of Development (Economic, Social and Environmental); Efficiency- Equity Debate. [8]

Regional Development: Concept of Region and Regional Development; Intral and Inter-regional Development pattern. [6]

Theories of development: Myrdal, Hirschman and Friedmann. [10]

Impact of Development: Interrelationship between environment and development; Impact on physical environment in terms soil erosion, land degradation, deforestation. [8]

Different Issues in Developed and Developing Countries: Pollution and issues in developed and developing countries of the world; Human development: International, interstate comparison of India. [7]

Text Books:

1. Claval, P.L. (1998). An Introduction to Regional Geography. Oxford and Massachusetts, Blackwell Publishers.
2. Gore, C.G. (1984). Regions in Question: Space, Development Theory and Regional Policy. London, Methuen.

Reference Books:

1. Abler, R., Adams, J. S., & Gould, P. R. (1971). Spatial Organization: A geographer's View of the World. Prentice-Hall, Englewood Cliffs.
2. Blij, H. J. (1971). Geography: Regions and Concepts. N.Y., John Wiley and Sons.
3. Friedmann, J. & Alonso, W. (1975). Regional Policy - Readings in Theory and Applications. Massachusetts, MIT Press.
4. Gore, C. G., Köhler, G., Reich, U-P. & Ziesemer, T. (1996). Questioning Development: Essays on the Theory, Policies and Practice of Development Intervention. Marburg, Metropolis-Verlag.
5. Haynes, J. (2008). Development Studies. U.K., Polity Short Introduction Series.
6. Peet, R. (1999). Theories of Development. N. Y., The Guilford Press.

GY 332 **Practical Geography-III** **0-0-4-2**

Basics of Survey: An introduction to survey and different instruments.

Prismatic Compass and Plane Table Survey: Prismatic compass survey and Plane Table Surveying

Weather instruments, Weather Maps and graphs: Introduction to weather instruments, Interpretation of weather maps, Hythergraph and climograph: uses and applications. 26

Introduction to Statistical Techniques: Frequency distribution, central tendency: mean, median and mode, measures of dispersions.

Text Books:

1. Hussain, S.K. & Nagaraj, M.S. (1992). Textbook of Surveying. New Delhi, S. Chand and Co. Ltd.
2. Pal, S. K. (1998). Statistics for Geoscientists. New Delhi, Tata McGraw Hill.
3. Sarkar, A. (1997). Practical Geography: A Systematic Approach. Hydrabad, Orient Longman Ltd.

Reference Books:

1. Elfic, M.H., Fryer, J.G. Brinkner, R.C. & Wolf, P.R. (1994). Elementary Surveying. London, Harper Collins Publishers.
2. Kanitkar, T.P. & Kulkarni, S.B. (1988). Surveying and Leveling, Part 1. Pune, Pune Vidyarathi Griha Prakashan,
3. Mahmood, A. (1977). Statistical Methods in Geographical Studies. New Delhi, Concept.
4. Monkhouse, F.J. & Wilkinson, R. (1971). Map and Diagrams: there compilation and construction. New Delhi, B.I. Publications Private Ltd.
5. Silk, J. (1979). Statistical Concepts in Geography. London, Allen and Unwin.
6. Singh, R.L. & Singh, R.P.B. (1991). Elements of Practical Geography. New Delhi, Kalyani Pub.
7. Venkatramaiah, C. (1996). A textbook of Surveying. Hydrabad, University Press/Orient Longman Ltd.

HY 111 Ancient Indian History– I

Objectives: The course intends to provide an extensive survey of early Indian history to the students of the history honors course. It also familiarizes them with the tools of studying ancient Indian history. It further aims empowers the students not only with the significance of sources in history writing but make them aware with the importance of environmental factors in the study of history

Unit1. Sources: Literary/written sources - Vedic/Hindu canonical literature: Buddhist Canonical Literature, Jain Canonical Literature, Secular Literary Sources - Sangam Literature. Foreign Accounts - The Greeks and Romans, Chinese. Material/Archaeological sources –Inscriptions, Epigraphs, Coins, and Monuments.

Unit 2. The Pre-Historic Period: Paleolithic Cultures – Sequence and geographical distribution, evolution and uses of stone industries. Mesolithic Cultures – regional and chronological distribution. Neolithic Age and Chalcolithic Age.

Unit 3. The Harappan Civilization: Origin, distribution, morphology of major sites (Mohanjodaro, Harappa, Kalibangan, Lothal, Dholavira). Society, economy, polity and religion as reflected in Vedic literature. Religious beliefs and practices and art and architecture.

Unit 4. Vedic age to 6th Century B.C: The origin of Aryans, geographical background, Political, Social, Economic and religious conditions of the Aryans in the Rig Vedic and Later Vedic Period. Rise of Territorial States in Northern India: Urbanisation of the Ganga Valley, Sixteen Mahajanapadas, Ascendency of Magadha. Iranian and Macedonian Invasion: Significance; Religious Movements in 6th Century B.C Buddhism and Jainism: Rise, Growth and Contribution to Indian History.

HY 121 Ancient River Civilization- I

Objectives: To offer a historical survey of human evolution. It details the features of material culture of early humankind by tracing the transitions from the hunting-gathering subsistence pattern to more advanced human subsistence patterns involving domestication of animals and food production. The paper highlights how such changes were gradual and did not unfold uniformly in all parts of the world; thereby allowing for coexistence of different subsistence forms.

Unit 1. Cradle of civilization Mesopotamia: Origin of Fertile Crescent, Geography, Early civilization of Sumerian, Akkadian, Babylonian and Assyrians, Religious Beliefs, Rituals and practices, Social Levels, Classification, Priest, King, Upper class, Nobles, Lower Class, Slavery, Medicines, Astronomy, Astrology, Time, Inventions, Mummification, Tools and Methods, Script on Tablets, Seals , Mode of warfare, Strategies, Government, Polity, Administrative units Law Code, Justice, Causes of Decline of Civilization.

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units, Social stratification in society, food, Dress, Social Classes, Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization, Contribution of Civilization

HY 112 Ancient Indian History–I

Objectives: This course is about early historical developments taking place in Indian history especially post-Harappan period, that is Vedic and later Vedic periods. Highlighting the features of early historic times , the course tries to trace the emergence of state system from proto-state stage and at the same time seeks to underline the important development in the arena of economy, society and culture.

Unit 1. The Age of Maurya: Sources of Mauryan History: Kautilyas Arthasastras and Meghsthenes Indica and Ashokan Inscriptions. Chandragupta Maurya, Bindusara and Asoka- Foundation and Consolidation of Empire, Administrative system. Ashoka's policy and reforms, Dhamma, Art and architecture: Decline of Mouryan Empire.

Unit 2. Post Mauryan Polity: Post Mouryan Polity in India: Ruling dynasties in Northern and Southern India: Sungas, Satavahanas and Kushanas. Rise of Kharavela in Kalinga. Sangam age- Literature, Economy and Society.

Unit 3. Age of the Guptas and Post-Gupta period (to c. 750): Political history of northern and southern India. Samanta system and Changes in political structure. Economy and Social structure. Culture and Religion.

Unit 4. Themes in early Indian cultural history: Languages and texts, Major stages in the evolution of art and architecture, Major philosophical thinkers and schools.

HY 122 Ancient River Civilization- II

Objectives: This paper traces the changing political formations, economic and social structures in the ancient Greek and Roman empires because ancient history of these two regions explain in great detail about Europe owes to the development of civilization to these particular regions in large measure**.**

Unit 1. Classical Greece civilization: Mythologies in ancient Greek, Social structure and stratification, Classes, Athens Olympics in ancient Greece, Art and Architecture in ancient Greece

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units Social stratification in society, food, Dress, Social Classes Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization Contribution of Civilization

HY 211 History of Medieval India (750-1526 A.D.)-I

Objectives: The purpose of this paper is to introduce to students the idea of major transition in early medieval India in the wake of disintegrating power at the Centre. It aims to guide students as to how the corresponding rise and rapid spread of Islam marks the advent of Islam in India through various channels**.**

Unit 1. Early Medieval India, 750-1200: Polity: Major political developments in Northern India and the Peninsula, Origin and the rise of Rajputs, The Cholas: administration, village economy and society -"Indian Feudalism" Agrarian economy and urban settlements, Trade and commerce, Society, Science and technology.

Unit 2. Cultural Traditions in India, 750- 1200: Philosophy: Skankaracharya and Vedanta, Ramanuja and Vishishtadvaita, Madhva and Brahma Mimansa, Religion, Tamil devotional cult, Growth of Bhakti, Islam and its arrival in India Sufism, Literature, Growth of Tamil literature, Kalhan's Rajtarangini, Alberuni's, Art and Architecture: Temple architecture, Sculpture, Painting.

Unit 3. Establishment of the Delhi Sultanate: The Ghurian invasions, Factors behind Ghurian success, Economic, Social and Cultural consequences, Foundation of Delhi Sultanate and early Turkish Sultans - Consolidation: The rule of Iltutmish and Balban.

Unit 4. "The Khalji Revolution": Alauddin Khalji, Muhammad Tughluq, Firuz Tughluq, Decline of the Sultanate, Foreign contacts and Ibn Battuta's account, Sayyid Dynasty: Khizr Khan, Mubarak Shah, Lodhi Dynasty : Bahlol Lodhi,. Sikander Lodhi, Ibrahim Lodhi, Sultanate administration.

HY 221 Main Outline of World History-I

Objectives: Through discussion of a period in Europe marked by Renaissance, Protestantism, Thirty-Years-War Counter-Reformation, rise of absolutism, this paper seeks to familiarize students with phenomenal movements in Europe in the fields of culture, religion and politics which laid the future roadmap for largerdevelopment in Europe and the world. It covers discussion on famous monarchs and friction between the state and the Church over the issue of power share.

Unit 1. Renaissance: Meaning and Definition, Nature & Impact, The Reformation, Causes, Nature of Reformation, Results, counter reformation.

Unit 2. Rise of National States: Causes Main monarchies and their growth - Ferdinand, Isabella of Spain, Louis XI of France, England - Henry VII, and Holy Roman Empire. Rise and Decline of Spain - Foreign Policy of Charles V, Philip II, Revolt of Netherland, Thirty Years War, Causes of downfall of Spain.

Unit 3. France under Henry IV: Growth of Royal absolutism, Cardinal Richelieu, Cardinal Mazarin, Louis-XIII, The Thirty Years War, Treaty of Westphalia, Louis XIV, Foreign Policy, Religious Policy , Policy of Colbert's.

HY 212 History of Medieval India (1526- 1740 A.D.)-II

Objectives: Teaching of this paper plans to demonstrate political transition with the establishment and consolidation of the Mughal Empire. It introduces students to a new rounds of social-political-cultural-religious and economic developments under the Mughal regime. By covering about a period of over two centuries, this paper covers the arrival of Europeans and takes into account a larger sort of development as a result of industrial development in Europe and its cascading impact all over places including India where it coincides with the downfall of a mighty Mughal empire. Other issues also get covered under this paper like

Unit 1. Mughal state's relation with regional powers (Rajput, Sikhs, Afghans, Marathas, Deccani kingdoms and the like.

Unit 2. Foundation and Expansion of the Mughal Empire: struggle for empire in North India; Babur's invasion; Mughal-Afghan conflict. Shershah Suri and his administrative reforms.

Unit 3. Consolidation of the Empire: Akbar's imperialist agenda—administration, Mansabdari system, Zabt system; Religion and state—Akbar to Aurangzeb; evolution of the nobility under the Mughals.

Unit 4. Mughal Economy, Society and Culture: rural society and agrarian relations; crafts and industries; monetary system; inland and oceanic trade; literature; technology; architecture and painting.

Unit 5. Disintegration of the Mughal Empire: problems of succession and court politics in the reign of Aurangzeb; popular revolts within the Mughal empire—the Jats, Satnamis, Afghans, and the Sikhs; crisis in the Jagirdari system; peasant uprising and agrarian crisis; Bhakti Movement & Prominent saints, Sufism meaning and Sects.

HY 222 Main Outline of World History-II

Objectives: The paper aims to acquaint the students with a brief history of Russia, Prussia and Austria from thematic standpoint of political and economic changes. Moreover, effort is to familiarize students with the development in the field of art and architecture along with the French revolution and further rise and fall of Napoleonic phase.

Unit 1. Rise of Modern Russia: Peter the great, Catherine II their foreign policies, Austrian Empire - War of Austrian succession - Treaty of Aix-La-Chapple, Causes of seven years' war, Foreign policy of Joseph II, The Rise of Prussia, Domestic, foreign and religious policy of Frederick the great.

Unit 2. The Baroque Age: Science and Technology in 17th and 18th Centuries, The Anglo-French Rivalry for overseas Colony, French Revolution, Causes and results.

Unit 3. Napoleon Bonaparte: Continental System, Battle of Waterloo-Fall of Napoleon-Vienna Congress-Concert of Europe .

HY 311 History of Modern India (1740-1857 A.D.)

Objectives: This paper on modern India familiarizes with the strategies of Europeans especially British traders who soon took over entire India under the initial garb of trading. Herein, the discussion encompasses the establishment, consolidation and ultimately dissolution of East India company and transfer of power to the British Queen in 1857-58. All sorts of developments during the stated period are discussed and debated in great detail. The ideas of modernity and modern ideas are also discussed in brief.

Unit 1. Political Condition of India in the 18th Century: Decline of Mughal emperor and its impact, Advent of Europeans in India – Establishment of bases and trading centres of East India Company and other European companies, Rise of Maratha power, Third battle of Panipat, Cause of defeat of Maratha's and impact of Maratha defeat, Early Anglo – French conflict.

Unit 2. Establishment of British rule in India: Causes of Anglo-French rivalry, Conflict in Bengal, Clive as Governor of Bengal, Battle of Plassey and Buxer, Administrative and Judicial Reforms. Consolidation of English Rule in India, Lord Cornwallis and his reforms, Judicial And Commercial reforms, Lord Wellesley, Lord William Bentinck, Lord Dalhousie and the policy of annexation (1848-56).

Unit 3. Relations of Leading Indian States with English powers: Anglo- Mysore relations – Anglo Mysore wars, Haidar Ali and Tipu Sultan, Anglo- Sikh Relations – Anglo-Sikh wars, Raja Ranjit Singh, Anglo- Maratha Relations- Anglo- Maratha wars.

Unit 4. Revolt of 1857: Causes, Nature and Impact, British Policy towards Burma, The British Afghan Policy –Afghan Wars, Policy Towards Sindh and Nepal, The British Social and Economic Policies.

HY 321 History of China and Japan(1840-1949)-I

Objectives. In this paper, focus is on gradual downfall of Chinese political system and gradual transition of power into the hands of Western powers especially Britain with the first and second Opium wars. The rise of regional powers and anti-manchus sentiments, anti-foreign sentiments, rise of Christianity, and occurrence of several rebellions and movements, the Chinese effort to modernize and militarize are planned to be cover under this paper.

Unit 1. Chinese Feudalism: Gentry, Bureaucracy and peasantry; The Confucian value system; Sino centrism; The Canton commercial system, The transformation of China into an 'informal' colony; the Opium Wars; The Unequal Treaties; The 'scramble' for concessions; Finance Imperialism; The 'Open Door' policy.

Unit 2. Agrarian and Popular Movements: Taiping and Yi Ho Tuan, Attempts at 'Self-Strengthening' (Tzu-Chiang): Reforms of 1860-95; 1898; and 1901-08.

Unit 3. The Revolution of 1911: Causes, Nature and significance; The social composition of the Revolution; Sun-Yet-Sen and his contribution; The formation of the Republic; Yuan Shih Kai; Warlordism. May Fourth Movement of 1919: Nature and significance.

HY 312 History of Modern India (1858-1947 A.D.)

Objectives: This paper provides a thematically arranged overview of the history of India from the first major revolt of 1857 to the making of the republic in 1950. The paper tries to bring up discussion about changing nature of leadership and forms of resistance over period of time.

Unit 1. Impact of the rule of British Rule in India: Destruction of village economy and handicrafts, Impact on agriculture and Industries, Social Impact- Social and Religious reform movements.

Unit 2. Early Stages of Emergence of Nationalism: Peasant and tribal revolts, rise of middle class, Formation of Associations and Pressure groups, Birth of the Indian national Congress, Rise of the Extremism in the Indian National Congress, Programs and objectives of moderate and extremist functions, partition of Bengal and Surat split, Swadeshi Movement, Leaders of Extremist and Moderate factors.

Unit 3. Rise of Revolutionary Nationalism: Impact of Bengal partition, Growth of revolutionary ideas and organization in India and abroad, Home Rule movement, Lucknow Pact, Rise of Communal organizations, Gandhian movements, Rowlett Act, Kilafat Movement, Round table conference, Poona Pact, British Response to Indian Demand – Simon Commission, Rise of communal Politics – Policies and Act of Muslim League and other communal bodies, the Jinnah Factor, Partition of India and attainment of freedom, August offer, Cripps mission, cabinet mission, Wavell Plan, Mount Batten Plan, Leaders of Indian National Movement.

Unit 4. Constitutional Development: Queen's Proclamation and Act of 1858, Indian Council Act 1892, Indian Council Act 1909, Govt. of India Act 1919, Govt. of India Acts 1935, 1947

HY 322 History of China and Japan(1840-1949) -II

Objectives: The purpose of this paper is to discuss the end of dynastic rule in China, beginning of new era altogether with contestation between nationalists and communists for Centre stage of politics along with unsuccessful attempt to revive the dynastic and traditional pattern. There is also an effort to situate China in a new global order which was underway. There is particular reference to the rise communism under the leadership of Mao Zedong. In this paper, the rise of Japan as a new force to reckon with in East Asia under the restored Meiji government has been discussed along with the Japanese antagonism with USA and its consequences.

Unit 1. Nationalism and Communism in China (1921-1937): Formation of the CCP, The Kuomintang (Nationalist Party or KMT), The First United Front.

Unit 2. The Communist Movement (1928-1949): The Jiangxi Period and the rise of Mao Tse-Tung, The Second United Front.

Unit 3. Transition from feudalism to capitalism: Crisis of Tokugawa, Bakuhan system, Meiji Restoration, Political Reorganization, Military Reforms, Social, Cultural and Educational reforms (Bunmeikaika), Financial reforms and Economic development in the 'Meiji' era, Meiji Constitution. Japanese Imperialism: China, Korea and Manchuria. Democracy and Militarism/Fascism: Popular/People's Rights Movement, Nature of political parties, Rise of Militarism, Second World War.

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology. [8]

Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services. [7]

Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling. [6]

Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures. [9]

Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures. [9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya	[12]
Bal Gangadhar Tilak, Gopal Krishna Gokhale	[15]
Raja Ram Mohan Roy, Dayanand Saraswati	[12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement	[8]
Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947	[8]
Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features	[13]
Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism	[10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha	[8]
Executive: President, Prime Minister and Cabinet	[8]
Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation	[12]
Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups	[11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress	[11]
Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China	[14]
Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China	[14]

M.A. Psychology 2016-17
M. A. in Psychology

PL 511 Advanced General Psychology-I 4-0-0-4

Introduction to Psychology: Definition, Nature, Scope, Purpose of psychology, Methods of Psychology: Observation, Experimental, Case Study. [6]

Biological Basis of Behaviour : Neuron and its structure, Nervous System; Peripheral & Central Nervous system, Endocrine gland and Personaliy. [12]

Sensory-Perceptual Processes: Visual, Auditory- Structure and function of eye and ear. Attention: Nature of Attention and its determinants, Perceptual organization: Perceptual Constancy, Determinants of perception, Types of perception: Form, Space, Depth. Methods of Psychophysics, Signal Detection theory and Subliminal Perception. [12]

Learning: Classical Conditioning: Procedure, phenomena & related issues **,** Operant Conditioning; Procedure, phenomena & related issues, Cognitive theories of learning: Latent, Insight, Observational**,** Neurophysiology of Learning. [10]

Memory & Forgetting: Models of memory; Atkinson & Shiffrin, Craik & Lockhart, Tulving**,** Sensory, Short term & Long term Memory; Flashbulb memory, Reconstruction and distortion of memory, Biological Basis of Memory, Improving memory strategies**,** Forgetting; Theories of forgetting [12]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology.* Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan.* Motilal Banarasi Das, Varanasi.

PL 521 Applied Psychology-I 4-0-0-4

Introduction: Nature, scope, history, fields, methods and importance of applied psychology. [8]

School Psychology: Role of psychologist in school system, measurement and evaluation, education technology, behavior modifications in classroom. [10]

Guidance & Counselling: Types of guidance and counselling, counselling process, characteristics of a effective counsellor, ethics of counselling, uses of psychological tests in counselling, counselling effectiveness in solving personal, social, educational and career, developmental, preventive and curative aspect of counselling. [12]

Mental Health and Hygiene: Factors affecting mental health, indicators of mental health, role of psychologists in promoting mental health, alternative therapies for promoting mental health. [12]

Neuropsychology: what is neuropsychology, scope, functions of neuropsychologists, techniques of neuropsychology. [10]

Suggested Books:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Singh, A. P. Vyavaharik Manovigyan. Abhishek Publication, Varanasi.
3. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
4. Rao, S. N. *Counselling and Guidance*. Tata McGraw-Hill, New Delhi.
5. Charles, J. G., & Bruce, R. F. *Counseling Psychology: Practices, Issues and Intervention*. CENGAGE Learning, New Delhi.
6. Sue, R., Sue, D., & Sue, S. *Understanding Abnormal Behaviour*. Houghton Mifflin.
7. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
8. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.

PL 531 Systems in Psychology 4-0-0-4

Development of Psychology as a Discipline: History of Psychology, how psychology as evolved as an independent discipline, Structuralism; Wundt and Tichener, Functionalism: Dewy, William James, Galton. [10]

Behaviourism school of psychology: Pavlov, Skinner, Thondike, Watson, Lashley. [10]

Gestalt School of Thought: Max Wertheimer, Kohler and Kofka, Jean Piaget. [10]

Psychoanalytic and Neo- Psychoanalytic Prospective: Freud, Jung, Erikson, Adler, Horney, Eric Fromm. [11]

Humanistic and Existential Perspective: Maslow and Carl Rogers, Victor Frankl, Rollo May. [11]

Suggested Books:

1. Wolman, B.B., *Contemporary theories and systems of Psychology*, Harper and Bors, N.Y.
2. Chaplin, T. Kraweic, T.S. *Systems and Theories of psychology*. Holt Rinehart and Winston.
3. Schiffman, H.R. *Sensation and Perception.* New York : John Wiley and Sons.
4. Hilgard, E.H., and Bower, G.H. *Theories of Learning*. Englewood Cliffs : Prentice Hall.
5. Matlin, M.W. *Cognition*. Bangalore : Prism.
6. Mazur, J.E. *Learning and Behaviour*. Englewood Cliff's : Prentice Hall.
7. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's *Experimental Psychology*. London : Methuen and Co.
8. Marks, M.H. and William, A. Cronan – Hillix, *Systems and Theories in psychology*. McGraw Hill International Editions, Psychology Series.
9. Vygotsky, L.S. *Thought and Language*, Cambridge, mass. MIT Press.
10. Hall C.S. : Lindzey, G. *Theories of Personlaity*. New York : Wiley Eastern Limited.
11. Leahey, Thomas.Hardy, *History of Psychology: main currents in psychological thought*, New Delhi: Peacock Books.

PL 541 Life Span Developmental Psychology 4-0-0-4

Introduction to life span psychology: Meaning, nature, purpose, scope, Methods; Longitudinal, cross-cultural, Stages of human development, Difference between growth and development, Types of development; Quantitative and qualitative. [12]

Pre-natal and Neonate development: Conception, Stages of pre natal development, types of birth and its impact. [10]

Infancy and Childhood: Developmental milestones, cognitive, motor, moral, social, emotional, language development. [10]

Adolescent: Physical and psychological changes, Developmental task of adolescent, Problems of adolescent. [10]

Adulthood and old age: Choice of vocation, Adjustment to career, marriage and family, Developmental tasks of adulthood, problem of aging, Special issues of old age. [10]

Suggested Books:

1. Hurlock, E. *Child Development*. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. *Child Development.* Prentice-Hall of India, New Delhi.
3. Kaluger, G. S., & Kaluger, M. F. *Human Development: The Span of Life*. Times Mirror, St. Louis.
4. Santrock, J. W. *Life-Span Development*. McGraw-Hill, New York.
5. Shaffer, D. R. *Developmental Psychology*. Brooks & Cole, California.

PL 551 Practicum-I 0-0-8-4

Assignments are based on the courses PL 511 Advanced General Psychology-I, PL 521 Applied Psychology-I, PL 531 Systems in psychology, PL 541 Life span development Psychology.

PL 561 Seminar-I 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 512 Advanced General Psychology-II 4-0-0-4

Motivation: Motivational Cycle, Biological & Social Motives, Theories of motivation. [8]

Emotion: Physiological correlates of emotions**,** Theories of emotions, Conflict & Stress management. [8]

Thinking: Language &Thought, Imagination, Theories of thinking**,** Problem Solving, Reasoning, Decision Making & Creative thinking with classroom implication. [10]

Cognition & Meta-cognition: Factor & Process theories, Abilities & achievement- concept & Role of Emotional Intelligence, Classroom implication of Gardner's Multiple Intelligence Theory, Meta-cognition-Concept & Implication. [12]

Personality Approaches of personality- Psychoanalytic, Neo-Freudian, Social Learning, Trait & Type, Cognitive, Existential & Humanistic**,** Personality Assessment- Projective, psychometric & Behavioral measure. [14]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology*. Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan*. Motilal Banarasi Das, Varanasi.

PL 522 Applied Psychology-II 4-0-0-4

Industrial and Organizational Psychology: Principles and dynamics of organizational behavior; Motivation, Job satisfaction, models of leadership, work enviorment, personnel psychology, engineering psychology, role of industrial and organizational psychologists. [12]

Consumer Psychology: Nature and functions, consumer decision making, Black Box model of consumer behavior, factors affecting consumer decision making, e-shopping, virtual mall, Different modes of advertisement, Role of psychological factors in making advertisement**.** [10]

Clinical Psychology: concept of normality and abnormality, characteristic of abnormal behavior, causes of psychopathology, various psychopathological disorders; neurosis, psychosis, assessment and treatment; psychoanalytic, behavioural, cognitive. [12]

Forensic and Law Psychology: Introduction and Historical Perspective, Fields of Forensic Psychology, Criminal Identification techniques, Psychology and judicial process, Eyewitness testimony, role of psychologist in legal judicial system, juvenile delinquency, ethical issues in forensic psychology, Police interrogation and false confession, Legal rights of inmates: Rights to treatment, Right to refuse treatment. [10]

Sports Psychology: What sports psychologists do, role of psychology in motivation, mental health, skills to enhance performance, sport injury and rehabilitation of athletes. [8]

Suggested Book:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. *Industrial Psychology*. Prentice Hall, Englewood Cliffs.
4. Misra, G. *Psychological Perspective on Stress and Health*. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. *Social Psychology*. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. *Psychology in Sports: A Contemporary Perspective*. Friends, New Delhi.

PL 532 Psychometrics and Statistics in Psychology 4-0-0-4

Psychometrics: Measurement in Psychology, History of psychological measurement & testing, Levels of Measurement; Scales, Functions of measurement, General problems of measurement. [10]

Test development: Meaning & Classification of psychological tests, Characteristics of a good test, Ethical issues in psychological testing, Uses and limitation of Psychological tests, General steps of test Construction; Item writing, Item analysis, reliability, validity & norms. [12]

Overview of descriptive statistics and probability: Overview of measures of Central tendency, variability, curves and graphs , Percentiles, percentile ranks and standard scores, Characteristics of normal distribution curve. [10]

Parametric statistics: t-test and ANOVA, Correlation and regression analysis. [10]

Non parametric statistics: Chi-square, Mann-Whitney U test, Rank-difference Method, Coefficient of Concordance, Kruskal –Wallis H test, Friedman test. [10]

Suggested Books:

1. Garrett, H. E. *Statistics in Psychology and Education*. Paragon International Publishers, New Delhi.
   McGuigan, F. J. *Experimental Psychology*. Prentice-Hall of India, New Delhi.
2. Broota, K. D. *Experimental Design in Behavioural Research.* Wiley Eastern, New Delhi.
3. Guilford, J. P., & Fruchter. *Fundamentals of statistics in Psychology and Education*. Kogakusha, Tokyo.
4. Kapil, H. K. *Sankhyiki Ke Mool Tatwa*. Vinod Pustak Mandir, Agra.
5. Anastasi, A. & Urbina, S. (1997). Psychological testing. N.D.: Pearson Education.
6. Singh, A.K. (2006). Tests, Measurements and Research Methods in Behavioural Sciences.Patna: Bharati Bhavan.

PL 542 Research Methodology 4-0-0-4

Research: Meaning and characteristics of research, Stages in Research, Types of Research and Meaning, types and methods of sampling. [8]

Problem and Hypothesis: Meaning and characteristic of a problem, Sources of stating up a problem, Types of problem, Meaning and characteristics of a good hypothesis, Formulating a hypothesis, Sources of hypothesis. [8]

Review of Literature: Purpose of the review, Sources of the review, Types of literature, Writing process of the literature review. [10]

Variables: Types of variables, Methods of measuring dependent variable, Approaches to manipulate variables**,** Techniques of controlling extraneous variables. [10]

Research Design: Meaning and purpose of research design, types of research design, between group and within group design. [10]

Research Report & Research Proposal: purpose, structure and style of writing a research report, preparing a research proposal. [6]

Suggested Books:

1. Guilord J.P. *Psychometric Method*. McGraw Hill. N.Y.
2. Guilford J.P. Fruchter's. *Fundamental Statistics in Psychology Education*. International McGraw Hill Publisher, New York.
3. Kerlinger, F.N. *Foundations of Behavioral Research*. ND : Surjeet.
4. Kothari, C.R. *Research Methodology, Methods and Techniques.* ND : Wiley Eastern Limited.
5. Broota; K.D. *Experimental Design in Behavioral Research*. Wiley Eastern. New Delhi.
6. Singh, A.K. Tests, *Measurements and Research Methods in Behavioural Sciences*.Patna: Bharati Bhavan.

PL 552 Practicum-II 0-0-8-4

Assignments are based on the courses PL 512 Advanced General Psychology-II, PL 522 Applied Psychology-I, PL 532 Psychometrics and Statistics in psychology, PL 542 Research Methodology and Field Study.

PL 562 Seminar-II 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 611 Peace Psychology 4-0-0-4

Introduction: Psychology of peace, Types of peace, Historical perspective of peace psychology, role of individual and society. [8]

Peace and Non-Violence: Indian perspective of peace**,** views of Buddha, Mahaveer, Gandhi, Values of non-corporation and Indian experience. [10]

Violence: what is violence, different types of violence as School, youth, domestic, cultural, structural, direct etc, causes of violence, impact of violence. Role of individual and society in reducing violence. [10]

Life Peace and Culture: role of peace education, colobration, humility and social values in promoting peace in individual and social living [12]

Psychology of specific conflicts and peace efforts: war ethics and Geneva convention, role of organizations promoting peace, accounts and challenges. [12]

Suggested Books:

1. Suryanarayan, N.V.S. Peace Psychology. Discovery Publishing House, Pvt. Ltd.
2. Christie, D. J., Wagner, R.V., and Winter, D.A., Peace, Conflict and Violence: Peace Psychology for the 21st century. Englewood Cliffs, N.J: Prentice Hall.
3. Aber, L.,Brown, J., and Henrich, C.Teaching Conflict Resolution: An Effective School based Approch to Violence Prevention. N.Y.:National Centre for Children for Poverty.

PL 621 Social Psychology 4-0-0-4

Social Psychology: Introduction to social psychology, definition, nature and scope of social Psychology, Methods of social Psychology: Experimental and Non-experimental. [10]

Social Per caption and Social Cognition: Meaning of social perception, Role of non verbal communication in social perception, Role of schemas, heuristics, automatic and controlled processing**,** Potential sources of error in social cognition. [12]

Attitudes: Meaning and Characteristics of attitudes**,** Attitude formation**,** Attitude change**,** Theories of attitude change; cognitive dissonance.

Interpersonal attraction: Meaning and nature of interpersonal [10] attraction, Internal and External determinants of attraction, Theories of attraction.

Stereotype, Prejudices and Discrimination: Meaning and nature [10] of prejudice**,** Formation of norms and prejudice**,** Techniques for countering its affects**,** Difference between prejudice, stereotype and discrimination.

[10]

Suggested Books:

1. Baron, R.A., Byrne, D. *Social Psychology* -Prentice-Hall.
2. Daniel, P, Cozby, P.C. *Social Psychology*, New York: CBS College Publishing Holt, Rinehart and Winston.
3. Lindzey, L., and Aronson, E..*The Handbook of Social Psychology* , Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S . *Social Psychology,* Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. *Handbook of Psychology* (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. *Social Psychology*-Tata McGraw Hill International Editions.
7. Penrod, S. *Social Psychology* ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K. *Samaj Manovigyan Ki Rooprekha*, NewDelhi: Moti Lal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O. *Social Psychology* - Pearson Education.

PL 631 Introduction to Guidance 4-0-0-4

Guidance: Historical Perspective**,** Objectives & Principles of guidance**,** Types of guidance-Educational, Career, Personal and Social. [6]

Guidance and School Education: Guidance and role of teacher, parents, Counsellor and school administration, facilitating learning through guidance. [10]

Pupil Personal Services: Orientation, Evaluation, Individual inventory service, Information service, counselling service, Placement and evaluation and research. [14]

Guidance and School curriculum: Meaning of curriculum, Why guidance and Curriculum is inseparable, role of counselor in curriculum planning, personalization of curriculum, guidance functions through the subject matter areas. [8]

Special Concern for Guidance: Guidance of special group of Children; Cognitive, Physical, Social and Emotional exceptionality**,** Guidance for Drug abuse, delinquent behavior, adult Sex abuse, spouse abuse ,child abuse, HIV, ADHD, Learning disability. [14]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
3. Jones. A.J., *Principal of Guidance*, McGraw Hill, N.Y.
4. Psricha, *Guidance and Counselling in Indian education*, New Delhi, NCERT.
5. Mayers, G.E., *Principles and Techinques of vocational Guidance*, McGraw Hill, N.Y.

PL 641 Introduction to Counselling Psychology 4-0-0-4

Definition and history of counselling: What is counselling, effectiveness of counsellor, ethical and legal aspects of counselling. Individual and Group counselling, Stages of group counselling. [10]

Counseling Process: External Conditions and preparation, Stages of counselling process. [12]

Rapport Building- Building counselling relationship, generic and specific skill for rapport building. [10]

Assessing the Problem: Purpose, component, types of problems, skills required by counsellor for assessing the problem. [10]

Goal Setting: Functions and types of goal, obstacles in setting specific goals, effect of goal setting , skills associated with goal setting. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.

3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). Therapeutic Psychology : Fundamentals of Counselling Psychotherapy. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) Career Counselling Techniques, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) Handbook Emotional and Behavioral Difficulties. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) Career Counselling a Developmental Approach, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 651 Practical of Guidance & Counselling Psychology 0-0-8-4

Assignments are based on the courses PL 631 Introduction to Guidance, PL 641Introduction to Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 661 Advanced Industrial Psychology 4-0-0-4

Introduction to industrial psychology: Definition, role, Nature and scope**,** Origin and History of industrial psychology**,** Contribution of Hugo Munsterberg, Taylor, Gilbreth and Alton Mayo. [10]

Job Analysis: Purpose, importance and uses of job analysis**,** Various methods of job analysis**,** Job design approaches and job enrichment [10]

Recruitment and selection: Purpose and importance of recruitment and selection**,** Recruitment process; external and internal**,** Stages in selection process**,** Selection methods. [10]

Personnel Training: Nature and principals of training**,** Assessing training needs**,** Training methods; on-the job training, of the job apprenticeship, business games, Evaluation of training programme. [10]

Performance appraisal system: Purpose, importance, Uses of Performance appraisal**,** Methods of evaluating Performance appraisal; traditional methods, 360 degree appraisal and management by objectives**,** Issues and biases related to Performance appraisal. [12]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975. *Industrial Psychology*, Prentice Hall, 6th Ed.
2. Glimer. *Industrial Psychology*.
3. Ghiseli and Brown. *Personnel and Industrial Psychology*.
4. Dunnette, M.D. Handbook of Industrial and Organizational Psychology.
5. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
6. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
7. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co

PL 671 Dynamics of Organization Behaviour-I 4-0-0-4

Introduction: Meaning and Importance of OB, Historical overview; Classical and Neo-classical**,** Approaches of OB; contingency and system approach. [10]

Motivation in Organization: Needs theories of motivation**,** Equity theories of motivation**,** Job Design and work motivation**,** Determinants of job satisfaction**,** Organizational commitment, citizenship behavior and organizational justice. [10]

Leadership: Trait Theories, Behavioural Theories, Contingency theories: Fiedler Modal and situational leadership Theory; Path Goal theory, Inspirational Approaches to leadership: Charismatic Leadership; Transformational Leaders**,** Authentic Leadership: Ethic and trust are the foundation of leadership**,** Contemporary Leadership Roles: Mentoring, self Leadership, E-Age. [12]

Organizational Communication: Meaning and functions**,** Directions of communication in organization**,** Directions and methods of improving communications**,** Barriers of effective communication. [10]

Decision Making: Nature of decision Making, Behavioural decision

making: decision rationality, models, decision making techniques: [10] traditional and Modern Participation technique.

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour,* Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
8. Nelson, D.B. and Quick J.C. (2005) *Understanding Organizational Behavior.* South Western Thomson Learning.

PL 681 Practical of Industrial & Organizational Psychology-I 0-0-8-4

Assignments are based on the courses PL 661 Advanced Industrial Psychology, PL 671 Dynamics of Organizational Behaviour-I. That also accompany by field visit, and practical's related to compulsory papers.

PL 691Synopsis 0-0-0-2

The student has to submit two copies of a research proposal by first week of November in the department. It will be followed by presentation for approval.

PL 612 Positive Psychology 4-0-0-4

Introduction to Positive Psychology: Positive Psychology; Goals & Definition, Western & Eastern view of Positive Psychology, Classification and measurement of Human Strengths & Positive outcomes**,** Developing Strength and living well. [10]

Positive Emotional states and processes: Pleasure, positive effect, Happiness & Wellbeing, Emotional intelligence**,** Living well across life stages. [10]

Positive cognitive states and processes: Self efficacy and self acceptance, wisdom, optimism & hope, Mindfulness and flow. [10]

Pro-social behavior and well-being: Empathy, altruism, gratitude, Forgiveness, attachment, Positive experiences in school life. [10]

Spirituality and Positive Psychology: Creativity, giftedness and industry, Religion & spirituality, Emotional and social intelligence. [12]

Suggested Books:

1. Snyder, C.R. & Lopez, S.J., *Positive Psychology*. New Delhi: Sage.
2. Snyder, C.R. & Lopez, S.J., Handbook of Positive Psychology. N.Y.Oxford.
3. Wong.P.T. & Fry. The Human Quest for meaning. Mahwah, New Jersey. Lawrence, Erlbum.
4. Baumgardner, S. & Crothers, M. Positive Psychology, New Delhi, Pearson Education.

PL 622 Health Psychology 4-0-0-4

Physical and Mental Health: what is health, what is physical and mental health, relationship between physical and mental health, different dimensions of mental health, concept of psychological health in india, the development of changed outlook in nature of health and illness, scope of health psychology [10]

Eating Behaviour: what is healthy diet, how does diet affect health, models of eating behavior, weight concern and eating behavior, dieting, overeating, under eating, Body dissatisfaction, causes of body dissatisfaction, obesity; role of psychological factors in obesity, relation of obesity with coronary heart diseases, diabetes and other health problems. [12]

Exercise: what is exercise, why exercise, different forms of exercise including yoga, meditation, pranayam, aerobics etc., physical and psychological benefits of exercise, Relation of exercise with mood, depression, pleasure and good health. [10]

Sex and women's health issues: sex as biological for reproduction, sex as a risk and pregnancy avoidance, use of contraception, sex as a risk to health in context of STDs/HIV and AIDS, Sex education. [10]

Health behaviour and Primary prevention: What is health bhaviour, Barriers to effective health promotion. Factors influencing the practice of health behavior, Modification of health behavior. Changing health behaviours by changing health beliefs, Changing health behaviours through social engineering. [10]

Suggested Books:

1. Ogden, Jane. *Health Psychology*.Mcgraw Hill Education, India.
2. Brannon, Linda. Introduction to Health Psychology, Australia: Thomson, Wadsworth.
3. Baum, A. Revenson, T.A. and Singer, J.E. Handbook of Health Psychology, New Jersey: Lawrence Erlbaum.
4. Dimatteo, M.R., and Martin, L.R. *Health Psychology*. Boston: Allyn and Bacon.
5. Marks, D., Murray, M., Evans, B. and Willing,C. *Health Psychology: Theory, research and practice*. New Delhi: Sage.

PL 632 Intervention in Guidance & Counselling 4-0-0-4

Psychoanalytical Approach: Classical psychoanalytic theory, view of human nature, role of counsellor, goals and techniques of psychoanalytic approach. [10]

Cognitive Approach: Back's cognitive therapy and ELLIs Rational Emotive theory, Transactional analysis. [10]

Gestalt Approach: Fritz Perls therapy, goal, view of human nature and techniques of gestalt therapy. [10]

Behavioural Approach: Techniques based on classical and operant conditioning for behavior modification: systematic desensitization, flooding, shaping, aversion, punishment, assertive training etc. [12]

Humanistic & Existential Approach: Carl Rogers Clint centered therapy, Rollo May and Victor Frankls therapy. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.
3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). Therapeutic Psychology : Fundamentals of Counselling Psychotherapy. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) Career Counselling Techniques, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) Handbook Emotional and Behavioral Difficulties. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) Career Counselling a Developmental Approach, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 642 Areas of Counselling Psychology 4-0-0-4

School Counselling: Developmental, Preventive and curative aspects of counselling at elementary, middle and secondary school, role of counselling in promoting academic excellence and personality development of the students. [10]

Career Counselling: Career as a way of life, concept of career choice, measurement of career choices, role of personality, interest and values in career choice, major theories of career counselling: Holland theory. [10]

Crisis Intervention counselling: Introduction, types of crisis, typical response to crisis, process and principles for crisis intervention. [10]

Counselling across the life span: Counselling before planning the pregnancy, during and after the pregnancy, counselling for parents, child and adolescent counselling, counselling for adults and old-age people. [12]

Emerging fields and trends in Counselling: Multi-cultural, homosexual, marriage, rehabilitation, mental health, substance abuse, [10]

HIV and Health counselling, computers, feminist prospective, group work etc.

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). *Introduction to Counselling*. W.G. : Brown Publishers.
3. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy* : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) *Career Counselling Techniques*, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) *Career Counselling a Developmental Approach*, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 652 Practical of Guidance & Counselling-II 0-0-8-4

Assignments are based on the courses PL 632 Interventions in Guidance & Counselling, PL 642 Areas of Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 662 Engineering Psychology 4-0-0-4

Human engineering: Scope and origin of engineering psychology**,** Importance of engineering psychology**,** Aim of engineering psychology. [10]

Man-machine system: Meaning of man-machine system**,** Design, display, control and action**,** Application of man-machine system. [10]

Working Conditions: Concept of efficiency and Work curve**,** Physical enviorment; noise, illumination, atmospheric conditions, music, rest pauses**,** Working conditions and performance. [10]

Accidents and Safety: Definition of accident, risk taking behavior and accident proneness**,** Human and economics cost of accidents**,** Causes of accidents**,** Individual, situational, organizational factors related to accident reduction; safety measures. [12]

Work and Fatigue: Concept of work and fatigue**,** Work schedule**,** Methods of design**,** Monotony and boredom, Way to reduce monotony and boredom. Industrial morale. [10]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975.*Industrial Psychology*, Prentice Hall, 6th Ed.
2. McCormick D.J. 1976. *Human Factors Engineering and Design*. McGraw Hill 4th Edition.
3. Glimer. *Industrial Psychology*.
4. Ghiseli and Brown. *Personnel and Industrial Psychology*.
5. Dunnette, M.D. *Handbook of Industrial and Organizational Psychology*.
6. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
7. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
8. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co.

PL 672 Dynamics of Organizational Behaviour-II 4-0-0-4

Organizational Structure: Meaning and issues in organizational structure**,** Work specialization, departmentalization, chain of command, span of control, centralization v/s Decentralization**,** Traditional organizational structure; The team structure, the virtual organization, the boundary less organization. [12]

Organizational culture: Organizational culture meaning and definition and related concepts**,** Perspective and topologies of organizational culture**,** Creating and sustaining culture. [10]

Organizational Change and development: Nature and perspective of change**,** Levels of change, structure, technology and leadership**,** Types of change; organizational change as growth, transformation and as turn [10]

around, Resistance to change, Strategies to overcome resistance to change, Nature and importance of organizational development, Role, values and ethics of organizational development practitioners.

Group Dynamics: Meaning, nature and types of group, concept of group dynamics and theories of group formation, group role, norms, decision making. Group cohesiveness and group conformity. [10]

Conflict and stress: Meaning and types of conflict, Interpersonal and Intergroup conflict, Work-family conflict, Strategies for conflict resolution, Work stress; sources, consequences, managing stress: individual and organizational coping strategies. [10]

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour*, Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
5. Nelson, D.B. and Quick J.C. (2005) Understanding Organizational Behavior (2nd Edition) South Western Thomson Learning.

PL 682 Practical of Industrial & Organizational Psychology -II 0-0-8-4

Assignments are based on the courses PL 662 Engineering Psychology, PL 672 Dynamics of Organizational Behaviour-II. That also accompany by field visit, and practical's related to compulsory papers

PL 692 Dissertation 0-0-0-4

The student has to submit two copies of dissertation by the first week of May in the department. It will be followed by presentation and viva-voce.

MA English 2016-2017
M. A. (English)

EL 551 Modern English Grammar and Usage 4-0-0-4

Basic Sentence Types: Subject, Predicate, Object, Adjunct	[10]
Coordination and Subordination: Simple Sentence and Complex Sentence	[6]
Different Concepts and Notions: Request, Order, Question, Condition, Purpose, Suggestion, Wish, Hope, Intention, Obligation, Contrast, Commission	[7]
Theme Writing: Development of thoughts, Consistency in writing, Vocabulary	[6]
Fallacies	[6]
Literary Appreciation	[5]
Précis Writing	[5]
Critical Reading Skills	[7]

Suggested Readings:

1. A.S. Hornby: A Guide to Patterns and Usage, (Oxford 1984).
2. CIEFL - Material on Morphology and Phonology from the Distance Education Dept.1992.
3. George Yule: The Study of Language, CUP (ELBS, 2002)
4. Geoffery Leech: English Grammar for Today (Longman, 2004)
5. Praveen K Thaker: Appreciating English Poetry: A Practical Course and Anthology, Orient Lognman,1999
6. Effective English Communication, Krishna Mohan and Meenakshi Rama, Tata McGraw Hill, 2001.
7. Spoken English, V. Sasi Kumar and P.V. Dhamija, Tata McGraw Hill, 2001.

EL 513 Middle Ages to the Seventeenth Century English Literature-I 4-0-0-4

Geoffrey Chaucer: General Prologue to the Canterbury Tales	[10]
Christopher Marlowe: Doctor Faustus	[8]
William Shakespeare: As You Like It, King Lear	[10]
Francis Bacon: Of Envy, Of Love, Of Adversity	[6]
John Donne: The Extasie, The Relique, The Flea	[7]
John Milton: Paradise Lost, Book I	[11]

Suggested Readings:

1.Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd, 1995.
2.Daiches, David: A Critical History of English Literature (vol. I), Delhi, Allied Publishers, 1998.

EL 571 Eighteenth Century to the Twentieth Century English Literature-I 4-0-0-4

John Dryden: Absalom and Achitophel	[9]
Jonathan Swift: The Battle of the Books	[4]
Alexander Pope: The Rape of the Lock	[9]
William Wordsworth: The Prelude, Book I	[8]
S.T. Coleridge : The Rime of Ancient Mariner	[4]
Percy Byssey Shelley: Adonais	[4]
Robert Browning: My Last Duchess	[5]
Gerard Manley Hopkins: The Windhover, Felix Randal.	[5]
Thomas Stearns Eliot: The Four Quarters	[4]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5.A,R, Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.1994.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.1964.

EL 523 American Literature 4-0-0-4

Ralph Waldo Emerson: The American Scholar	[4]
Walt Whitman: Crossing Brooklyn Ferry, Passage to India, I Hear It Charged Against Me	[8]
Sojourner Truth : Ar‟n‟t I a Woman?- Speech to the Women‟s Rights Convention in Akron, Ohio, 1851	[4]
Robert Frost: Birches, Mending Wall	[6]
Wallace Stevens : Thirteen Ways of looking at a Blackbird	[4]
Eugene O'Neill: Emperor Jones	[8]
N. Hawthorne: The Scarlet Letter	[8]
Tony Morrison: The Bluest Eye	[10]

Suggested Readings:

1.Bloom, Harold. ed. EuqueneO‟neill. New York, Chelsea, 1987.
2.Bentley, Eric. in Search of Theatre. New York, Knop, 1953.
3.Baqohee, Shymal. ed. Perspectives on O‟Neil:New Essays. New york:University of Victoria,1988
4.Lewis, Allan. American Plays and Playwrights of the Contemporary Theatre. New York:Crown, 1965.
5.Mukharjee, Sujit, and D.V.K. Raghara-Charyulu eds. Indian Essays in American Literature. 1969.
6.Ford, Boris. ed. The New Pelican Guide to English Literature, Vol. 9.1994.
7. Morrison, Toni. Playing in the Dark, I Chapter.2004.
8. Robert Spiller: Literary History of the United States, (Amerind Publishing Co.2006)
9.Marcus Cunliffe : American Literature to 1900, (Sphere Reference)
10.F.O.Matthiessen. American Renaissance, 1992.
11. George McMichel : Concise Anthology of American Literature.2000.
12. SD Palwekar, Literature and Environment:A Select Study of British, American and Indian Writings, Lambert Academic Publishing, Germany, 2012.

EL 591 Indian Writing in English 4-0-0-4

Raja Rao : Kanthapura	[8]
Anita Desai : Clear Light of Day	[8]
Salman Rushdie: Midnight‟s Children	[10]
A. K. Ramanujan : Is There an Indian Way of Thinking: An Informal Essay	[4]
Toru Dutt : Savitri- Part I	[4]
Nissim Ezekiel : "Goodbye Party for Ms Pushpa T.S., Background, Casually, Night of the Scorpion	[5]
JayantaMahapatra : Evening Landscape by the River, From Temple	[5]
Mahesh Dattani: Tara	[8]

Suggested Readings:

1. Ahmad, Aijaz. In Theory: Classes, Nations, Literatures.1994
2. Devy, G. N. After Amnesia: Tradition and Change in Indian Literary Criticism, 1992.
3. Gopal, Priyamvada. Indian English Novel: Nation,History and Narration, 2005.
4. Guha, Ranajit, ed. The Subaltern Studies Reader (Selected Essays), Delhi: OUP.2006
5. Iyenger, K. R. Srinivasa. Indian Writing in English.1998.
6. King, Bruce. Modern Indian Poetry in English.2002.
7. Khair, Tabish. Babu Fictions: Alienation in Contemporary Indian English Novels.2008.
8. Mukherjee, Meenakshi. The Twice Born Fiction, 2nd edn, 2001.
9. Naik, M. K. A History of Indian English Literature.2000.
10. Naik, M.K. and Shyamala A. Narayan. Indian English Literature 1980-2000: A Critical Survey. 2001.
11. Suleri, Sara. The Rhetoric of English India. 1992.
12. Vishwanathan, Gauri, Masks of Conquest: Literary Study and British Rule in India.1984.

EL 562 Introduction to Linguistics and Phonetics 4-0-0-4

Introduction: Linguistics and its Scope, Branches of Linguistics, Some Basic Concepts in Linguistics	[7]
Language and Communication, Language Variation and Language Change.	[6]
Phonetics and Phonology: Phoneme, Allophone, Human Speech Mechanism, Vowels and Consonants in English	[11]
Syllable structure, Supra-segmental features; GIE, Phonemic Transcription.	[14]
Morphology and Syntax; Morpheme, Word Formation Processes in English	[8]
IC Analysis, Phrase Structure Grammar, Transformation-Generative Grammar	[6]

Suggested Readings:

1.Abercrombie, D. Elements of General Phonetics (Edinburgh University Press, 1967).
2.Balasubramaniam, T. A Textbook of English Phonetics for Indian Students (Macmillan1981).
3.Chomsky, Noam. Aspects of the Theory of Syntax (Cambridge, Mass: MIT Press, 1965).
4.Crystal, David. Linguistics (Penguin, 1971).
5.Hockett, C.F. A Course on Modern Linguistics (New York: Macmillan, 1958).
6.Katamba, F. Morphology (Basingstoke: Macmillan, 1993).
7.Lyons J. 1968. Introduction to Theoretical Linguistics (CUP, 1981).
8.O'Connor, J.D. Phonetics (Penguin, 1973).
9.Robins, R.H. General Linguistics (Longman, 3rd Edition 1980).
10. Saussure, Ferdinand de. A Course in General Linguistics, Trans. Wade Baskin (New York: McGraw Hill), 1998.
11. Verma, S.K. and N. Krishnaswamy. Introduction to Modern Linguistics (OUP, 1993).

EL 572 Middle Ages to the Seventeenth Century English Literature-II 4-0-0-4

Geoffrey Chaucer: The Squire‟s Tale	[10]
Ben Jonson: Every Man in His Humour	[10]
Shakespeare: Othello	[7]
Edmund Spenser: Epithalamion	[8]
John Donne: Forbidding Mourning, Forbidding Weeping.	[6]
John Milton: Paradise Lost, Book II	[11]

Suggested Readings:

1. Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.1995.
2. Daiches, David:A Critical History of English Literature (vol. I), Delhi, Allied Publishers.1998.
3. Grose, M. W.: Chaucer: Literature in Perspective.2002.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Comedy.1988.
5. Rudram, Alan: A Critical Commentary on Milton‟s Paradise Lost.1978.

EL 582 Eighteenth Century to the Twentieth Century English Literature-II 4-0-0-4

William Collins: Ode to Simplicity, Ode to Music, Ode to Evening	[9]
Thomas Gray: Distant Prospects of Eton College, Death of a Favourite Cat, Elegy Written in a Country Churchyard	[11]
W. B. Yeats: When You Are Old, A Bronze Head, Lapis Lazuli, Sailing to Byzantium	[9]
W. H. Auden: Sir, No Man‟s Enemy, September 1, 1939, In Memory of W. B. Yeats	[11]
James Joyce: A Portrait of the Artist as a Young Man	[12]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5. A.R. Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.2004.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953.
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harvard University Press.1964.

EL 592 Creative and Technical Writing 4-0-0-4

Study of Literary Works in progress: Analysis of the Creative Writing Components (Poem, Novel, Short Story, Drama, Diary)	[8]
Craft of poetry: Subject matter, theme, rhythm, metre, stanza forms, sub-genres of Poetry	[8]
Fundamental Norms of Writing	[5]
Tools of Technical Writing: Feature Writing and Technical Writing	[5]
Editing & Proof Reading	[5]
Business Correspondence	[5]
Writing for various media: Learning to write scripts for Publishers and Copy Writing, Writing for Radio, Theatre, Television and Films	[8]
Assignment in Creative Writing: Poetry/Fiction/Drama	[8]

Suggested Readings:

1.Corbeff, Edward P. J. The little Rhetorica, Handbook. New York; John Wiley Sons, (1977).
2.Watkins, F. C. and Knight, K. E. Write to Write: Readings on the Craft of Writing. Bouston, HoughtounMifelin, (1966).
3.Mullins, Carolyne J. A Guide to writing and Publishing, New York; John Wiley & Sons, (1987).
4.The Writer‟s Manual, Califirnia; ETC Publications, (1977)
5. Baker, Sheridial. The Practical Stylistics, New York; Harper and Raw, (1977).
6. Vrooman Alan. Good writing An informal Mannual of Style. Athemeum: New York, 1972
7. Belcher, Diane D. (ED.) English for Specific Purposes in Theory and Practice. (University of Michigan Press, 2009).

EL 592 Comparative Literature 4-0-0-4

History of Development of Schools of Comparative Literature (French, American, British & Indian)	[8]
Influence and Reception Study	[8]
Genology, Literary History (Period and Movement Study)	[5]
Thematology	[5]
Comparative Literature and Intercultural Studies	[5]
Comparative Literature and Other Disciplines	[5]
The Future of Comparative Literature	[8]
Assignment in Comparative Literature	[8]

Suggested Readings:

1.Jost, Francois, Introduction to Comparative Literature. (Penguin, 2002).
2.Prawer, S.S. Comparative Literary Studies: An Introduction. (Allied, 1999).
3.Brandt, Corstius J. Introduction to the Comparative Study of Literature. (OUP, 2002).
4.Wellek,Rane & Warren, Austin. Theory of Literature. (OUP, 1998).
5.Weisstein, Ulrich (Ed.) Comparative Literature and Literary Theory: Survey and Introduction, Cambridge, 2002.
6.Susan Bassanett. Comparative Literature: Introduction, (Routledge, 2002).
7.Nagendra, Comparative Literature. Delhi, University of Delhi, OUP, 2004.

EL 661 Principles of Criticism-I 4-0-0-4

Aristotle: Poetics	[9]
Horace: Ars Poetica	[6]
John Dryden: Essay on Dramatic Poesy	[6]
Alexander Pope: Essay on Criticism	[4]
Dr. Samuel Johnson: Preface to Shakespeare	[5]
Samuel Taylor Coleridge: Biographia Literaria	[8]
Thomas Love Peacock: Four Ages of Poetry	[8]
T. S. Eliot: Metaphysical Poets	[6]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. "The Genetic-Structuralist Method in the History of Literature".
4. Gramsci, Antonio. "Hegemony".1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. "Crisis in Orientalism". 1987.
8. Sedgwick, Eve Kosofsky. "Introduction: Axiomatic" from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984.
10. Thiong'o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 671 Literature and Society-I 4-0-0-4

The Middle English Period: Norman Conquest of England	[5]
Manorial System of the Normans	[4]
Crusades in the Middle Ages	[4]
Hundred Years War	[4]
Social Life of England	[4]
England in the Sixteenth to the Eighteenth Century: Reformation and Renaissance in England	[6]
University Wits, Social Life in the Age of Milton	[5]
Puritan Revolution, Glorious Revolution of 1688	[4]
Industrial Revolution	[4]
Main Literary Trends in Poetry and Drama	[4]
Emergence of Novel	[4]
Humanism	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, Gale publication, 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2004.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism, Blackwell, 2013
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2000.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 681 Commonwealth Literature-I 4-0-0-4

Dom Moraes: A Letter	[5]
Gopal Honnalgere: The Donkeys	[5]
Kenneth Slessor: Country Towns	[5]
A.D. Hope: Australia	[5]
Les Murray: The Wilderness	[6]
Gabriel Okara: Were I to Choose	[5]
David Rubadiri: A Negro Labourer in Liverpool	[5]
Wole Soyinka: Death and the King's Horseman	[5]
Ngugi' wa Thiong'O:A Grain of Wheat	[6]
Chinua Achebe: Things Fall Apart	[5]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).
4. Césaire, Aimé. Discourse on Colonialism (1950).
5. Fanon, Frantz. The Wretched of the Earth (1961).
6. Gilbert, Helen and Joanne Tompkins. Post-Colonial Drama: Theory, Practice, Politics (London: Routledge, 1996).
7. Memmi, Albert. The Colonizer and the Colonized (1965).
8. Rushdie, Salman. Imaginary Homelands: Essays and Criticism,1981-1991 (London: Granta, 1991).
9. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
10. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984
11. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 691 Translation Studies 4-0-0-4

Concept of Translation in the West and in the Indian Tradition	[7]
Types of translation – intra-lingual and inter-semiotic; „word for word‟ or „sense for sense‟; decoding and recoding	[7]
Equivalence – linguistic and cultural; formal and dynamic; Equivalent Effect	[5]
Language and Culture	[5]
Translators' Invisibility – Domestication and Foreignization	[5]
Self-translation (Auto Translation), Transcreation	[5]
Translation of an actual text: a short story / excerpts from a novel or play / poems	[5]
Philosophical Theories of Translation – Steiner‟s Hermeneutic Motion; Ezra Pound and the Energy of Language; The Task of the translator; Walter Benjamin; Deconstruction	[5]
Literary Translation in Nineteenth Century India	[4]
Postcolonial Translation Theory	[4]

Suggested Readings:

1.Bassnett, Susan. Translation Studies (Revised ed 2000).
2.Catford, J.C. A Linguistic Theory of Translation.2002
3.Mukherjee, Sujit. Translation as Discovery and Other Essays, and Translation as Recovery.2004
4.Susan Bassnett and Harish Trivedi, eds. Post-Colonial Translation: Theory and Practice (London & New York: Routledge, 1999).
5.Venuti, Lawrence. Translation‟s Invisibility: A History of Translation.2009.

EL 613 Indian Writing in Translation 4-0-0-4

Munshi Premchand: Godan	[10]
Mohan Rakesh: Aadhe Adhure	[8]
U. R. Ananthamurthy: Samskara	[8]
Saadat Hasan Manto: Toba Tek Singh	[5]
Mahasweta Devi: Draupadi	[5]
Vijay Tendulkar: Kanyadan	[8]
Baby Kamble: The Prisons We Broke	[8]

Suggested Readings:

1. A.K. Mehrotra, The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008.
2. The Norton Anthology of World Literature. Volume F, 2009.
3. P.France, The Oxford Guide to Literature in English Translation (Oxford, 2000).
4. E Grossman, Why Translation Matters, Orient black swan Pvt. Ltd, 2007.
5. The Oxford India Premchand. OUP:Delhi, 1999.
6. Ananthmurthy. Samskara. OUP: Delhi.2000.
7. Collected Stories of Saadat Hasan Manto.2003.
8. Draupadi. Translated by Gayatri Spivak, 2001.
9. Baby Kamble. The Prisons We Broke. Orient Blackswan, Hyderabad.2004.
10. Tendulkar, Vijay. Kanyadaan. Trans. Gouri Ramnarayan. Delhi: Oxford U P, 1996

EL 623 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Autumn Semester of Second year shall be between 5,000 words and 8,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

EL 662 Principles of Criticism-II 4-0-0-4

Northrop Frye : The Archetypes of Literature	[8]
Ferdinand de Saussure : The Object of Study	[8]
Jacques Derrida : Structure, Sign and Play in the Discourse of the Human Sciences	[8]
Elaine Showalter: Towards a Feminist Poetics	[4]
Jean-François Lyotard : Answering the Question: What is Postmodernism?	[5]
Michel Foucault : What is an Author?	[5]
Roland Barthes : From Work to Text	[4]
Homi K. Bhabha : Cultural Diversity and Cultural Difference	[5]
Jacques Lacan : The Agency of the Letter in the Unconscious or Reason since Freud	[5]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. “The Genetic-Structuralist Method in the History of Literature”.
4. Gramsci, Antonio. “Hegemony”.1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. “Crisis in Orientalism”. 1987.
8. Sedgwick, Eve Kosofsky. “Introduction: Axiomatic” from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
10. Thiong‘o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 672 Literature and Society-II 4-0-0-4

England in the Nineteenth Century: Social and Religious tendencies of the Victorian Age	[6]
Oxford Movement	[5]
Feminist Movement	[5]
The Naughty Nineties	[5]
England in the Twentieth Century: Social and Literary Tendencies of the Early Twentieth Century	[5]
Emergence of the Labour Party	[5]
The Rise of the Problem Plays	[4]
The Stream of Consciousness Technique in Fiction	[5]
Main Trends in Poetry, Drama and Fiction	[8]
Cultural Studies	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, gale publication , 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2002.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism , Blackwell, 2004.
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2003.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 682 Commonwealth Literature-II 4-0-0-4

George Frederick Cameron: The Future	[5]
J. M. Smith: Ode on the Death of William Butler Yeats	[5]
Margaret Atwood: Journey to the Interior	[5]
Edward Brathwaite: Tizzic	[5]
Edwin Thumboo: Gods Can Die	[5]
Yasmine Goooneratne: There was a Country	[5]
Katherine Mansfield: The Man with the Wooden Leg	[4]
Pankaj Mishra: The Romantics	[9]
Kiran Desai: The Inheritance of Loss	[9]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).

1991).
4. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
5. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
6. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 692 Women Studies 4-0-0-4

Rokeya Sakhawat Hussain: Sultana‟s Dream	[8]
Katherine Mansfield: A Cup of Tea	[6]
Charlotte Perkins Gilman: If I were a Man	[6]
Ernest Hemingway: The Short Happy Life of Francis Macomber	[6]
Coventry Patmore: Angel in the House	[6]
Imtiaz Dharker: Purdah, Battle Line, She Must Be From Another Country	[6]
Virginia Woolf: A Room of One‟s Own	[6]
Suniti Namjoshi: The Mothers of Maya Diip	[8]

Suggested Readings:

1. Butler, Judith. Gender Trouble (1990).
2. de Beauvoir, Simone. The Second Sex (1949).
3. Freidan, Betty. The Feminine Mystique (1963).
4. Gardener, Judith Kegan, ed. Masculinity Studies and Feminist Theory: New Directions (Columbia University Press, 2002).
5. Greer, Germaine. The Female Eunuch (1970).
6. Lal, Malashri. The Law of the Threshold (Shimla: Indian Institute of Advanced Study, 1995)
7. Mill, John Stuart. The Subjection of Woman (1869).
8. Sedgwick, Eve Kosofsky. Gender Criticism: What Isn‟t Gender.2002.
9.Tharu, Susie and K.S. Lalita, eds. Introduction Women Writing in India (New Delhi: O.U.P., 1993)
10. Wolf, Naomi. The Beauty Myth (1991).
11. Wollstonecraft, Mary. A Vindication of the Rights of Woman (1792).
12. Woolf, Virginia. Shakespeare‟s Sister from A Room of One‟s Own (1929).

EL 614 World Literature(s) 4-0-0-4

Ibsen: A Doll‟s House	[8]
Brecht: Mother Courage	[8]
Dario Fo: Accidental Death of an Anarchist	[7]
Rabindranath Tagore: Gitanjali	[7]
Albert Camus: The Outsider	[8]
Pablo Neruda: Everyday You Play, I‟m Explaining a Few Things, Ode to a Tomato	[7]

Rainer Maria Rilke: Fear of the Inexplicable, Falling Stars, You Who Never Arrived [7]

Suggested Readings:

1. Kahns, Richards. Tragedy: Contradictions and Repression. Chicago: Chicago University Press, 1993.
2. Ellmann, Richard (ed.). The Modern Tradition: Backgrounds of Modern Literature. New York: Oxford University Press, 1992.
3. Parkar, Emmett. Albert Camus: the Artist in the Arena. New York: Routledge and Kegan Paul, 1965.
4. Northam, John. Ibsen: A Critical Study. London: Everyman, 1970.
5. Hirst, David. Dario Fo and Franca Rame. Hampshire: Macmillan, 1989.
6. Bloom, Harold. Modern Critical Views: Gabriel Garcia Marquez. New York: Chelsea House Publishers, 1989.
7. Metzger, Erika A. & Metzger, Michael M. (eds.). A Companion to the Works of Rainer Maria Rilke (Studies in German Literature Linguistics and Culture). New York: Camden House, 2004.
8. Raymond Williams. Drama from Ibsen to Brecht. London: Chatto and Windus,1968.

EL624 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Spring Semester of Second year shall be between 8,000 words and 10,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The Dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

Session 2017-2018

BA Honours English 2017-18
B. A. (Hons.) in English

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]

W S Maugham: The Verger [4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct) [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative) [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most) [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation [4]

Reading Comprehension: Efficient reading and note taking [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

Suggested Books:

1. Approach to Life, Kolkata, Orient Longman Ltd.
2. Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press.
3. Lascelles, Abercrombie, Thomas Hardy: A Critical Study, New York, Russel & Russel.
4. Cecil, David, Hardy, the Novelist, London, Constable & Co.

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers [13]

V.S. Naipaul: A House for Mr. Biswas [13]

Khushwant Singh: A Train to Pakistan [13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry [9]

Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists [7]

Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening [9]

Sylvia Plath: Morning Song, Death and Company [5]

R.W. Emerson: Brahma [4]

Edgar Allan Poe: The Fall of the House of Usher [5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree [4]

Sarojini Naidu: Indian Weaver, The Song of Radha. [4]

Rabindranath Tagore: Where the Mind is Without Fear [4]

Sri Aurobindo: Transformation [3]

Kamala Das: An Introduction as a Writer [4]

Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S. [4]

A K Ramanujan: Love Poem for a Wife [4]

Arun Kolatkar: Chaitanya [4]

Chinua Achebe: Refugee Mother and Child [4]

Wole Soyinka: Agbor Dancer [4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.

5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 331 Modern English Language and Phonetics-I 3-0-0-3

Basic Sentence Types – Subject, Verb, Object, Complement, Adverbials [5]

Coordination and Subordination Clauses [5]

Different Notions and Concepts (Request, Order, Purpose, Wish, Suggestion, Obligation, Concession, Condition) [5]

Morphology and Phonology (Various morphs and phonemes) [4]

Word Substitutions and Idioms [3]

Synonyms and Antonyms [3]

Theme Writing [4]

Literary Appreciation [4]

Advanced Comprehension [5]

Suggested Books:

7. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
8. Leech Geoffery: English Grammar for today, Longman, Delhi.
9. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
10. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
11. Quirk & Greenbaum: University English Grammar, Longman Publications.
12. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 341 English Literature : Pre and Post Elizabethans 3-0-0-3

Geoffrey Chaucer : General Prologue to Canterbury Tales (Line1-100) [6]

John Milton : Paradise Lost BK – I (Line 1-49, 94- 124) [10]

John Dryden : Absalom and Achitophel (Line 1-70) [10]

Alexander Pope : Rape of the Lock (Canto I & V) [13]

Suggested Books:

1. Chaucer, Geoffrey, The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.
2. Daiches, David, A Critical History of English Literature (vol. I), Delhi, Allied Publishers.
3. Grose, M. W.: Chaucer: Literature in Perspective.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Tragedy.
5. Rudram, Alan: A Critical Commentary on Milton's Paradise Lost.
6. Pope, Alexander: Rape of the Lock.
7. Dryden, John: Absalom and Achitophel.

EL 351 English Literature: Pre- romantics & Romantics-I 3-0-0-3

Thomas Gray : Elegy Written in a Country Churchyard	[6]
William Collins : Ode to Evening	[6]
William Wordsworth : Ode on the Intimation of Immortality	[5]
John Keats : Ode to Grecian Urn, Ode to Autumn, La Belle Dam Sans Merci	[7]
William Hazlitt : On the Ignorance of the Learned	[7]
Jane Austen : Mansfield Park (Non-detailed)	[8]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Ausen, Jane: Mansfield Park.
6. Hazlitt, William: On the Ignorance of the Learned.

EL 361 Twentieth Century English Literature-I 3-0-0-3

W B Yeats : When you are Old, The Second Coming, Byzantium, Lapis Lazuli	[9]
W H Auden : In Memory of W B Yeats	[4]
T S Eliot : The Wasteland	[13]
Samuel Backett : Waiting for Godot (detailed)	[13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).
4. Beckett, Samuel: Waiting for Godot.
5. Eliot, T S : The Wasteland
6. Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers.
7. Smith, Grover: T. S. Eliot's Poetry and Plays.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

EL 332 Modern English Language and Phonetics-II 3-0-0-3

Question Tags	[4]
Transformation : Active-Passive voice, Direct-Indirect Narration, Assertive into Negatives and Interrogatives	[5]
Punctuations	[4]
Translations (English to Hindi, Hindi to English)	[6]
Phonemic Symbols for Sounds of English, practice of Phonetic transcription	[5]
Word Structure and word Stress	[5]
Fallacies (Hasty Generalisation, *Petipio Principi*, Non-Sequitur, Composition, Division, *Post Hoc Ergo Propter Hoc*)	[5]
Common Errors in English	[3]
Word Power and Vocabulary	[2]

Suggested Books:

1. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
2. Leech Geoffery: English Grammar for today, Longman, Delhi.
3. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
5. Quirk & Greenbaum: University English Grammar, Longman Publications.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 342 English Literature: Pre- romantics & Romantics-II 3-0-0-3

S T Coleridge : Kubla Khan	[6]
P B Shelley : Ode to Skylark, To Night	[6]
A. Tennyson : The Lotus Eaters	[5]
Charles Lamb : Imperfect Sympathies, All Fools' Day	[9]
Charles Dickens : A Tale of Two Cities (non-detailed)	[13]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Dickins, Charles: A Tale of Two Cities.

Lamb, Charles: Imperfect Sympathies and All Fools

EL 352 Victorian Literature 3-0-0-3

Robert Browning : My Last Duchess, Porphyria's Lover, Andrea Del Sarto [10]

G M Hopkins : Spring and Fall, Windhover, Felix Randal [10]

Emily Bronte : Wuthering Heights (non- detailed) [10]

Thomas Hardy : Far From the Madding Crowd (non- detailed) [9]

Suggested Books:

1. Pick, John: Gerard Manley Hopkins: Priest and Poet, Delhi, Oxford University Press
2. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books
3. Rhys, E.: Robert Browning and His Poetry.
4. De Vane, W. C.: A Browning Handbook.
5. Bronte, Emily: Wuthering Heights.
6. Hardy, Thomas. Far From the Madding Crowd.

EL 362 Twentieth Century English Literature-II 3-0-0-3

Ted Hughes : Pike, View of a Pig, Thought Fox [7]

Philip Larkin : Toad, Coming, At Grass [6]

James Joyce : A Portrait of the Artist as a Youngman (non- detailed) [13]

Virginia Woolf : To the Lighthouse (non- detailed) [13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).
4. Joyce, James:A Portrait of the Artist as a Youngman.
5. Woolf, Virginia: To the Lighthouse.
6. Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers.
7. Smith, Grover: T. S. Eliot's Poetry and Plays.

BA Honours Political Science 2017-18

B. A. (Hons.) in Political Science

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya [12]

Bal Gangadhar Tilak, Gopal Krishna Gokhale [15]

Raja Ram Mohan Roy, Dayanand Saraswati [12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement [8]

Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence [8]

of India Act, 1947

Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features [13]

Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism [10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha [8]

Executive: President, Prime Minister and Cabinet [8]

Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation [12]

Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups [11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress [11]

Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China [14]

Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China [14]

PS 331 Western Political Thought: From Plato to Bodin 3-0-0-3

Plato: ideal state, philosopher King, theory of education, theory of justice, theory of communism and its comparison with modern communism. [9]

Aristotle: father of political science, views on state, classification of states, justice, citizenship, slavery, revolution [9]

St. Augustine: political philosophy [3]

St. Aquinas: Christianized Aristotle, nature and functions of government, theory of law and justice [6]

Machiavelli: Father of modern political science, the child of his times, views on state and Prince [8]

Jean Bodin: political ideas, theory of sovereignty [4]

PS 341 International Relations-I 3-0-0-3

International relations: meaning, nature and scope. [3]

Theories in international relations: Idealism, Realism, Neo-realism, System theory, Functionalist [8]

Approaches: Decision making, Game theory and Bargaining theory [7]

National Interest and national power: meaning and elements. [4]

Balance of power: meaning and features. [2]

World War I: Causes and impacts [3]

World War II: Causes and impacts [3]

Cold war and détente: features and major events, post-cold war era [9]

PS 351 Contemporary Political Thought 3-0-0-3

Lenin: changes introduced into Marxism, Views on party organization and Imperialism [4]

Laski: On state & sovereignty [4]

F.A.Hayek: Concept of freedom [4]

Jean Paul Sartre: Existentialism [4]

Milton Friedman: Concept of freedom [4]

Herbert Marcuse: Critical Theory [4]

John Rawls: theory of Justice [4]

Robert Nozick: entitlement theory [4]

Samuel P. Huntington: Clash of civilizations [4]

Amartya Sen: views on justice [3]

PS 361 Public Policy-I 3-0-0-3

Public Policy: Introduction,Nature and scope, Concepts of public and policy [4]

Policy Analysis: Introduction, Meaning and issues of policy analysis, Stages in policy analysis [4]

Models of Policy analysis: System Model, Institutional approach, Rational Policy making model, Public choice approach, Political Public policy approach, Mixed approach by Hogwood and Gunn [16]

Forces in Policy making approach: Electorate power, Policy agenda, Influence of media, Pressure groups, Political parties [6]

Official policy maker (with reference to India): Legislature, Executive, Bureaucracy, Judiciary [9]

PS 371 Principles of Public Administration-I 3-0-0-3

Public Administration: Meaning, Nature and Scope [6]

Types of administration: Public and Private Administration [5]

New Public Administration and New Public Management: meaning and implications [4]

Theories of Organization: Classical, Scientific Management, Human Relations.[12]

Line Staff relationship: Hierarchy, Delegation, Coordination and Supervision. [12]

PS 381 Indian Administration 3-0-0-3

Evolution of Administration in India: The British legacies, the constitutional and Political system in Indian and its implications. The nature of administrative problems in India. Organization and working of Union Ministers of Home, Finance and Foreign Affairs. [12]

State Administration: role of Chief Secretary, Police administration in the state. [6]

District Administration: Divisional Commissioner, Role of Collector and its changing patterns. [8]

Role of Bureaucracy: the problem of Generalist and specialist in Public Services. Ministers-Civil Services relationship. [6]

Financial Administration in India: Budget- its formulation and execution, role of Public Accounts and Estimate Committee, Comptroller and auditor General in India. [7]

PS 332 Western Political Thought from Hobbes to Marx 3-0-0-3

Thomas Hobbes: human nature, state of nature, social contract, sovereignty and individualism [5]

John Locke: human nature, state of nature, social contract, sovereignty and individualism[5]

J.J.Rousseau: social contract theory, General Will, comparison with theory of Hobbes and Locke [5]

Jeremy Bentham: Utilitarianism, political philosophy [5]

J.S.Mill: Revision of Bentham's utilitarianism, views on liberty and representative government [6]

Hegel: views on state, dialectical idealism [5]

Karl Marx: dialectical materialism, class struggle, historical materialism, surplus value, communism [8]

PS 342 International Relations-II 3-0-0-3

United Nations: organs and functions, Reforms and Relevance. [13]

Nuclear Issues and disarmament: NPT, CTBT and India's nuclear policy. [6]

Foreign policy of major countries: United States, United Kingdom, Russia and China [8]

Regional organizations: SAARC, ASEAN, NAM and BRICS [8]

New International Economic Order: North- South Dialogue, South-South Cooperation [4]

PS 352 Indian Foreign Policy 3-0-0-3

Determinants and Principles of India's Foreign Policy: [6]

a) Domestic and International sources of India's Foreign Policy
b) Objectives and Principles

India and the Global Economic and Political Regimes – Main Issues [8]

a) India and World Trade Organization (WTO)
b) India at the United Nations: Security Council Reforms

India and South Asian States [8]

a) Pakistan: Challenges and Prospects
b) Afghanistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives: Main Issues

Changing Relations with the US and Russia from Cold War to Post Cold War [8]

India China Relations: Challenges and Prospects [4]

Security Challenges of India: An Appraisal [5]
a) Terrorism
b) Energy Security

PS 362 Public Policy-II 3-0-0-3

Policy implementation: Meaning, Elements in implementation, Techniques of implementation, Conditions for successful implementation [5]

Approaches to policy implementation: Top-down model, Bottom-up model, Policy action model, Managerial approach [10]

Policy Evaluation: Forms of policy evaluation, Criteria for evaluation, Techniques of evaluation, Problems in evaluation [6]

Policy change and continuity: Policy cycle approach, Organizational approach, Policy learning models [9]

Globalization of National policy making: an international perspective: Impacts of global events on national policy making, Need for a global perspective, Policy agenda in global context [9]

PS 372 Principles of Public Administration-II 3-0-0-3

Administrative Behaviour: Leadership, Decision Making and Communication. [6]

Management of Public Enterprises: with Special reference to the problem of Public Corporation. [5]

Control over Public Administration: Legislative, Judicial and Popular Nature, Limits and role of these controls. [10]

Personnel Administration: Recruitment, Training and Discipline. [8]

Financial Administration: Budget Formulation and Execution, Parliamentary control. [10]

PS 382 Local Self Government in India 3-0-0-3

Local Self Government: nature and scope [2]

Committees on Democratic Decentralization: Balwant Rai Mehta & Ashok Mehta Committee [2]

Rural Local Government: 73rd Amendment Act, 1992

a) Main features [2]

b) **Structural Facets of the Rural Local Government**: Gram Sabha, Panchayat, Panchayat Samiti, Zila Parishad. [6]

Urban Local Government: 74th Amendment Act 1992

a) Main features [2]

b) **Structural Facets of the Municipal Government**: Municipal Councils , Municipal committee and Corporations [6]

Election and Finance: Composition and Functions of State Election Commission and State Finance Commission [4]

Evaluation:

Regional Variations: Experience from the Indian States since the 73rd and 74th Amendment Acts. [5]

Critical Evaluation: SWOT (Strengths, Weaknesses, Opportunities & Threats) Analysis of Rural and Urban Local Institutions. [6]

Important Issues and Themes in Local Government in India: An Overview. [4]

BA Honours Psychology 2017-18
COURSE DESCRIPTION
B. A. (Hons.) in Psychology

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I **3-0-0-3**

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology.	[8]
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services.	[7]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling.	[6]
Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.	[9]
Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.	[9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PL 311	**Social Psychology - I**	**3-0-0-3**
	Social Psychology: Nature and Subject Matter; Relationship with other social sciences.	[3]
	Methods: Experimental, Observation, and Sociometry.	[5]
	Socialization: Nature, Process and Agents of Socialization.	[4]
	Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.	[8]
	Social Norms: Meaning, Characteristics and Formation	[5]
	Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants	[6]
	Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional	[8]

PL 321	**Biological Basis of Behaviour**	**3-0-0-3**
	Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical.	[6]
	Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters.	[7]
	Nervous System: Central nervous system and Peripheral nervous system –Structure and Functions. Endocrine system and its behavioral implications.	[9]
	Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention.	[6]
	Motivation: Neural mechanism of Hunger, Thirst and Sex	[5]
	Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory.	[6]

PL 331 Systems of Psychology 3-0-0-3

Nature and scope of Psychology: Psychology as science; Historical Origins: Preexperimental period- Science Among Greeks, British Empiricism, German Nativism.	[4]
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status	[5]
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner.	[7]
Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.	[6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).	[6]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.	[5]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.	[6]

PL 341 Psychopathology-I 3-0-0-3

Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.	[3]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.	[7]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.	[3]
Diagnostic Assessment: Case History, Interview, Projective Techniques	[5]
Anxiety Based Disorders: Nature, Symptoms and Etiology- Generalized Anxiety Disorders, Phobia, O.C.D, Somatoform and Dissociative Disorders	[12]
Psycho physiological Disorders: Nature, Symptoms and Etiology –Asthma, Peptic Ulcer, CHD, Hypertension	[5]
Mental Retardation: Nature, Types, Causes and its Management	[4]

PL 351	**Industrial and Organizational Psychology-I**	**3-0-0-3**
	Industrial/Organizational Psychology: Nature, historical development and scope.	[5]
	Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.	[9]
	Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme	[9]
	Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal	[10]
	Work environment: Noise, atmospheric conditions. Illumination and performance	[6]

PL 361 Psychological Testing-I 3-0-0-3

Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.	[9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.	[9]
Validity: meaning, validation procedures, and special problems.	[9]
Construction and Standardization of Psychological Tests General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.	[12]

PL 312	**Social Psychology-II**	**3-0-0-3**
	Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.	[6]
	Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects. .	[6]
	Attribution process Nature and theories: Kelly and Weiner.	[6]
	Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies	[5]
	Propaganda: Nature, Tools and Techniques	[5]
	Aggression and Violence: Nature, Determinants and Management**.**	[5]
	Social Change: Nature, Factors and Theories.	[6]

PL 322 Guidance and Counseling 3-0-0-3

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational.	[5]
Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.	[5]
Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.	[9]
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.	[9]
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling.	[7]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.	[4]

PL 332	**Experimental Psychology**	**3-0-0-3**
	Experimental Psychology: Nature and History, Experimental Method	[4]
	Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. **Perception:** Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.	[9]
	Psychophysics: Problems and Methods of Classical Psychophysics.	[8]
	Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.	[6]
	Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning	[5]
	Verbal Learning: Methods, Materials, Organizational Processes.	[3]
	Discrimination Learning: Phenomena, Procedures and paradigms	[4]

PL 342	Psychopathology-II	**3-0-0-3**
	Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation.	[6]
	Mood Disorders: Unipolar and Bipolar Symptoms and Etiology	[10]
	Schizophrenia: Nature , Symptoms , Types and Etiology	[11]
	Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT	[12]

PL 352	**Industrial and Organizational Psychology-II**	**3-0-0-3**
	Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory.	[7]
	Job Satisfaction: Concept, determinants and measurement.	[5]
	Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.	[6]
	Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.	[6]
	Human engineering: Man-machine system. Designs, displays, controls and action.	[6]
	Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions.	[9]

PL 362	**Psychological Testing-II**	**3-0-0-3**
	Personality Tests: Purpose and Types, **Inventories**-Cattell's 16 PF, MMPI and Neo-five factors.	[9]
	Projective- Rorschach and TAT.	[9]
	Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.	[8]
	Measurement of aptitude and Interest	[6]
	Measurement of Creativity- Torrance Test	[7]
	Anxiety and Depression,	

Pass Course 2017-18

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]
W S Maugham: The Verger	[4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct)	[4]
Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	[4]
Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most)	[6]
Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing	[4]
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	[4]
Reading Comprehension: Efficient reading and note taking	[4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

SO 111 Introduction to Sociology-I 3-0-0-3

Sociology: The Meaning of Sociology, Nature of Sociology, Scope of Sociology-Formalistic and Synthetic School, Sociology and other Social Sciences [10]

Basic Concepts: Society, Community, Social Group, Status and Role [10]

Socialisation: Meaning of Socialisation, Agencies of Socialisation, Theories of Socialisation [9]

Culture: Meaning and Characteristics of Culture, Theory of Cultural Lag, Civilisation, Interrelationship and distinction between Culture and Civilisation [10]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 121 Social Thinkers-I 3-0-0-3

Auguste Comte: Positivism, Law of Three Stages, Social Statics and Social Dynamics [14]

Herbert Spencer: The Evolutionary Doctrine, The Organic Theory [10]

Talcott Parsons: Social Action, AGIL, Pattern Variables [15]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 111 Textile Science and Care 3-0-0-3

Introduction to Textile: basic terminology and classification of textile fibres	[2]
General Properties of Textile Fibres: physical, chemical and other properties of textile fibres	[2]
Properties of different textile fibres and their importance: Cotton, Wool, Silk and other natural fibres Rayon, Acetate, Nylon, Polyester, Acrylic, Glass and other manmade fibres	[4]
Preparation and manufacturing of different textile fibres: Cotton, wool and silk, rayon, acetate, nylon, polyester and acrylic	[10]
Yarn and fabric construction: Spinning methods- mechanical and chemical, yarn classification, methods of fabric construction	[7]
Laundry agents: water, detergents, soaps and other agents	[6]
Stain removal: classification and methods of stain removal	[4]
Care and storage of textiles-care of textiles with reference to service, appearance and economy	[4]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Dantyagi, S.: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
4. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
5. Mullick, P.: Textbook of Home science, Kalyani Publication.
6. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
7. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.

GM 121 Textile Science and care Laboratory 0-0-4-2

Suggested Experiments: Identification of textile fibres- burning, microscopic and solubility tests; Removal of stains from fabrics; Washing, ironing and finishing of textile articles

Suggested Books:

1. Dantyagi, S: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
2. Deulkar, D: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
3. Hollen, N. and Saddler, J: Textiles, New York, Mac millan company.
4. Tortora, P.G: Understanding Textiles, New York, Mac millan company.

GM 131 Apparel Industrial Management 2-0-0-2

Textile Industry: Overview of textile industry, globalization and its impact on textile industry [6]

Status of garment industry in India: Production, marketing, distribution, consumption and export trends over the last five years [4]

Organization and association related to garment industry:

Problems of apparel industry and remedial measures, government role in promoting the growth of garment industry [13]

Sales promotion techniques [3]

Suggested Books:

1. Soundarapandian, M: Textile Industry Under Globalization, New Delhi, Vedams Books (P) Ltd.
2. Gurumurthy, G: A book on Textile Industry's 6-decade Journey, Coimbatore, The Hindu Business Line.
3. The Textile Industry and Trade Journal, Baroda, Comput –Media Services.
4. The Indian Textile Journal. Chennai, IPFonline limited.
5. Textile Trends. Kolkata, Eastland Publications Pvt. Ltd.
6. Textile Research Journal. New Jersey, Textile Research Institute.
7. Textile magazine, Chennai, Gopali and CO.

Note: The Students are advised to refer recent Journals of textiles.

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

Suggested Books:

1. Approach to Life, Kolkata, Orient Longman Ltd.
2. Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press.
3. Lascelles, Abercrombie, Thomas Hardy: A Critical Study, New York, Russel & Russel.
4. Cecil, David, Hardy, the Novelist, London, Constable & Co.
5. Kettle, Arnold (ed), Hardy, the Novelist: A reconsideration in the Nineteenth Century Novel, London, Heinemann.
6. Walker, Hugh: The English Essay and the Essayists.

SO 112 Introduction to Sociology-II 3-0-0-3

Family: Meaning and Characteristics of Family, Functions, Types of Family, Changing Family Patterns	[10]
Marriage: Meaning and Functions of Marriage, Types of Marriage	[6]
Social Change: Meaning and Characteristics of Social Change, Causes of Social Change	[7]
Social Stratification: Meaning and Characteristics of Social Stratification, Caste and Class	[8]
Social Control: Meaning and Nature of Social Control, Process and Means of Social Control	[8]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 122 Social Thinkers - II 3-0-0-3

Karl Marx: Historical Materialism, Class and Theory of Class Struggle	[10]
Max Weber: Social Action, Ideal Type, Protestant Ethics and Spirit of Capitalism	[15]
Emile Durkheim: Social Fact, Suicide, Division of Labour	[14]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 112 Fundamentals of Textile Designing 2-0-0-2

Types of designs: structural and decorative	[2]
Elements of design: line, form, shape, colour and texture	[3]
Principles of design: proportion, rhythm, balance, emphasis and harmony	[3]
Weaving: history of weaving, looms and its parts, different types of weaves	[5]
Knitting: terminology, principles of knitting	[2]
Dyeing: types of dyes, different techniques of dyeing	[6]
Printing: styles and techniques of printing	[5]

Suggested Books:

1. Vastala, R.: Textbook of Clothing and Textiles, Indian Council of Agriculture and Research Publication.
2. Yadla,Vijay Lakshmi and Jasrai, Sucheta: UGC Guide to Home Science.
3. Smith, J. L.: Textiles Processing Printing Dyeing Finishing, Chandigarh, Abhishek Publications.
4. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
5. Tortora, P.G. : Understanding Textiles, New York, Mac millan company.

GM 122 Clothing Construction-I 1-0-0-1

Sewing equipment: Tools required for clothing construction	[3]
Sewing machine: parts of machine their use and care, common machine problems	[3]
Fabric terms and definition	[1]
Preparation of fabric before cutting, placing, marking and cutting patterns	[2]
Taking body measurements	[1]
Simple stitches, seam and seam finish, Disposal of fullness in a garment	[3]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction, Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.

GM 132 Fundamentals of Textile Designing Laboratory 0-0-4-2

Suggested Experiments: Preparation of different types of weave; Preparation of samples of knitting; Dyeing-tie and dye technique; Printing- direct, discharge and resist style

Suggested Books:

1. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.
2. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.

GM 142 Clothing Construction-I Laboratory 0-0-4-2

Suggested Experiments: Sewing tools and handling of sewing machine; Taking body measurements; Construction of following samples: stitches, seams, disposal of fullness, plackets, fasteners and binding

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. The Complete Guide to Sewing: Readers Digest, DK publishing.

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

SO 211 Methodology of Social Research-I 3-0-0-3

Social Research: Meaning, Scope and Significance of Social Research, Scientific Method, Difference between Social Research and Social Survey [12]

Research Design: Meaning and Purpose of Research Design, Types – Exploratory, Descriptive and Experimental Research Design [10]

Sampling: Meaning and Characteristics of Sampling, Steps in Sampling Design, Types of Sampling - Random, Stratified, Cluster and Multi-stage Sampling [12]

Hypothesis: Meaning and Procedure of Hypothesis, Types of Hypothesis. [5]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 221 Sociological Theories-I 3-0-0-3

Structure-functionalism: Radcliffe-Brown – The idea of Social Structure, Malinowski - Functional Analysis [12]

Empirical Functionalism: Merton – Theory of Middle Range, Merton's critique and reformulation of Functional analysis [11]

Conflict Theory: Marx – Conflict Theory, Coser – Functional Analysis of Conflict [11]

Sociology of Knowledge: Karl Mannheim [5]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

GM 211 Textile Finishes 2-0-0-2

Finishes: meaning and its classification	[3]
Basic finishes: singeing, stiffening, mercerization and others	[6]
Surface finishes: delustering, flocking, napping, calendaring and others	[7]
Functional finishes: fireproof, water proof, wrinkle resistance, mothproof and other finishes	[7]
Consumer problems and care labels	[3]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill International Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
4. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
5. Tortora, P.G.: Understanding Textiles, New York, Mac millan publishing company.

GM 221 Clothing Construction-II 1-0-0-1

Importance of clothing	[2]
Application of elements and principles of design for clothing construction	[3]
Factors affecting clothing: Social, psychological and economic	[3]
Wardrobe planning: Principles of wardrobe planning and wardrobe planning for different age groups	[3]
Consumer rights and responsibilities	[2]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Carson, B.: How You Look and Dress, Webster Division, Mc Graw-Hill Book company.
3. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
4. Erwin, M.D and Kinchen, A.L.: Clothing for Moderns, Mac millan Publishing, New York.
5. The Complete Guide to Sewing-Readers Digest, DK publishing.
6. Brocknam, H.L. The Theory of Fashion Design, John Wiley and Sons Inc., New York.

GM 231 Textile Finishes Laboratory 0-0-2-1

Suggested Experiments: Study and identification of finishes; Market survey for collection of fabric samples of different types of weaves; Laboratory tests for different fabric finish; Collection of care labels

GM 241 Clothing Construction-II Laboratory 0-0-4-2

Suggested Experiments: Construction of garments for different age groups

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers	[13]
V.S. Naipaul: A House for Mr. Biswas	[13]
Khushwant Singh: A Train to Pakistan	[13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

SO 212 Methodology of Social Research-II 3-0-0-3

Observation Method: Meaning and Characteristics of Observation Method, Types- Participant, Non- participant and Quasi- participant Observation [10]

Interview Method: Meaning, Objectives and Techniques of Interview Method, Types- Structured, Unstructured and Focused Interview [10]

Questionnaire and Schedule: Meaning, Construction and Application [08]

Analysis of Data and Report Writing: Tabulation, Interpretation of Data and Steps in writing Report [11]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 222 Sociological Theories-II 3-0-0-3

Phenomenology and Ethnomethodology: A. Schutz- Phenomenological Sociology, H.Ganfinkel- Ethnomethodology [11]

Interactionalist Perspective: G.H. Mead and H. Blumer- Symbolic Interactionism [11]

***Verstehen* Approach:** Max Weber [6]

Exchange Theory: Homans - Psychological Exchange Perspective, Blau - Structural Exchange Theory [11]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

CA 111 Fundamentals of Computers and Information Technology 3-0-0-3

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing: Data, Information, Knowledge and Wisdom [8]

Data representation: Representation of Data, Bits and Bytes, Number System; Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Number, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language; Machine Language, Assembly Language, High Level Language, Generation of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 212 Clothing Construction-III 1-0-0-1

Basic pattern: definition and methods of making pattern [2]

Pattern making: Principles of pattern making and process of designing by flat pattern method [4]

Figure irregularities: Types and methods of changing garment according to it [2]

Pattern making: different types of collars, sleeves and skirts [5]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.
4. Hollen, Norma R. and Carolyn J. Kundel: Pattern Making by the Flat Pattern Method. Prentice Hall
5. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

CA 141 Application Software Laboratory 0-0-4-2

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 222 Clothing Construction-III Laboratory 0-0-4-2

Suggested Experiments: Construction of different types of collars, sleeves and skirts by flat pattern method

Suggested Books:

1. The Complete Guide to Sewing.: Readers Digest, DK publishing.
2. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry [9]

Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists [7]

Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening [9]

Sylvia Plath: Morning Song, Death and Company [5]

R.W. Emerson: Brahma [4]

Edgar Allan Poe: The Fall of the House of Usher [5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree	[4]
Sarojini Naidu: Indian Weaver, The Song of Radha.	[4]
Rabindranath Tagore: Where the Mind is Without Fear	[4]
Sri Aurobindo: Transformation	[3]
Kamala Das: An Introduction as a Writer	[4]
Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S.	[4]
A K Ramanujan: Love Poem for a Wife	[4]
Arun Kolatkar: Chaitanya	[4]
Chinua Achebe: Refugee Mother and Child	[4]
Wole Soyinka: Agbor Dancer	[4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.
5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

Suggested Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press.
2. Hutcheun, Linda, Theorizing the Postmodern in K. M. Newton edited Twentieth Century Literary Theory, London, Macmillan,
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press.
4. Chandra, Naresh, New Criticism: An Appraisal, New Delhi, Doaba Publishing House.
5. Aristotle, Poetics, translated by S. H. Butcher.
6. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press.
7. Wright, Elizabeth, Psychoanalytic Criticism: Theory in Practice, Metheun,
8. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Oxford University Press.
9. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan.

SO 311 Gender and Society-I 3-0-0-3

Social Construction of Gender: Gender vs. Biology, Equality vs. Difference, Women in the Family, Gender roles, Development and Women's Empowerment. [9]

Emergence of Feminist Thought: Socio-historical perspective, Mapping various Women's movements. [11]

Gender and Sociological Analysis: Feminist critiques of Sociological Theories, Emergence of Women's Studies. [11]

Gender based Division of Labour: Production vs. Reproduction, Household work, Invisible work, Women's work and technology. [8]

SO 321 Society in India-I 3-0-0-3

Social Change in India: Sanskritisation, Westernisation and Modernisation.	[10]
Marriage in India: *Hindu Marriage- a sacrament, Types and changing patterns; Muslim Marriage- a contact, Types and changing patterns, Divorce among Muslims, Differences between Hindu and Muslim Marriages.*	[9]
Kinship in India: Meaning and Types of Kinship, Kinship Behaviour and Usages, Classificatory Terminology of Kinship.	[7]
Varna and Jati: Origin and changing dimensions.	[7]
Jajmani System: Functions, Roles and Changes in Jajmani System.	[6]

SO 312 Gender and Society-II 3-0-0-3

Women in India: Changing profile, The changing status of women in India—pre-colonial, colonial and post-colonial. [8]

Demographic profile: Sex ratio, Child Sex ratio. [8]

Gender and Society in India: Economy: Marginalisation of Women and Sexual Division of Labour, Polity — Reservation for Women, Religion and Culture, Marriage, Dowry and Property. [15]

Issues affecting the Quality of Life of Women: Health, Education, and Domestic Violence. [8]

SO 322 Society in India-II 3-0-0-3

Indian Society: *Hindu View of Life- Ashramas and Purusharthas*	[9]
India as a Plural Society: *Religion, Language and Region.*	[6]
Challenges of Unity in Diversity: Problems of Communalism, Religionalism, Casteism, Regionalism.	[10]
Tribal Life in India: Religious beliefs and practices, Tribal problems in India.	[5]
Population Problems and Society in India: Population explosion, causes and its remedies, Population Policy, Population and Sustainable Development.	[9]

FR 111 Grammar and Composition-I 3-0-0-3

Articles (definite, indefinite and partitive, contracted)-le,la,les,un,une des and du,de la,des,de l',au,a la,a l',aux.	[6]
Gender: The formation of feminine, The Formation of the Plural, Collective noun. Numbers (coordinal and ordinal).	
Conjugation of different regular and irregular verbs.	[5]
Verb: Regular conjugation, standard spelling irregularities, reflexive verbs, impersonal verbs.	[8]
The sentence, word order, negative expression, direct questions, answers.	[6]
Introduction of Adjectives and their uses in different sentences, Agreement of adjectives, position of adjectives. Affirmative, Interrogative and Negative Sentences.	[5]
Adjectives: demonstrative and possessive	[5]
Plural of adjectives, comparatives and superlatives of adjectives.	[4]
Audio Visual Programme	

FR 121 Written Expression-I 3-0-0-3

Greeting someone in formal and informal situation, Knowledge of etiquettes through telephonic conversation.	[4]
Introducing oneself / speaking of oneself, Giving the time/ giving one's telephone number.	[4]
Introducing someone/ describing a person (indicating one's nationality, saying where one lives, revealing one's profession, saying what one likes or does not like).	[4]
Fixing an appointment over the phone, Expressing one's agreement and disagreement.	[4]
Describing about one's daily activities, Seeking clarification on something.	[3]
Asking and giving information, Describing an action.	[4]
Making hypotheses**,** Solution to problem.	[2]
Study of monuments and different public places	[6]
Study of different geographical/historical/political regions of France.	[8]
Audio Visual Programme	

FR 211 Comprehension, Grammar and Translation-I 3-0-0-3

Adverbs: Adverbs of manner, Adverbs of time. Adverbs of place, Adverbs of intensity and quantity.	[7]
Pronoun relative, interrogative, demonstrative, possessive.	[4]
Pronoun: (emphatic, disjunctive, indefinite pronouns, personal pronoun).	[4]
Present indicative and recent past.	[5]
Questions based on seen or unseen passages	[9]
Passive form, subjunctive, impersonal form, translation from English to French	[6]
Possessive adjectives and pronouns.	[4]
Audio Visual Programme	

FR 221 Letter Writing, Composition, Culture and Civilization-I 3-0-0-3

Current important French personalities and events after World War Second in France	[8]
Function of national and regional institution of France.	[7]
History of France (Medieval era & 16th to 18th century)	[8]
Writing of paragraphs and Dialogues, Letter writing (Formal Letters)	[8]

[8]

FR 222 Letter Writing, Composition, Culture and Civilization-II 3-0-0-3

Simple translation, applied translation, skills and techniques in translation.	[8]
Writing resume, application.	[8]
Report writing (formal and informal).	[7]
Translation of passage from French to English and English to French.	[10]
History of France (19th & 20th century).	[6]
Audio Visual Programme	

FR 311 **History of French literature-I** **3-0-0-3**

History of French Literature: Middle age to 17th century.	[5]
Renaissance in France, its origin and significance.	[5]
French revolution: its impact on social and religious philosophy, politics & literature.	[6]
Writer and poets: life & work.	[7]
Classical Literature in 17th century	[8]
General idea of 16th, & 17th century	[8]

FR 312	**History of French literature-II**	**3-0-0-3**

L’histoire de la littérature française : moyen âge au 17ème siècle.	[5]
La renaissance en France, son origine et signification.	[5]
La révolution française : son impact sur philosophie sociale et religieuse, politique et littérature.	[6]
Les écrivains et les poètes : leurs vies et leurs travails.	[7]
La littérature Classique au 17e siècle	[8]
L’idée générale de 16e et le 17e siècle	[8]

FR 312	**History of French literature-III**	**3-0-0-3**

History of French Literature: 18th century.	[5]
History of French Literature: 19th century.	[5]
History of French Literature: 20th century.	[6]
Romantic movement.	[7]
Realism, realistic, symbolisms periods in France.	[8]
Music cinema, theater in 20th century.	[8]

FR 322	**History of French literature-IV**	**3-0-0-3**

L’histoire de la littérature française : le 18ème siècle.	[5]
L’histoire de la littérature française : le 19ème siècle.	[5]
L’histoire de la littérature française : le 20ème siècle.	[6]
Le mouvement romantique	[7]
Les périodes de réalisme, réaliste et symbolismes en France.	[8]
La musique, le cinéma, et le théâtre au 20ème siècle.	[8]

SN 131 Origin and Development of Sanskrit 3-0-0-3

Evolution of Sanskrit: Nomenclature of Sanskrit, Vedic Sanskrit and Classical Sanskrit, Prakrita, Pali, Apabhransha, Modern Indian Languages [9]

Vedic Sanskrit: Origin of the word veda, Vedic hymns, division of Vedic hymns, branches, content of the Samhitas, women vedic seers [11]

Post Vedic Literature: Brahmana, Aranyaka, Upanishad [8]

Classical Sanskrit: Epics, Mahabharata, Ramayana, Gita, Purana, Poetry, Prose, Champoo, Modern Sanskrit Literature [11]

Suggested Books:

1. Keith, A.B.; History of Sanskrit Literature, MLBD, Delhi
2. Krishnamachariar; History of Classical Sanskrit Literature, MLBD, Delhi
3. Macdonell, A.A.; History of Sanskrit Literature, MLBD, Delhi
4. Shastri, Gaurinath; A Concise History of Sanskrit Literature, MLBD, Delhi
5. Winternitz, Maurice; History of Indian Literature (Vol. I & II), MLBD, Delhi
6. Warder, A.K.; Indian Kavya Literature, MLBD, Delhi
7. Gairola, Vachaspati; Sanskrit Sahitya Ka Itihas, Chaukhamba Vidyabhawan, Varanasi
8. Tripathi, Radhavallabha; Sanskrit Sahitya Ka Abhinav Itihas, Vishvavidyalaya Prakashan, Varanasi
9. Dasgupta, S.N.; A History of Sanskrit Literature: Classical Period, University of Calcutta
10. Burrow, T.; Sanskrit Language (also Trans. into Hindi by Bholashankar Vyas), Chaukhamba Vidya Bhawan, Varanasi
11. Altekar,A.S.; Education in Ancient India, Delhi
12. Altekar,A.S.; Position of Women in Hindu Civilization, MLBD, Delhi
13. Basham, A.L.,; The Wonder that was India, London
14. Dandekar, R.N.; Vedic Religion & Mythology: A Survey of the Works of Some Western Scholars, University of Poona, Poona
15. Vaidya,C.V.; Epic India, Delhi

SN 141 Self Management in the Bhagavad Gita 3-0-0-3

Mind and its Functions- Nature of Mind-7.4-6,15.7,15.9,3.42,10.20,10.22, Mental Conflict-1.1, 2.60, 67,3.36-38,40,16.21, Factors responsible for Mental Conflict-16.21, 2.62-63, Factors responsible for *Karma* & *Swabhava*- 18.13-16	[9]
Infirmity of Mind and Quandary of Intelligence- Sense control and Importance of Intellect- 2.3,2.49,52,55,62,65,67, 4.38,39,42, 18.63,18.3.-32, Versatility of Mind and restraint- 6.11-14, 25-26,34,36, Factors for Perfection in Yoga- 3.8, 6.3, 16-17, 17.8-10, 3.12-13, 17.14-19, 6.36	[7]
Importance of Karma-Nature of soul and its difference from the material world- 2.19-26 , *Karma-yoga* :as a means to attain the knowledge – 2.40-44, 47-50, *Bhakti-yoga*: as a means to facilitate *Nishkaam karmayoga*- 12.19-20, Concept of *Lokasangraha*- 3.18-25	[16]
Relationship between consciousness and divine-13.31-32, 10.41, 7.12, 10.4,18.51-66,78	[7]

SN 132 Grammar and Composition-I 3-0-0-3

Inititialising Sanskrit Language through conversation -Diclension (Shabdaroopa), Conjugation (Dhaturoopa), Avayay with their applications in simple sentences	[10]
Laghusiddhanta Kaumudi- Maheshvara Sutra and concept of Pratyahara, Sanjna and Sandhi (Only essential rules based on application in the texts to be taught)	[12]
Elementary Knowledge of Case (Karaka) – Meaning, Numbers, Vibhakti	[5]
Translation -From English into Sanskrit, From Sanskrit into English	[12]

SN 142 Classical Sanskrit Literature-I 3-0-0-3

Panchatantram of Vishnu Sharman- Fifth Episode- Aparikshitakarakam	[15]
NitiShatakam of Bhartrihari (selected verses only) - Mangalacharan, Moorkhapaddhati, Vidwatpaddhati, Manshauryapaddhati	[9]
Raghuvansham of Kalidasa- 1st Canto (Verse 1-35)	[15]

SN 231 भारतीय-वैज्ञानिक-निधिः (Indian Scientific Heritage) 3-0-0-3

13. D. D. Kosambi; Bhartrihari's Shatakatrayam (with the Oldest Commentary of Jain Scholar Dhanasaragani) , Bharatiya Vidya Bhavan, Mumbai

Text Books:

संस्कृत साहित्ये प्रतिबिम्बित-वैज्ञानिक-भिज्ञता (Scientific Awareness reflected in Sanskrit Literature),वैदिकसाहित्ये ऋतुविज्ञानम्(Rituvigyana in Vedic Literature),संवत्सरचक्रम्(Samvatsarchakra),वृष्टिविज्ञानम्(Vristhivigyana),वराहमिहिरमते प्राचीनभारते जलवायुविज्ञानस्यावधारणा (Concept of Climatology in Ancient India-according to Varahmihira), बृहत्-संहिता 21.1-2,28.1-5(Brihatsamhita-21.1-2,28.1-5), भद्रबाहुसंहिता-9.1-15(Bhadrabahusamhita-9.1-15) ,प्राचीनभारते जलसंसाधनप्रबन्धस्य इतिहासः (History of Water Resource Management in Ancient India)-ऋग्वेद-10.9 (Rigveda-10.9),अर्थशास्त्रम्(Arthashastra(2.1.20-24,3.9.29-38,7.12.4-5), बृहत्संहिता(Brihatsamhita-54.1-10),महाभारत-आदिपर्वः(Mahabharata -Adi Parva-96) [10]

पातञ्जलयोगसूत्रसंदर्भे तनाव-प्रबन्धनम् (Stress Management: In context of PatanjaliYogasutra)समाधिपादः(Samadhipad 1.1,1.2,1.5,1.12,1.13,1.15,1.23, 1.30,1.30-37),साधनपादः(Sadhanapada (2.1, 2.3 ,2.11, 2.16, 2.27, 2.29) [20]

वैदिकजीवनचर्या आसनं प्राणायामः च –सिद्धान्तमात्रं (Vedic Life Style- Aasana and Pranayama (theory only), यौगिक-षट्कर्मः(Yogic Satkarma), ऋतुचर्या (Ritucharya),आहार: विहार:(Ahaara-Vihaara),आयुर्वेदतः प्राकृतिकचिकित्सा (Naturopathy from Ayurveda) [09]

SN 241 व्याकरणं रचना च- द्वितीयः भागः (Grammar and Composition-II) 3-0-0-3

सिद्धान्तकौमुद्यानुसारं कारकम् **(Case)-** Based on Siddhantakaumudi) [15]

लघुसिद्धान्तकौमुद्यानुसारं समासः**(Compound)-**Based on Laghusiddhantakaumudi) [14]

वाच्यम् (Voice) [10]

Text Books:

1. Kale, M.R. (2011). *Higher Sanskrit Grammar*. Delhi: MLBD.
2. Apte, V.S. (1996). *The Students' Guide to Sanskrit Composition*. Varanasi Chowkhambha Sanskrit Series.

Reference Books:

3. Kanshiram (2009). *Laghusiddhantakaumudi (Vol. 1-2)*. Delhi: MLBD.
4. Shastri, B. (2008). *Laghusiddhantakaumudi- Bhaimivyakhya* (Vol. 3-6). Delhi: Bhaimi Prakashan.
5. Shastri, C. (1960).*Vyakaranchandrodaya* (Vol. 1-3). Delhi: MLBD.

SN 232 लौकिकसंस्कृतसाहित्यम्- द्वितीयः भागः (Classical Sanskrit Literature-II) 3-0-0-3

कालिदासविरचितम् अभिज्ञानशाकुन्तलम् –चतुर्थाङ्कः पञ्चमाङ्कः च (Abhigyana-Shakuntalam of Kalidasa- 4th & 5th Act) [24]

बाणभटविरचितम् कादंबरी(शुकनासोपदेशः)- (Shukanasopadesha –Kadambari- of Banabhatta) [15]

Text Books:

1. Kale, M.R. (2010). *Abhigyana-Shakuntalam of Kalidasa*. Delhi:MLBD.
2. Kumar, P. (1974). *Shukanasopadesha (Kadambari).* Delhi: Meharchand Lachchmandas.

Reference Books:

3. Pant, S.C. (1992). *Abhigyana-Shakuntalam*. Delhi: MLBD.
4. Dwivedi, K. (1989). *Abhigyana-Shakuntalam*. Allahabad: Ramnarayan Lal Benimadhav Press.
5. Tiwari, R. (2005). *Natakakar Kalidasa aur Kavyakar Kalidas*. Delhi: Parimal Publication.
6. Macdonell, A.A. (1970). *History of Sanskrit Literature*. Delhi: MLBD.
7. Saxena, R. (1990). *Shukanasopadesha (Banabhatta).* Indore: Bharati Publication.
8. Karmarkar, R.D. (1980). *Bana*. Dharwar: Karnataka University.
9. Dwivedi, H. (1976). *Kalidas ki Lalitya Yojana*. Delhi: Rajkamal Prakashan.

SN 242 राष्ट्रवादः भारतीय-राजशास्त्रं च (Nationalism and Indian Polity) 3-0-0-3

संस्कृतसाहित्यम् राष्ट्रवादः च (**Sanskrit Literature and Nationalism**)- शुक्लयजुर्वेदः 22.22(Shuklayajurveda (22.22),अथर्ववेदः-12.1.1-2(Atharvaveda (12.1.1-2), रामायण कृ.कि. काण्डम् .46-48 (Ramayana (KK 46-48), विष्णुपुराणम्2.3 (Vishnupurana (2.3), अम्बिकादत्तव्यासः, Ambikadutt Vyas, प.क्षमारावः Pt. Kshama Rao,मथुराप्रसाददीक्षितः (Mathura Prasad Dixit), चारुदेवशास्त्री (Charudev Shashtri)	[24]
भारतीयराजशास्त्रम्- स्वरूपम्,महत्त्वम्,सैद्धान्तिकविकासः च Indian Polity: Nature, Importance and Development- कौटिल्यः(Kautilya),भीष्मः(Bhishma),मनुः (Manu), शुक्राचार्यः (Shukracharya),सोमदेवसूरी(Somdev Suri),कमंदकः(Kamandaka)	[7]
भारतीयराजशास्त्रस्य प्रमुखग्रन्थानि (Important Texts on Indian Polity)-ऋग्वेदः-10.173,10.174 (Rigveda -10.173,10.174), अथर्ववेदः-6.87,7.13 (Atharvaveda 6.87,7.13),शतपथब्राह्मण 5.1.1.8-13,9.4.1.1-5(Shatapath Brahmana -5.1.1.8-13, 9.4.1.1-5),अर्थशास्त्रम् -1.4.1-19 (Arthashastra 1.4.1-19), महाभारत-शान्तिपर्वः-120.1-35(Mahabharata- Shantiparva 120.1-35),मनुस्मृतिः-7.1-35(Manusmriti 7.1-35),गान्धीगीता-सत्याग्रहनिरुपणम् 5.1-25 (Gandhigita- Satyagraha Nirupana - 5.1-25)	[8]

SN 311 वैदिकसाहित्यम् (Vedic Literature) 3-0-0-3

ऋग्वेद: - अग्नि: 1.1 (**Rigveda-** Agni-1.1), इन्द्र:-1.18(Indra-1.18), उषस् 3.61 (Ushas- 3.61), विष्णु: -1.154 (Vishnu- 1.154), हिरण्यगर्भ: 10.121(Hiranyagarbha-10.121),संज्ञानम्(Sangyana-10.191),**यजुर्वेद**:-शिवसङ्कल्प: -34.१-6 (**Yajurveda-** Shivasankalpa- 34.1-6), **अथर्ववेद**: -सामनस्य 3.30 (**Atharvaveda-** Sammanasya-3.30),भूमि: -12.1-12 (Bhoomi- 12.1-12) [20]

उपनिषद् -कठोपनिषद्, **1-2** (**Upanishad-** Kathopanishad (1st and 2nd Chapter) [19]

Text Books:

1. Velankar, H.D. (1965). *Riksuktashati*. Pune: Vaidika Samshodhana Mandal.
2. Bandhu, V. (1960). *Atharvaveda (Shaunakiya)* Hoshiyarpur: VVRI.

Reference Books:

3. Upadhyay, G.P. (2001). *Shatapatha Brahmana.* Delhi: S.L.B.S.Rastriya SanskritVidyapeetha.
4. Shashtri, J. L. (1978).*Shuklayajurveda-Samhita(Vajasneyi-Madhyandina).* Delhi: MLBD.
5. Trivedi, R. (1996). *Rigveda Samhita*. Delhi: Chaukhambha Sanskrit Pratishthan.
6. Shashtri, S. D. (1986). *Kathopanishad(Shankarbhashya*). Delhi: Chaukhambha Sanskrit Pratishthana.
7. Krishnalal (1998).*Vaidiksangraha.* Delhi:Eastern Book Linkers.
8. Tripathi,V.N. (1986).*Vedachayanam.*Varanasi:Vishwavidyalaya Prakashan.
9. Velankar, H.D. (1970). *Riksuktavaijayani.* Mumbai:Bharatiya Vidya Bhawana.

SN 321 सौन्दर्यशास्त्रम् भारतीयनाट्यशाला च (Aesthetics and Indian Theatre) 3-0-0-3

सौन्दर्यशास्त्रम्(**Aesthetics**)-काव्यप्रकाशः-4.27-28 (Kavyaprakasha-4.27-28), सहित्यदर्पणः-दशमपरिच्छेदः (Sahityadarpana -Dashamparichcheda)	[12]
छन्दशास्त्रम्-(**Chhandashastr**a)- अनुष्टुपः(Anushtupa), आर्या(Arya), इन्द्रवज्रा(Indravajra), उपेन्द्रवज्रा(Upendravajra), उपजातिः(Upajati), वन्शस्थ:(Vanshastha), द्रुतविलंबित:(Drutavilambita), पुष्पिताग्रा(Pushpitagra), वसन्ततिलका(Vasantatilaka), मालिनी(Malini), मन्दाक्रान्ता(Mandakranta), शिखरिणी(Shikharini), शार्दूलविक्रिडीतं (Shardulavikridita),स्रग्धरा(Sragdhara)	[15]
नाट्यशास्त्रम्- द्वितीय अध्यायः (**Natyashastra (2nd Chapter)**परम्परागतभारतीय आधुनिकनाट्यशाला च (Traditional Indian and Modern Theatre), नाट्यमण्डपम् (Natyamandapa),रङ्गशीर्ष(Rangashirsha),रङ्गपीठम् (Rangapeetha), रङ्गमञ्चः (Rangamancha) स्वरूपम् विकासश्च (Features and Developments)	[12]

Text Books:

1. Nagendra (1996). *Kavyaprakash of Mammata with Vishveshwar Vyakhya*. Varanasi: Gyanmandal Ltd.
2. Nagar, R. (1994). Natyashashtra of Bharata. Delhi: Parimal Publication.

Reference Books:

1. Shastri, S. (1978). *Sahityadarpana*. Delhi: MLBD.
2. Bakshi, M.C. (1971). *The Concept of Ancient Theatre*. Delhi: Munsiram Manoharlal.

3. Ghosh, M.M. (2007). *Natyashastra of Bharat,* Delhi: Chaukhambha Publication.
4. Gupta, C.B. (1987). *Indian Theatre*. Delhi: Munshiram Manoharlal.
5. Mankad, D.R. (1996). *Ancient Indian Theatre*. Delhi: MLBD
6. Warder, A.K. (2004). *Indian Kavya Literature*. Delhi: MLBD

SN 312 संस्कृतव्याकरणम् भारतीयतर्कपद्धतिः च **3-0-0-3**
Sanskrit Grammar and Indian System of Reasoning

वरदराजाचार्यविरचितलघुसिद्धान्तकौमुदी- अच्-सन्धिःसूत्रबोधसहितः- - 6.1.47,1.1.65,1.149,6.1.75,1.3.10,1.1.2,1.1.69,6.1.84,1.3.2,1.1.50,1.1.1,6.1.85,6.1.91,6.1.97 (**Laghusiddhantakaumudi of Varadaraja** (Achsandhi with sutrabodha)- 6.1.47, 1.1.65, 1.149, 6.1.75, 1.3.10, 1.1.2, 1.1.69, 6.1.84, 1.3.2, 1.1.50, 1.1.1, 6.1.85, 6.1.91, 6.1.97 [20]

अन्नम्भट्टप्रणीतः तर्कसंग्रहः (**Tarkasangraha of Annambhatta**) [19]

SN 322 **वैदिकगणितम् खगोलविद्या च** **3-0-0-3**

(Vedic Mathematics and Astronomy)

Text Books:

भारतीयगणितस्य खगोलविद्यायाः च संक्षिप्त-इतिहासः (A Brief History of Vedic Mathematics & Astronomy- वेदाङ्ग-ज्योतिषम्(Vedanga Jyotisha), शुल्बसूत्रं (Shulbasutra),पञ्चसिद्धान्तिका(Panchasiddhantika),सूर्यसिद्धान्तः Suryasiddhanta, आर्यभट्टः-I(Aryabhatta-I),गणेशदैवज्ञः(Ganesh Daivagya),कमलाकरः Kamalakara, जयसिंहः Jay Singh, सुधाकरद्विवेदी (Sudhakar Dwivedi)	[8]
वैदिकगणितम्-लगध्-ज्योतिषम्(4&42) **Vedic Mathematics-** Selected section of LagadhJyotish(4&42),लीलावती(21श्लोकाः)),Lilawati(21Verses),श्रीभारतीकृष्णतीर्थः(5 सूत्राणि), Shri Bharati Krishna Teertha(5 Aphorism)	[12]
खगोलविद्या (लगधज्योतिषं -1-3&43)**Astronomy-** Selected section of Lagadh Jyotisha(1-3&43),सूर्यसिद्धान्तः(चतुर्दश-अध्यायः)Suryasiddhanta(14thChapter), आर्यभटीयम(गोलपद-1-22)Aryabhatiyam (Golapada- 1-22)	[12]
वेधशाला अथ च खगोलीयगणनार्थं प्रमुखप्राचीनयन्त्राणि (Observatories and Important Ancient Instruments for Astronomical Calculations)	[7]

GY 111 **Physical Geography-I** **3-0-0-3**

Solar System and origin of planets: Introduction to Solar system, Theories regarding origin of planets- hypothesis by Kant, Nebular hypothesis by Laplace, Planetesimal hypothesis of Chamberlin, Tidal hypothesis of James Jeans, Binary Star hypothesis of Russell and Big-bang.	**[15]**
Earth & Its components: Rotation, revolution of the earth and its consequences, Axis of the earth, Longitude and Latitude of the earth, Shape of the earth, Local time and standard time, Time zone and International Date line, Internal structure of the earth, Distribution of land and water on the earth.	**[7]**
Rocks, Earth movements, Volcanoes & Earth quake: Mode of occurrences of rocks: Igneous, Metamorphic and Sedimentary, Earth movements-folding and faulting of rocks, Earth quake: causes and consequences, Volcanoes: causes and consequences.	**[8]**
Work of different agents and resulted landforms: Weathering: Physical, Chemical and Biological, Work of River, Wind, Glacier, Sea wave and Karst: erosion, transportation, deposition and resulted landforms, Groundwater, springs and artesian wells.	**[9]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 121 **Bio-Geography-1** **3-0-0-3**

Biogeography: Introduction: Biogeography: Meaning, Definitions, Concept, importance and relevance, Ecology and Ecosystem: Definitions and principles, Dimensions in Ecology: Definition of Ecotope, Ecotone and Habitat, Biosphere, food chain, food web and ecological pyramid.	**[14]**
Biogeochemical Cycles and Soil: Biogeochemical cycles- Carbon cycle, Nitrogen cycle, Oxygen cycle and Phosphorus cycle, Soil: forming processes, factors responsible. Soil profile.	**[7]**
Distribution of Flora and fauna: Distribution of flora and fauna over geographical space, Factors affecting plant ecology: light, temperature, moisture etc.	**[5]**
Introduction to Biome, Biodiversity and Issues: Biome: meaning, concept and importance, Introduction to Bio-diversity-meaning and concept, Major bio-diversity hotspots in India, Issues related to the bio-diversity with special reference to India, Human induced changes in the ecosystem: causes and consequences.	**[13]**

Text Books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998) Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones, G.R. (eds) (1966) Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.

GY 112 **Physical Geography-II** **3-0-0-3**

Isostasy, Processes and Mountain building: Theories of Isostasy: Models of Pratt & Airy, Brief understanding of Geological time, Endogenetic and Exogenetic processes, Concept of geosynclines and orogenic processes, Mountains: types and their formations, Mountain building theories: theories by Kober, Joly, Holmes, Daly **[18]**

Concept of Scale, Cycles and landform evolution: Concept of scale in physical geography: spatial and temporal, Cyclic and non-cyclic concept of erosion, Normal cycle of erosion by W.M. Davis, Landscape evolution theory by W. Penk **[14]**

Evolution of drainage network on different topography: Development of drainage network on uniclinal structure, Development of drainage network on folded structure, Development of drainage network on faulted structure **[7]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 122 **Bio-Geography-2** **3-0-0-3**

Introduction to Community: Concept of community, Factors affecting community: Succession, vegetation climax, Effects of human interventions in the community (with special reference to India), Effects of industrial effluents on the community with special reference to India, management practices **[10]**

Spatial distribution of Biomes: Description of major biomes of the world in reference to the location, extension, climate, soil, flora, fauna, succession and human activates **[12]**

Soil formation, erosion and management: Mechanism of formation of podzol, laterite, chernozem and saline alkaline soils, Soil erosion and land degradation: Types and factors, their impacts on soil fertility and their management, Major ecological regions of India: Tropical rain forest, Desert, Mountain, aquatic ecosystem, mangrove and deciduous forest **[17]**

Text books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998): Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography: An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones G.R. (eds) (1966): Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.
4. Barry C. (1993) Biogeography, Blackwell Scientific Publication, Oxford, London.
5. Huggett R.J. (2004) Fundamentals of Biogeography, Psychology Press.

GY 132 **Practical Geography-1** **0-0-4-2**

Scale and Maps: Introduction and Types: Introduction of Practical Geography, Concept of Maps and their importance in Geography, Concept of Scales and their importance in Geography, Type of Scales: Construction of Linear, Diagonal and Vernier scales **[16]**

Projections and Contours, Types and representation: Concept of projection in their importance, types and uses in Geography, Construction of projection in graphical method: polar, conical and cylindrical cases, Contours: Concept and representation **[14]**

Text Books:

1. Singh R. L., Singh R. P. B. (1999) Elements of Practical Geography, Kalyani Publishers.
2. Sarkar A. (1997) Practical Geography, A systematic Approach, Orient Longman Ltd.

Reference Books:

1. Anson R., Ormelling F. J. (1994) International Cartographic Association: Basic Cartographic Vol. Pregmen Press.
2. Gupta K.K., Tyagi, V. C. (1992) Working with Map, Survey of India, DST, New Delhi.
3. Loxton J. (1980) Practical Map Production, John Wiley.
4. Mishra R.P., Ramesh A. (1989) Fundamentals of Cartography, Concept, New
5. Delhi.
6. Monkhouse F. J., Wilkinson H. R., (1973) Maps and Diagrams, Methuen, London.
7. Rhind D. W., Taylor D. R. F. (eds.) (1989) Cartography: Past, Present and Future, Elsevier, International Cartographic Association.
8. Robinson A. H. (2009) Elements of Cartography, John Wiley and Sons, New York.
9. Sharma J. P. (2010) Prayogic Bhugol, Rastogi Publishers, Meerut.
10. Steers J. A. (1965) An Introduction to the Study of Map Projections, London.

GY 211 Geography of India 3-0-0-3

Physiography and brief Geology of India: India: location, shape, size, boundaries and extent; Major physiographic divisions of India: Northern Hills, Northern plains, Peninsular Plateau, Coastal plains, Indian deserts and the islands, Brief understanding of major Geological structures of India. **[8]**

Drainage and Climate of India: Drainage of India: Himalayan drainage and Peninsular drainage, National Water grid., Characteristics of Indian climate and seasons (Temperature, Humidity and Precipitation), Indian Monsoon: mechanism and consequences and its relation to Indian agriculture. **[8]**

Soils and Vegetation of India: Distribution of Soils of India, Distribution of Vegetation of India, Problem of flood and drought in India. **[4]**

Demographic Aspects of India:
Population distribution, density, sex ratio and literacy pattern of India. **[8]**

Cultural and Social Aspects of India:
Schedule tribes and scheduled tribes, Religious diversity in India, Linguistic diversity in India, Distribution of different races in India, Contemporary Issues: Poverty, Population explosion, globalization and its impact on the environment, regional disparity. **[11]**

GY 221 Human Geography 3-0-0-3

Basic concepts and Theory of Population: Introduction to the Human Geography: meaning, definitions and concept, Relation of Human geography with other fields of sciences, Population resource relationship: concept of over population, optimum population and under population, Population transition theory. **[15]**

Adaptation and Distribution of Population: Human adaptation in different parts of the world: Equatorial, Tropical, Temperate, and Polar area; Settlements: meaning and concept; Rural and Urban settlements: types and pattern, Elements of the environment and their impact on the Habitat, economy and Society of Eskimos, Pygmies, Bushman, Distribution of Population - World patterns, Factors influencing spatial patterns of population distribution – physical, economic and social aspects. **[15]**

Migration, Urbanization and Globalization: Migration of population: causes and consequences, brain drain, World population problems and policies, Urbanization, problems of urbanization, Globalization: causes and its impact, Concept of a region: types of regions. [9]

GY 212 **Economic Geography** **3-0-0-3**

Introduction to Different Economic Sectors: Introduction to economic geography: definition, meaning and concept, Economic geography and its relation to human geography, Classification of economic activities of the world: Primary, Secondary and tertiary activities (Hunting and food gathering, agriculture, industries and market economy). **[11]**

Agricultural Resources: an Introduction to Primary activities: Agriculture systems: Intensive subsistence agriculture (Rice) and plantation agriculture (Tea), Commercial grain farming (Wheat), Horticulture and mixed farming. **[8]**

Industrial locations and Manufacturing Industries: Industrial activities: an introduction, Factors Affecting location of Economic Activity with special reference to Industry; Secondary Activities: Manufacturing (Cotton Textile, Iron and Steel) (World pattern). **[10]**

Manufacturing Regions: Concept of Manufacturing Regions, Special Economic Zones and Technology Parks., Tertiary activities: Transport, Trade and Services. **[10]**

Text books:

1. Bagchi-Sen, S. & Smith, H.L. (2006). *Economic Geography: Past, Present and Future*. U.K., Taylor and Francis.
2. Sharma, T.C. & Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Publication.

Reference Books:

1. Alexander, J. W. (1963). *Economic Geography*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
2. Clark Gordon, L., Feldman, M.P. & Gertler, M.S., (eds.) (2000). *The Oxford Handbook of Economic Geography*. N.Y., Oxford University Press.
3. Coe, N. M., Kelly, P. F. & Yeung, H. W. (2007). *Economic Geography: A Contemporary Introduction*. U.K., Wiley-Blackwell.
4. Combes, P., Mayer, T. and Thisse, J. F. (2008). *Economic Geography: The Integration of Regions and Nations*. U.S., Princeton University Press.
5. Hodder, B.W. & Lee, R. (1974). *Economic Geography*. U.K., Taylor and Francis.
6. Leong, G.C. & Morgan, G.C. (1979). *Human & Economic Geography*. N.Y., Oxford University Press, Oxford.
7. Wheeler, J. O. (1998). *Economic Geography*. U.S., Wiley.
8. Willington, D. E. (2008). *Economic Geography*. U.K., Husband Press.

GY 222 **Geography of Resources** **3-0-0-3**

Distribution of Mineral Resources: Resources: meaning, concept and Definitions; Mineral resources: Uses and distribution: Iron ore, Coal, Bauxite, Zinc, Gold, Silver, Mica. **[8]**

Energy Resources: Renewable energy resource: Wind energy and Solar energy, Non-renewable energy resource: Petroleum, Natural Gas. **[5]**

Distribution of Agricultural Resources and Agricultural Infrastructure: Rice, wheat, Millet, Cotton, Sugarcane, Tea and Coffee; HYV seeds, Irrigation, Fertilizers and Pesticides. **[13]**

Concept of Industry, industrial resources and Industrial Regions: Iron and steel industry, Cotton textile industry, Aluminum industry, Cement Industry; Free trade zones and Special Economic Zones, Concept of Human Resource. **[13]**

Text books:

1. Roy, P. (2007). *Economic Geography, A Study of Resources.* New Delhi, New Central Book Agency Pvt. Ltd.

Reference Books:

1. Gautam, A. (2009). *Advanced Geography of India*. Allahabad, Sharda Pustak Bha.
2. Khullar, D.R. (2000). *India: A Comprehensive Geography*. New Delhi, Kalyani Publishers.
3. Krishnaswamy, K. (1972). *India's Mineral Resources*. New Delhi, Oxford IBM.
4. Rao, K.L. (1975). *India's Water Wealth*. New Delhi, Orient Longman.
5. Sharma, T.C. and Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Pub.
6. Singh, G. (1988). *Geography of India*. New Delhi, Atmaram & Sons.

GY 232 **Practical Geography-II** **0-0-4-2**

Cartographic techniques and Introduction to the topographical Maps: Construction of one dimensional, two dimensional and three dimensional graphs and diagrams, Topographical maps and their interpretation.

Basics of Field Survey and Chain and Tape Survey: Introduction to the field survey, Chain and tape surveying and plotting.

Introduction of Remote Sensing: Mechanism of remote sensing, Different platforms of Remote sensing, Spectral signature and its application in remote sensing, Introduction to GPS and GIS, Applications of GIS.

Text books:

1. Joseph, G. (2005). *Fundamentals of Remote Sensing*. India, United Press India.
2. King, L.S. (1969). *Statistical Analysis in Geography*. U.S., Prentice-Hall.
3. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2004). *Remote Sensing and Image Interpretation*. U.S., Wiley. (Wiley Student Edition).
4. Mishra, R.P. and Ramesh, A. (1989). *Fundamentals of Cartography.* New Delhi, Concept.
5. Monkhouse, F.J. and Wilkinson H.R. (1973). *Maps and Diagrams*. London, Methuen.

Reference Books:

1. Gupta, K.K. and Tyagi, V.C. (1992). *Working with Map*. Survey of India, New Delhi, DST.
2. Hammond, P. and Mc. Cullagh, P.S. (1978). *Quantitative Techniques in Geography: An Introduction*. U.K., Oxford University Press.
3. Loxton, J. (1980). *Practical Map Production*. U.K., John Wiley.
4. Rhino, D.W. and Taylor, D.R.F. (eds.) (1989). *Cartography: Past, Present and Future*. Elsevier, Amsterdam, International Cartographic Association.
5. Robinson, A. H. (2009). *Elements of Cartography*. New York, John Wiley and Sons.
6. Sharma, J. P. (2010). *Prayogic Bhugol.* Meerut, Rastogi Publishers.

GY 311 Climatology and Oceanography 3-0-0-3

Basic Components of atmosphere: Atmosphere, Climate and Seasons: concept and meaning; Structure and composition of atmosphere, Humidity; Distribution of Temperature. **[6]**

Circulation of atmosphere: Pressure and wind and their broad pattern, General circulation of atmosphere, jet streams. **[5]**

Atmospheric Disturbances and Winds: Different types of atmospheric disturbances: Tropical cyclone, Extra-tropical cyclone and Hurricane, Winds: planetary, seasonal and local, Climatic classification, climate change: causes and consequences. **[8]**

Geography of Ocean Basins: Ocean basin relief (Indian ocean, Atlantic ocean and pacific ocean). **[4]**

Salinity and Temperature of ocean water: Salinity: causes, determinants and distribution, Distribution of temperature and salinity. **[5]**

Dynamics of Ocean water:
Waves, Currents and Tide: formation and types. **[6]**

Coral Reefs and Ocean Deposits:
Coral reefs: types and theories; Ocean deposits. **[5]**

Text books:

1. Lal, D.S. (2011). *Climatology*. India, Sharda Pustak Bhawan.
2. Sharma, R.C. and Vatal, M.(1980). *Oceanography for Geographers*. Allahabad, Chaitanya Publishing House.

Reference Books:

1. Anthes, R.A., Panofsky, H.A., Cahir, J.J. & Rango, A. (1978). *The Atmosphere*. SRA, Columbus.
2. Barry, R.G. & Carleton, A.M. (2001). *Synoptic and Dynamic Climatology*. U.K., Routledge.
3. Barry, R.G. & Corley, R.J. (1998). *Atmosphere, Weather and Climate*. N.Y., Routledge.
4. Batten, L.J. (1979). *Fundamentals of Meteorology*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
5. Pinet, P.R. (2008). *Invitation to Oceanography (Fifth Edition)*. USA, UK and Canada, Jones and Barlett Publishers.
6. Stowe, K. (1987). *Essentials of Ocean Science*. New York, John Wiley &Sons.
7. Sverdrup, K.A. & Armbrust. E.V. (2008). *An Introduction to the World Ocean*. Boston, McGraw Hill,
8. Thurman, H.V. (1996). *Essentials of Oceanography*. New Jersey, Prentice-Hall.
9. Tikka, R.N. (1989). *Physical Geography*. Meerut, Kedarnath Ramnath & Co.

GY 321 **Man and Environment** **3-0-0-3**

Basics of Environment: Environment: meaning, concept, definitions and types; Components of physical and cultural environment.

Relationship between Man and Environment:
Man and environmental relationship of time and space; Approaches in understanding the man and environment relation-Deterministic approach, Possibilistic approach and neo determinism, Geography and geographers: association with man and environment.

Changing relationship of Man and Environment and Issues:
Population explosion, technology and environment: changing relationship.

Environmental Issues: Environmental issues in Tropical, Temperate and Polar areas; Environmental hazards: natural and manmade.

Environmental Management: Environmental policies, Management, Concept of Sustainability.

Text Book:

1. Singh, S. (2015): *Environmental Geography*. Allahabad, Pravalika Publications.

Reference Books:

1. Chandna, R.C. (2002). *Environmental Geography*. Ludhiana, Kalyani.
2. Cunninghum, W.P. and Cunninghum M.A. (2004). *Principals of Environmental Science: Inquiry and Applications*. New Delhi, Tata Macgraw Hill.
3. Goudie, A. (2001). *The Nature of the Environment*. U.K., Blackwell, Oxford.
4. Miller, G.T. (2004). *Environmental Science: Working with the Earth*. Singapore, Thomson Brooks Cole,

GY 312 **Geography of Settlement** **3-0-0-3**

Basics of Settlement: Introduction: Nature and Scope; Basic Concepts: Rural and Urban Settlements, Hamlet, Village, Town, City, Metropolis, Megalopolis, Conurbation, Rural-Urban Fringe. **[9]**

Rural Settlements: Types and Patterns, Determinants. **[4]**

Theories of Settlement: Regional Settlement Hierarchy: Central Place Theory, Rank-Size Rule, Primate City. **[10]**

Urban Land use: Models; Types – Residential, Commercial, Industrial, Institutional, Recreational, Heritage, Public and Green Spaces, and Transport. **[9]**

Site and situation: Concept of Site and Situation, and Landuse, Services and Infrastructure; Problems and their prospects. **[7]**

Text Books:

1. Ghosh, S. (1999). A Geography of Settlements. Kolkata, Orient Longman.
2. Singh, R.Y. (1994). The Geography of Settlement. New Delhi, Rawat Publication.

Reference Books:

1. Chishlom, M. (2007). Rural Settlement and Land Use. U.S., Transaction Publishers.
2. Daniel, P. (2002). Geography of Settlement. Jaipur & New Delhi, Rawat publication.
3. Kaplan, D.H., Wheeler J.O. & Holloway S.R. (2008). Urban Geography. John U.S., Wiley.
4.Misra, R.P. and Misra, K. eds. (1998). Million Cities of India. New Delhi, Sustainable Development Foundation.
5. Pacione, M. (2009). Urban Geography: A Global Perspective. U.K., Taylor and Francis.
6. Ramachandran, R. (1989). Urbanisation and Urban Systems in India. India, Oxford University Press, India.
7. Ramachandran, R. (1992). The Study of Urbanisation. New Delhi, Oxford University Press.

GY 322 Spatial Dimensions of Development 3-0-0-3

Introduction to Development: Concept of Development; Measures of Development (Economic, Social and Environmental); Efficiency- Equity Debate. [8]

Regional Development: Concept of Region and Regional Development; Intral and Inter-regional Development pattern. [6]

Theories of development: Myrdal, Hirschman and Friedmann. [10]

Impact of Development: Interrelationship between environment and development; Impact on physical environment in terms soil erosion, land degradation, deforestation. [8]

Different Issues in Developed and Developing Countries: Pollution and issues in developed and developing countries of the world; Human development: International, interstate comparison of India. [7]

Text Books:

1. Claval, P.L. (1998). An Introduction to Regional Geography. Oxford and Massachusetts, Blackwell Publishers.
2. Gore, C.G. (1984). Regions in Question: Space, Development Theory and Regional Policy. London, Methuen.

Reference Books:

1. Abler, R., Adams, J. S., & Gould, P. R. (1971). Spatial Organization: A geographer's View of the World. Prentice-Hall, Englewood Cliffs.
2. Blij, H. J. (1971). Geography: Regions and Concepts. N.Y., John Wiley and Sons.
3. Friedmann, J. & Alonso, W. (1975). Regional Policy - Readings in Theory and Applications. Massachusetts, MIT Press.
4. Gore, C. G., Köhler, G., Reich, U-P. & Ziesemer, T. (1996). Questioning Development: Essays on the Theory, Policies and Practice of Development Intervention. Marburg, Metropolis-Verlag.
5. Haynes, J. (2008). Development Studies. U.K., Polity Short Introduction Series.
6. Peet, R. (1999). Theories of Development. N. Y., The Guilford Press.

GY 332 **Practical Geography-III** **0-0-4-2**

Basics of Survey: An introduction to survey and different instruments.

Prismatic Compass and Plane Table Survey: Prismatic compass survey and Plane Table Surveying

Weather instruments, Weather Maps and graphs: Introduction to weather instruments, Interpretation of weather maps, Hythergraph and climograph: uses and applications. 26

Introduction to Statistical Techniques: Frequency distribution, central tendency: mean, median and mode, measures of dispersions.

Text Books:

1. Hussain, S.K. & Nagaraj, M.S. (1992). Textbook of Surveying. New Delhi, S. Chand and Co. Ltd.
2. Pal, S. K. (1998). Statistics for Geoscientists. New Delhi, Tata McGraw Hill.
3. Sarkar, A. (1997). Practical Geography: A Systematic Approach. Hydrabad, Orient Longman Ltd.

Reference Books:

1. Elfic, M.H., Fryer, J.G. Brinkner, R.C. & Wolf, P.R. (1994). Elementary Surveying. London, Harper Collins Publishers.
2. Kanitkar, T.P. & Kulkarni, S.B. (1988). Surveying and Leveling, Part 1. Pune, Pune Vidyarathi Griha Prakashan,
3. Mahmood, A. (1977). Statistical Methods in Geographical Studies. New Delhi, Concept.
4. Monkhouse, F.J. & Wilkinson, R. (1971). Map and Diagrams: there compilation and construction. New Delhi, B.I. Publications Private Ltd.
5. Silk, J. (1979). Statistical Concepts in Geography. London, Allen and Unwin.
6. Singh, R.L. & Singh, R.P.B. (1991). Elements of Practical Geography. New Delhi, Kalyani Pub.
7. Venkatramaiah, C. (1996). A textbook of Surveying. Hydrabad, University Press/Orient Longman Ltd.

HY 111 Ancient Indian History– I

Objectives: The course intends to provide an extensive survey of early Indian history to the students of the history honors course. It also familiarizes them with the tools of studying ancient Indian history. It further aims empowers the students not only with the significance of sources in history writing but make them aware with the importance of environmental factors in the study of history

Unit1. Sources: Literary/written sources - Vedic/Hindu canonical literature: Buddhist Canonical Literature, Jain Canonical Literature, Secular Literary Sources - Sangam Literature. Foreign Accounts - The Greeks and Romans, Chinese. Material/Archaeological sources –Inscriptions, Epigraphs, Coins, and Monuments.

Unit 2. The Pre-Historic Period: Paleolithic Cultures – Sequence and geographical distribution, evolution and uses of stone industries. Mesolithic Cultures – regional and chronological distribution. Neolithic Age and Chalcolithic Age.

Unit 3. The Harappan Civilization: Origin, distribution, morphology of major sites (Mohanjodaro, Harappa, Kalibangan, Lothal, Dholavira). Society, economy, polity and religion as reflected in Vedic literature. Religious beliefs and practices and art and architecture.

Unit 4. Vedic age to 6th Century B.C: The origin of Aryans, geographical background, Political, Social, Economic and religious conditions of the Aryans in the Rig Vedic and Later Vedic Period. Rise of Territorial States in Northern India: Urbanisation of the Ganga Valley, Sixteen Mahajanapadas, Ascendency of Magadha. Iranian and Macedonian Invasion: Significance; Religious Movements in 6th Century B.C Buddhism and Jainism: Rise, Growth and Contribution to Indian History.

HY 121 Ancient River Civilization- I

Objectives: To offer a historical survey of human evolution. It details the features of material culture of early humankind by tracing the transitions from the hunting-gathering subsistence pattern to more advanced human subsistence patterns involving domestication of animals and food production. The paper highlights how such changes were gradual and did not unfold uniformly in all parts of the world; thereby allowing for coexistence of different subsistence forms.

Unit 1. Cradle of civilization Mesopotamia: Origin of Fertile Crescent, Geography, Early civilization of Sumerian, Akkadian, Babylonian and Assyrians, Religious Beliefs, Rituals and practices, Social Levels, Classification, Priest, King, Upper class, Nobles, Lower Class, Slavery, Medicines, Astronomy, Astrology, Time, Inventions, Mummification, Tools and Methods, Script on Tablets, Seals , Mode of warfare, Strategies, Government, Polity, Administrative units Law Code, Justice, Causes of Decline of Civilization.

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units, Social stratification in society, food, Dress, Social Classes, Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization, Contribution of Civilization

HY 112 Ancient Indian History–I

Objectives: This course is about early historical developments taking place in Indian history especially post-Harappan period, that is Vedic and later Vedic periods. Highlighting the features of early historic times , the course tries to trace the emergence of state system from proto-state stage and at the same time seeks to underline the important development in the arena of economy, society and culture.

Unit 1. The Age of Maurya: Sources of Mauryan History: Kautilyas Arthasastras and Meghsthenes Indica and Ashokan Inscriptions. Chandragupta Maurya, Bindusara and Asoka- Foundation and Consolidation of Empire, Administrative system. Ashoka's policy and reforms, Dhamma, Art and architecture: Decline of Mouryan Empire.

Unit 2. Post Mauryan Polity: Post Mouryan Polity in India: Ruling dynasties in Northern and Southern India: Sungas, Satavahanas and Kushanas. Rise of Kharavela in Kalinga. Sangam age- Literature, Economy and Society.

Unit 3. Age of the Guptas and Post-Gupta period (to c. 750): Political history of northern and southern India. Samanta system and Changes in political structure. Economy and Social structure. Culture and Religion.

Unit 4. Themes in early Indian cultural history: Languages and texts, Major stages in the evolution of art and architecture, Major philosophical thinkers and schools.

HY 122 Ancient River Civilization- II

Objectives: This paper traces the changing political formations, economic and social structures in the ancient Greek and Roman empires because ancient history of these two regions explain in great detail about Europe owes to the development of civilization to these particular regions in large measure**.**

Unit 1. Classical Greece civilization: Mythologies in ancient Greek, Social structure and stratification, Classes, Athens Olympics in ancient Greece, Art and Architecture in ancient Greece

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units Social stratification in society, food, Dress, Social Classes Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization Contribution of Civilization

HY 211 History of Medieval India (750-1526 A.D.)-I

Objectives: The purpose of this paper is to introduce to students the idea of major transition in early medieval India in the wake of disintegrating power at the Centre. It aims to guide students as to how the corresponding rise and rapid spread of Islam marks the advent of Islam in India through various channels**.**

Unit 1. Early Medieval India, 750-1200: Polity: Major political developments in Northern India and the Peninsula, Origin and the rise of Rajputs, The Cholas: administration, village economy and society -"Indian Feudalism" Agrarian economy and urban settlements, Trade and commerce, Society, Science and technology.

Unit 2. Cultural Traditions in India, 750- 1200: Philosophy: Skankaracharya and Vedanta, Ramanuja and Vishishtadvaita, Madhva and Brahma Mimansa, Religion, Tamil devotional cult, Growth of Bhakti, Islam and its arrival in India Sufism, Literature, Growth of Tamil literature, Kalhan's Rajtarangini, Alberuni's, Art and Architecture: Temple architecture, Sculpture, Painting.

Unit 3. Establishment of the Delhi Sultanate: The Ghurian invasions, Factors behind Ghurian success, Economic, Social and Cultural consequences, Foundation of Delhi Sultanate and early Turkish Sultans - Consolidation: The rule of Iltutmish and Balban.

Unit 4. "The Khalji Revolution": Alauddin Khalji, Muhammad Tughluq, Firuz Tughluq, Decline of the Sultanate, Foreign contacts and Ibn Battuta's account, Sayyid Dynasty: Khizr Khan, Mubarak Shah, Lodhi Dynasty : Bahlol Lodhi,. Sikander Lodhi, Ibrahim Lodhi, Sultanate administration.

HY 221 Main Outline of World History-I

Objectives: Through discussion of a period in Europe marked by Renaissance, Protestantism, Thirty-Years-War Counter-Reformation, rise of absolutism, this paper seeks to familiarize students with phenomenal movements in Europe in the fields of culture, religion and politics which laid the future roadmap for largerdevelopment in Europe and the world. It covers discussion on famous monarchs and friction between the state and the Church over the issue of power share.

Unit 1. Renaissance: Meaning and Definition, Nature & Impact, The Reformation, Causes, Nature of Reformation, Results, counter reformation.

Unit 2. Rise of National States: Causes Main monarchies and their growth - Ferdinand, Isabella of Spain, Louis XI of France, England - Henry VII, and Holy Roman Empire. Rise and Decline of Spain - Foreign Policy of Charles V, Philip II, Revolt of Netherland, Thirty Years War, Causes of downfall of Spain.

Unit 3. France under Henry IV: Growth of Royal absolutism, Cardinal Richelieu, Cardinal Mazarin, Louis-XIII, The Thirty Years War, Treaty of Westphalia, Louis XIV, Foreign Policy, Religious Policy , Policy of Colbert's.

HY 212 History of Medieval India (1526- 1740 A.D.)-II

Objectives: Teaching of this paper plans to demonstrate political transition with the establishment and consolidation of the Mughal Empire. It introduces students to a new rounds of social-political-cultural-religious and economic developments under the Mughal regime. By covering about a period of over two centuries, this paper covers the arrival of Europeans and takes into account a larger sort of development as a result of industrial development in Europe and its cascading impact all over places including India where it coincides with the downfall of a mighty Mughal empire. Other issues also get covered under this paper like

Unit 1. Mughal state's relation with regional powers (Rajput, Sikhs, Afghans, Marathas, Deccani kingdoms and the like.

Unit 2. Foundation and Expansion of the Mughal Empire: struggle for empire in North India; Babur's invasion; Mughal-Afghan conflict. Shershah Suri and his administrative reforms.

Unit 3. Consolidation of the Empire: Akbar's imperialist agenda—administration, Mansabdari system, Zabt system; Religion and state—Akbar to Aurangzeb; evolution of the nobility under the Mughals.

Unit 4. Mughal Economy, Society and Culture: rural society and agrarian relations; crafts and industries; monetary system; inland and oceanic trade; literature; technology; architecture and painting.

Unit 5. Disintegration of the Mughal Empire: problems of succession and court politics in the reign of Aurangzeb; popular revolts within the Mughal empire—the Jats, Satnamis, Afghans, and the Sikhs; crisis in the Jagirdari system; peasant uprising and agrarian crisis; Bhakti Movement & Prominent saints, Sufism meaning and Sects.

HY 222 Main Outline of World History-II

Objectives: The paper aims to acquaint the students with a brief history of Russia, Prussia and Austria from thematic standpoint of political and economic changes. Moreover, effort is to familiarize students with the development in the field of art and architecture along with the French revolution and further rise and fall of Napoleonic phase.

Unit 1. Rise of Modern Russia: Peter the great, Catherine II their foreign policies, Austrian Empire - War of Austrian succession - Treaty of Aix-La-Chapple, Causes of seven years' war, Foreign policy of Joseph II, The Rise of Prussia, Domestic, foreign and religious policy of Frederick the great.

Unit 2. The Baroque Age: Science and Technology in 17th and 18th Centuries, The Anglo-French Rivalry for overseas Colony, French Revolution, Causes and results.

Unit 3. Napoleon Bonaparte: Continental System, Battle of Waterloo-Fall of Napoleon-Vienna Congress-Concert of Europe .

HY 311 History of Modern India (1740-1857 A.D.)

Objectives: This paper on modern India familiarizes with the strategies of Europeans especially British traders who soon took over entire India under the initial garb of trading. Herein, the discussion encompasses the establishment, consolidation and ultimately dissolution of East India company and transfer of power to the British Queen in 1857-58. All sorts of developments during the stated period are discussed and debated in great detail. The ideas of modernity and modern ideas are also discussed in brief.

Unit 1. Political Condition of India in the 18th Century: Decline of Mughal emperor and its impact, Advent of Europeans in India – Establishment of bases and trading centres of East India Company and other European companies, Rise of Maratha power, Third battle of Panipat, Cause of defeat of Maratha's and impact of Maratha defeat, Early Anglo – French conflict.

Unit 2. Establishment of British rule in India: Causes of Anglo-French rivalry, Conflict in Bengal, Clive as Governor of Bengal, Battle of Plassey and Buxer, Administrative and Judicial Reforms. Consolidation of English Rule in India, Lord Cornwallis and his reforms, Judicial And Commercial reforms, Lord Wellesley, Lord William Bentinck, Lord Dalhousie and the policy of annexation (1848-56).

Unit 3. Relations of Leading Indian States with English powers: Anglo- Mysore relations – Anglo Mysore wars, Haidar Ali and Tipu Sultan, Anglo- Sikh Relations – Anglo-Sikh wars, Raja Ranjit Singh, Anglo- Maratha Relations- Anglo- Maratha wars.

Unit 4. Revolt of 1857: Causes, Nature and Impact, British Policy towards Burma, The British Afghan Policy –Afghan Wars, Policy Towards Sindh and Nepal, The British Social and Economic Policies.

HY 321 History of China and Japan(1840-1949)-I

Objectives. In this paper, focus is on gradual downfall of Chinese political system and gradual transition of power into the hands of Western powers especially Britain with the first and second Opium wars. The rise of regional powers and anti-manchus sentiments, anti-foreign sentiments, rise of Christianity, and occurrence of several rebellions and movements, the Chinese effort to modernize and militarize are planned to be cover under this paper.

Unit 1. Chinese Feudalism: Gentry, Bureaucracy and peasantry; The Confucian value system; Sino centrism; The Canton commercial system, The transformation of China into an 'informal' colony; the Opium Wars; The Unequal Treaties; The 'scramble' for concessions; Finance Imperialism; The 'Open Door' policy.

Unit 2. Agrarian and Popular Movements: Taiping and Yi Ho Tuan, Attempts at 'Self-Strengthening' (Tzu-Chiang): Reforms of 1860-95; 1898; and 1901-08.

Unit 3. The Revolution of 1911: Causes, Nature and significance; The social composition of the Revolution; Sun-Yet-Sen and his contribution; The formation of the Republic; Yuan Shih Kai; Warlordism. May Fourth Movement of 1919: Nature and significance.

HY 312 History of Modern India (1858-1947 A.D.)

Objectives: This paper provides a thematically arranged overview of the history of India from the first major revolt of 1857 to the making of the republic in 1950. The paper tries to bring up discussion about changing nature of leadership and forms of resistance over period of time.

Unit 1. Impact of the rule of British Rule in India: Destruction of village economy and handicrafts, Impact on agriculture and Industries, Social Impact- Social and Religious reform movements.

Unit 2. Early Stages of Emergence of Nationalism: Peasant and tribal revolts, rise of middle class, Formation of Associations and Pressure groups, Birth of the Indian national Congress, Rise of the Extremism in the Indian National Congress, Programs and objectives of moderate and extremist functions, partition of Bengal and Surat split, Swadeshi Movement, Leaders of Extremist and Moderate factors.

Unit 3. Rise of Revolutionary Nationalism: Impact of Bengal partition, Growth of revolutionary ideas and organization in India and abroad, Home Rule movement, Lucknow Pact, Rise of Communal organizations, Gandhian movements, Rowlett Act, Kilafat Movement, Round table conference, Poona Pact, British Response to Indian Demand – Simon Commission, Rise of communal Politics – Policies and Act of Muslim League and other communal bodies, the Jinnah Factor, Partition of India and attainment of freedom, August offer, Cripps mission, cabinet mission, Wavell Plan, Mount Batten Plan, Leaders of Indian National Movement.

Unit 4. Constitutional Development: Queen's Proclamation and Act of 1858, Indian Council Act 1892, Indian Council Act 1909, Govt. of India Act 1919, Govt. of India Acts 1935, 1947

HY 322 History of China and Japan(1840-1949) -II

Objectives: The purpose of this paper is to discuss the end of dynastic rule in China, beginning of new era altogether with contestation between nationalists and communists for Centre stage of politics along with unsuccessful attempt to revive the dynastic and traditional pattern. There is also an effort to situate China in a new global order which was underway. There is particular reference to the rise communism under the leadership of Mao Zedong. In this paper, the rise of Japan as a new force to reckon with in East Asia under the restored Meiji government has been discussed along with the Japanese antagonism with USA and its consequences.

Unit 1. Nationalism and Communism in China (1921-1937): Formation of the CCP, The Kuomintang (Nationalist Party or KMT), The First United Front.

Unit 2. The Communist Movement (1928-1949): The Jiangxi Period and the rise of Mao Tse-Tung, The Second United Front.

Unit 3. Transition from feudalism to capitalism: Crisis of Tokugawa, Bakuhan system, Meiji Restoration, Political Reorganization, Military Reforms, Social, Cultural and Educational reforms (Bunmeikaika), Financial reforms and Economic development in the 'Meiji' era, Meiji Constitution. Japanese Imperialism: China, Korea and Manchuria. Democracy and Militarism/Fascism: Popular/People's Rights Movement, Nature of political parties, Rise of Militarism, Second World War.

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology. [8]

Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services. [7]

Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling. [6]

Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures. [9]

Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures. [9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya	[12]
Bal Gangadhar Tilak, Gopal Krishna Gokhale	[15]
Raja Ram Mohan Roy, Dayanand Saraswati	[12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement	[8]
Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947	[8]
Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features	[13]
Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism	[10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha	[8]
Executive: President, Prime Minister and Cabinet	[8]
Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation	[12]
Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups	[11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress	[11]
Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China	[14]
Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China	[14]

M.A. Psychology 2017-2018
M. A. in Psychology

PL 511 Advanced General Psychology-I 4-0-0-4

Introduction to Psychology: Definition, Nature, Scope, Purpose of psychology, Methods of Psychology: Observation, Experimental, Case Study. [6]

Biological Basis of Behaviour : Neuron and its structure, Nervous System; Peripheral & Central Nervous system, Endocrine gland and Personaliy. [12]

Sensory-Perceptual Processes: Visual, Auditory- Structure and function of eye and ear. Attention: Nature of Attention and its determinants, Perceptual organization: Perceptual Constancy, Determinants of perception, Types of perception: Form, Space, Depth. Methods of Psychophysics, Signal Detection theory and Subliminal Perception. [12]

Learning: Classical Conditioning: Procedure, phenomena & related issues **,** Operant Conditioning; Procedure, phenomena & related issues, Cognitive theories of learning: Latent, Insight, Observational**,** Neurophysiology of Learning. [10]

Memory & Forgetting: Models of memory; Atkinson & Shiffrin, Craik & Lockhart, Tulving**,** Sensory, Short term & Long term Memory; Flashbulb memory, Reconstruction and distortion of memory, Biological Basis of Memory, Improving memory strategies**,** Forgetting; Theories of forgetting [12]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology.* Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan.* Motilal Banarasi Das, Varanasi.

PL 521 Applied Psychology-I 4-0-0-4

Introduction: Nature, scope, history, fields, methods and importance of applied psychology. [8]

School Psychology: Role of psychologist in school system, measurement and evaluation, education technology, behavior modifications in classroom. [10]

Guidance & Counselling: Types of guidance and counselling, counselling process, characteristics of a effective counsellor, ethics of counselling, uses of psychological tests in counselling, counselling effectiveness in solving personal, social, educational and career, developmental, preventive and curative aspect of counselling. [12]

Mental Health and Hygiene: Factors affecting mental health, indicators of mental health, role of psychologists in promoting mental health, alternative therapies for promoting mental health. [12]

Neuropsychology: what is neuropsychology, scope, functions of neuropsychologists, techniques of neuropsychology. [10]

Suggested Books:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Singh, A. P. Vyavaharik Manovigyan. Abhishek Publication, Varanasi.
3. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
4. Rao, S. N. *Counselling and Guidance*. Tata McGraw-Hill, New Delhi.
5. Charles, J. G., & Bruce, R. F. *Counseling Psychology: Practices, Issues and Intervention*. CENGAGE Learning, New Delhi.
6. Sue, R., Sue, D., & Sue, S. *Understanding Abnormal Behaviour*. Houghton Mifflin.
7. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
8. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.

PL 531 Systems in Psychology 4-0-0-4

Development of Psychology as a Discipline: History of Psychology, how psychology as evolved as an independent discipline, Structuralism; Wundt and Tichener, Functionalism: Dewy, William James, Galton. [10]

Behaviourism school of psychology: Pavlov, Skinner, Thondike, Watson, Lashley. [10]

Gestalt School of Thought: Max Wertheimer, Kohler and Kofka, Jean Piaget. [10]

Psychoanalytic and Neo- Psychoanalytic Prospective: Freud, Jung, Erikson, Adler, Horney, Eric Fromm. [11]

Humanistic and Existential Perspective: Maslow and Carl Rogers, Victor Frankl, Rollo May. [11]

Suggested Books:

1. Wolman, B.B., *Contemporary theories and systems of Psychology*, Harper and Bors, N.Y.
2. Chaplin, T. Kraweic, T.S. *Systems and Theories of psychology*. Holt Rinehart and Winston.
3. Schiffman, H.R. *Sensation and Perception.* New York : John Wiley and Sons.
4. Hilgard, E.H., and Bower, G.H. *Theories of Learning*. Englewood Cliffs : Prentice Hall.
5. Matlin, M.W. *Cognition*. Bangalore : Prism.
6. Mazur, J.E. *Learning and Behaviour*. Englewood Cliff's : Prentice Hall.
7. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's *Experimental Psychology*. London : Methuen and Co.
8. Marks, M.H. and William, A. Cronan – Hillix, *Systems and Theories in psychology*. McGraw Hill International Editions, Psychology Series.
9. Vygotsky, L.S. *Thought and Language*, Cambridge, mass. MIT Press.
10. Hall C.S. : Lindzey, G. *Theories of Personlaity*. New York : Wiley Eastern Limited.
11. Leahey, Thomas.Hardy, *History of Psychology: main currents in psychological thought*, New Delhi: Peacock Books.

PL 541 Life Span Developmental Psychology 4-0-0-4

Introduction to life span psychology: Meaning, nature, purpose, scope, Methods; Longitudinal, cross-cultural**,** Stages of human development, Difference between growth and development, Types of development; Quantitative and qualitative. [12]

Pre-natal and Neonate development: Conception**,** Stages of pre natal development, types of birth and its impact. [10]

Infancy and Childhood: Developmental milestones, cognitive, motor, moral, social, emotional, language development. [10]

Adolescent: Physical and psychological changes**,** Developmental task of adolescent**,** Problems of adolescent. [10]

Adulthood and old age: Choice of vocation, Adjustment to career, marriage and family, Developmental tasks of adulthood**,** problem of aging**,** Special issues of old age. [10]

Suggested Books:

1. Hurlock, E. *Child Development*. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. *Child Development.* Prentice-Hall of India, New Delhi.
3. Kaluger, G. S., & Kaluger, M. F. *Human Development: The Span of Life*. Times Mirror, St. Louis.
4. Santrock, J. W. *Life-Span Development*. McGraw-Hill, New York.
5. Shaffer, D. R. *Developmental Psychology*. Brooks & Cole, California.

PL 551 Practicum-I 0-0-8-4

Assignments are based on the courses PL 511 Advanced General Psychology-I, PL 521 Applied Psychology-I, PL 531 Systems in psychology, PL 541 Life span development Psychology.

PL 561 Seminar-I 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 512 Advanced General Psychology-II 4-0-0-4

Motivation: Motivational Cycle, Biological & Social Motives, Theories of motivation. [8]

Emotion: Physiological correlates of emotions**,** Theories of emotions, Conflict & Stress management. [8]

Thinking: Language &Thought, Imagination, Theories of thinking**,** Problem Solving, Reasoning, Decision Making & Creative thinking with classroom implication. [10]

Cognition & Meta-cognition: Factor & Process theories, Abilities & achievement- concept & Role of Emotional Intelligence, Classroom implication of Gardner's Multiple Intelligence Theory, Meta-cognition-Concept & Implication. [12]

Personality Approaches of personality- Psychoanalytic, Neo-Freudian, Social Learning, Trait & Type, Cognitive, Existential & Humanistic**,** Personality Assessment- Projective, psychometric & Behavioral measure. [14]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology*. Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan.* Motilal Banarasi Das, Varanasi.

PL 522 Applied Psychology-II 4-0-0-4

Industrial and Organizational Psychology: Principles and dynamics of organizational behavior; Motivation, Job satisfaction, models of leadership, work enviorment, personnel psychology, engineering psychology, role of industrial and organizational psychologists. [12]

Consumer Psychology: Nature and functions, consumer decision making, Black Box model of consumer behavior, factors affecting consumer decision making, e-shopping, virtual mall, Different modes of advertisement, Role of psychological factors in making advertisement**.** [10]

Clinical Psychology: concept of normality and abnormality, characteristic of abnormal behavior, causes of psychopathology, various psychopathological disorders; neurosis, psychosis, assessment and treatment; psychoanalytic, behavioural, cognitive. [12]

Forensic and Law Psychology: Introduction and Historical Perspective, Fields of Forensic Psychology, Criminal Identification techniques, Psychology and judicial process, Eyewitness testimony, role of psychologist in legal judicial system, juvenile delinquency, ethical issues in forensic psychology, Police interrogation and false confession, Legal rights of inmates: Rights to treatment, Right to refuse treatment. [10]

Sports Psychology: What sports psychologists do, role of psychology in motivation, mental health, skills to enhance performance, sport injury and rehabilitation of athletes. [8]

Suggested Book:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. *Industrial Psychology*. Prentice Hall, Englewood Cliffs.
4. Misra, G. *Psychological Perspective on Stress and Health*. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. *Social Psychology*. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. *Psychology in Sports: A Contemporary Perspective*. Friends, New Delhi.

7. Singh, A. P. Vyavaharik Manovigyan. Abhishek Publication, Varanasi.
8. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
9. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publisher.

PL 532 Psychometrics and Statistics in Psychology 4-0-0-4

Psychometrics: Measurement in Psychology, History of psychological measurement & testing, Levels of Measurement; Scales, Functions of measurement, General problems of measurement. [10]

Test development: Meaning & Classification of psychological tests, Characteristics of a good test, Ethical issues in psychological testing, Uses and limitation of Psychological tests, General steps of test Construction; Item writing, Item analysis, reliability, validity & norms. [12]

Overview of descriptive statistics and probability: Overview of measures of Central tendency, variability, curves and graphs , Percentiles, percentile ranks and standard scores, Characteristics of normal distribution curve. [10]

Parametric statistics: t-test and ANOVA, Correlation and regression analysis. [10]

Non parametric statistics: Chi-square, Mann-Whitney U test, Rank-difference Method, Coefficient of Concordance, Kruskal –Wallis H test, Friedman test. [10]

Suggested Books:

1. Garrett, H. E. *Statistics in Psychology and Education*. Paragon International Publishers, New Delhi.
   McGuigan, F. J. *Experimental Psychology*. Prentice-Hall of India, New Delhi.
2. Broota, K. D. *Experimental Design in Behavioural Research*. Wiley Eastern, New Delhi.
3. Guilford, J. P., & Fruchter. *Fundamentals of statistics in Psychology and Education*. Kogakusha, Tokyo.
4. Kapil, H. K. *Sankhyiki Ke Mool Tatwa*. Vinod Pustak Mandir, Agra.
5. Anastasi, A. & Urbina, S. (1997). Psychological testing. N.D.: Pearson Education.
6. Singh, A.K. (2006). Tests, Measurements and Research Methods in Behavioural Sciences. Patna: Bharati Bhavan.

PL 542 Research Methodology 4-0-0-4

Research: Meaning and characteristics of research, Stages in Research, Types of Research and Meaning, types and methods of sampling. [8]

Problem and Hypothesis: Meaning and characteristic of a problem, Sources of stating up a problem, Types of problem, Meaning and characteristics of a good hypothesis, Formulating a hypothesis, Sources of hypothesis. [8]

Review of Literature: Purpose of the review, Sources of the review, Types of literature, Writing process of the literature review. [10]

Variables: Types of variables, Methods of measuring dependent variable, Approaches to manipulate variables**,** Techniques of controlling extraneous variables. [10]

Research Design: Meaning and purpose of research design, types of research design, between group and within group design. [10]

Research Report & Research Proposal: purpose, structure and style of writing a research report, preparing a research proposal. [6]

Suggested Books:

1. Guilord J.P. *Psychometric Method*. McGraw Hill. N.Y.
2. Guilford J.P. Fruchter's. *Fundamental Statistics in Psychology Education*. International McGraw Hill Publisher, New York.
3. Kerlinger, F.N. *Foundations of Behavioral Research*. ND : Surjeet.
4. Kothari, C.R. *Research Methodology, Methods and Techniques.* ND : Wiley Eastern Limited.
5. Broota; K.D. *Experimental Design in Behavioral Research*. Wiley Eastern. New Delhi.
6. Singh, A.K. Tests, *Measurements and Research Methods in Behavioural Sciences*.Patna: Bharati Bhavan.

PL 552 Practicum-II 0-0-8-4

Assignments are based on the courses PL 512 Advanced General Psychology-II, PL 522 Applied Psychology-I, PL 532 Psychometrics and Statistics in psychology, PL 542 Research Methodology and Field Study.

PL 562 Seminar-II 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 611 Peace Psychology 4-0-0-4

Introduction: Psychology of peace, Types of peace, Historical perspective of peace psychology, role of individual and society. [8]

Peace and Non-Violence: Indian perspective of peace**,** views of Buddha, Mahaveer, Gandhi, Values of non-corporation and Indian experience. [10]

Violence: what is violence, different types of violence as School, youth, domestic, cultural, structural, direct etc, causes of violence, impact of violence. Role of individual and society in reducing violence. [10]

Life Peace and Culture: role of peace education, colobration, humility and social values in promoting peace in individual and social living [12]

Psychology of specific conflicts and peace efforts: war ethics and Geneva convention, role of organizations promoting peace, accounts and challenges. [12]

Suggested Books:

1. Suryanarayan, N.V.S. Peace Psychology. Discovery Publishing House, Pvt. Ltd.
2. Christie, D. J., Wagner, R.V., and Winter, D.A., Peace, Conflict and Violence: Peace Psychology for the 21st century. Englewood Cliffs, N.J: Prentice Hall.
3. Aber, L.,Brown, J., and Henrich, C.Teaching Conflict Resolution: An Effective School based Approch to Violence Prevention. N.Y.:National Centre for Children for Poverty.

PL 621 Social Psychology 4-0-0-4

Social Psychology: Introduction to social psychology, definition, nature and scope of social Psychology, Methods of social Psychology: Experimental and Non-experimental. [10]

Social Per caption and Social Cognition: Meaning of social perception, Role of non verbal communication in social perception, Role of schemas, heuristics, automatic and controlled processing**,** Potential sources of error in social cognition. [12]

Attitudes: Meaning and Characteristics of attitudes**,** Attitude formation**,** Attitude change**,** Theories of attitude change; cognitive dissonance.

Interpersonal attraction: Meaning and nature of interpersonal [10] attraction, Internal and External determinants of attraction, Theories of attraction.

Stereotype, Prejudices and Discrimination: Meaning and nature [10] of prejudice**,** Formation of norms and prejudice**,** Techniques for countering its affects**,** Difference between prejudice, stereotype and discrimination.

[10]

Suggested Books:

1. Baron, R.A., Byrne, D. *Social Psychology* -Prentice-Hall.
2. Daniel, P, Cozby, P.C. *Social Psychology*, New York: CBS College Publishing Holt, Rinehart and Winston.
3. Lindzey, L., and Aronson, E..*The Handbook of Social Psychology* , Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S . *Social Psychology,* Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. *Handbook of Psychology* (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. *Social Psychology*-Tata McGraw Hill International Editions.
7. Penrod, S. *Social Psychology* ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K. *Samaj Manovigyan Ki Rooprekha*, NewDelhi: Moti Lal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O. *Social Psychology* - Pearson Education.

PL 631 Introduction to Guidance 4-0-0-4

Guidance: Historical Perspective**,** Objectives & Principles of guidance**,** Types of guidance-Educational, Career, Personal and Social. [6]

Guidance and School Education: Guidance and role of teacher, parents, Counsellor and school administration, facilitating learning through guidance. [10]

Pupil Personal Services: Orientation, Evaluation, Individual inventory service, Information service, counselling service, Placement and evaluation and research. [14]

Guidance and School curriculum: Meaning of curriculum, Why guidance and Curriculum is inseparable, role of counselor in curriculum planning, personalization of curriculum, guidance functions through the subject matter areas. [8]

Special Concern for Guidance: Guidance of special group of Children; Cognitive, Physical, Social and Emotional exceptionality**,** Guidance for Drug abuse, delinquent behavior, adult Sex abuse, spouse abuse ,child abuse, HIV, ADHD, Learning disability. [14]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
3. Jones. A.J., *Principal of Guidance*, McGraw Hill, N.Y.
4. Psricha, *Guidance and Counselling in Indian education*, New Delhi, NCERT.
5. Mayers, G.E., *Principles and Techinques of vocational Guidance*, McGraw Hill, N.Y.

PL 641 Introduction to Counselling Psychology 4-0-0-4

Definition and history of counselling: What is counselling, effectiveness of counsellor, ethical and legal aspects of counselling. Individual and Group counselling, Stages of group counselling. [10]

Counseling Process: External Conditions and preparation, Stages of counselling process. [12]

Rapport Building- Building counselling relationship, generic and specific skill for rapport building. [10]

Assessing the Problem: Purpose, component, types of problems, skills required by counsellor for assessing the problem. [10]

Goal Setting: Functions and types of goal, obstacles in setting specific goals, effect of goal setting , skills associated with goal setting. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.

3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). Therapeutic Psychology : Fundamentals of Counselling Psychotherapy. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) Career Counselling Techniques, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) Handbook Emotional and Behavioral Difficulties. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) Career Counselling a Developmental Approach, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 651 Practical of Guidance & Counselling Psychology 0-0-8-4

Assignments are based on the courses PL 631 Introduction to Guidance, PL 641Introduction to Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 661 Advanced Industrial Psychology 4-0-0-4

Introduction to industrial psychology: Definition, role, Nature and scope**,** Origin and History of industrial psychology**,** Contribution of Hugo Munsterberg, Taylor, Gilbreth and Alton Mayo. [10]

Job Analysis: Purpose, importance and uses of job analysis**,** Various methods of job analysis**,** Job design approaches and job enrichment [10]

Recruitment and selection: Purpose and importance of recruitment and selection**,** Recruitment process; external and internal**,** Stages in selection process**,** Selection methods. [10]

Personnel Training: Nature and principals of training**,** Assessing training needs**,** Training methods; on-the job training, of the job apprenticeship, business games, Evaluation of training programme. [10]

Performance appraisal system: Purpose, importance, Uses of Performance appraisal**,** Methods of evaluating Performance appraisal; traditional methods, 360 degree appraisal and management by objectives**,** Issues and biases related to Performance appraisal. [12]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975. *Industrial Psychology*, Prentice Hall, 6th Ed.
2. Glimer. *Industrial Psychology*.
3. Ghiseli and Brown. *Personnel and Industrial Psychology*.
4. Dunnette, M.D. Handbook of Industrial and Organizational Psychology.
5. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
6. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
7. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co

PL 671 Dynamics of Organization Behaviour-I 4-0-0-4

Introduction: Meaning and Importance of OB, Historical overview; Classical and Neo-classical**,** Approaches of OB; contingency and system approach. [10]

Motivation in Organization: Needs theories of motivation**,** Equity theories of motivation**,** Job Design and work motivation**,** Determinants of job satisfaction**,** Organizational commitment, citizenship behavior and organizational justice. [10]

Leadership: Trait Theories, Behavioural Theories, Contingency theories: Fiedler Modal and situational leadership Theory; Path Goal theory, Inspirational Approaches to leadership: Charismatic Leadership; Transformational Leaders**,** Authentic Leadership: Ethic and trust are the foundation of leadership**,** Contemporary Leadership Roles: Mentoring, self Leadership, E-Age. [12]

Organizational Communication: Meaning and functions**,** Directions of communication in organization**,** Directions and methods of improving communications**,** Barriers of effective communication. [10]

Decision Making: Nature of decision Making, Behavioural decision

making: decision rationality, models, decision making techniques: [10] traditional and Modern Participation technique.

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour,* Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
8. Nelson, D.B. and Quick J.C. (2005) *Understanding Organizational Behavior.* South Western Thomson Learning.

PL 681 Practical of Industrial & Organizational Psychology-I 0-0-8-4

Assignments are based on the courses PL 661 Advanced Industrial Psychology, PL 671 Dynamics of Organizational Behaviour-I. That also accompany by field visit, and practical's related to compulsory papers.

PL 691Synopsis 0-0-0-2

The student has to submit two copies of a research proposal by first week of November in the department. It will be followed by presentation for approval.

PL 612 Positive Psychology 4-0-0-4

Introduction to Positive Psychology: Positive Psychology; Goals & Definition, Western & Eastern view of Positive Psychology, Classification and measurement of Human Strengths & Positive outcomes**,** Developing Strength and living well. [10]

Positive Emotional states and processes: Pleasure, positive effect, Happiness & Wellbeing, Emotional intelligence**,** Living well across life stages. [10]

Positive cognitive states and processes: Self efficacy and self acceptance, wisdom, optimism & hope, Mindfulness and flow. [10]

Pro-social behavior and well-being: Empathy, altruism, gratitude, Forgiveness, attachment, Positive experiences in school life. [10]

Spirituality and Positive Psychology: Creativity, giftedness and industry, Religion & spirituality, Emotional and social intelligence. [12]

Suggested Books:

1. Snyder, C.R. & Lopez, S.J., *Positive Psychology*. New Delhi: Sage.
2. Snyder, C.R. & Lopez, S.J., Handbook of Positive Psychology. N.Y.Oxford.
3. Wong.P.T. & Fry. The Human Quest for meaning. Mahwah, New Jersey. Lawrence, Erlbum.
4. Baumgardner, S. & Crothers, M. Positive Psychology, New Delhi, Pearson Education.

PL 622 Health Psychology 4-0-0-4

Physical and Mental Health: what is health, what is physical and mental health, relationship between physical and mental health, different dimensions of mental health, concept of psychological health in india, the development of changed outlook in nature of health and illness, scope of health psychology [10]

Eating Behaviour: what is healthy diet, how does diet affect health, models of eating behavior, weight concern and eating behavior, dieting, overeating, under eating, Body dissatisfaction, causes of body dissatisfaction, obesity; role of psychological factors in obesity, relation of obesity with coronary heart diseases, diabetes and other health problems. [12]

Exercise: what is exercise, why exercise, different forms of exercise including yoga, meditation, pranayam, aerobics etc., physical and psychological benefits of exercise, Relation of exercise with mood, depression, pleasure and good health. [10]

Sex and women's health issues: sex as biological for reproduction, sex as a risk and pregnancy avoidance, use of contraception, sex as a risk to health in context of STDs/HIV and AIDS, Sex education. [10]

Health behaviour and Primary prevention: What is health bhaviour, Barriers to effective health promotion. Factors influencing the practice of health behavior, Modification of health behavior. Changing health behaviours by changing health beliefs, Changing health behaviours through social engineering. [10]

Suggested Books:

1. Ogden, Jane. *Health Psychology*.Mcgraw Hill Education, India.
2. Brannon, Linda. Introduction to Health Psychology, Australia: Thomson, Wadsworth.
3. Baum, A. Revenson, T.A. and Singer, J.E. Handbook of Health Psychology, New Jersey: Lawrence Erlbaum.
4. Dimatteo, M.R., and Martin, L.R. *Health Psychology*. Boston: Allyn and Bacon.
5. Marks, D., Murray, M., Evans, B. and Willing,C. *Health Psychology: Theory, research and practice*. New Delhi: Sage.

PL 632 Intervention in Guidance & Counselling 4-0-0-4

Psychoanalytical Approach: Classical psychoanalytic theory, view of human nature, role of counsellor, goals and techniques of psychoanalytic approach. [10]

Cognitive Approach: Back's cognitive therapy and ELLIs Rational Emotive theory, Transactional analysis. [10]

Gestalt Approach: Fritz Perls therapy, goal, view of human nature and techniques of gestalt therapy. [10]

Behavioural Approach: Techniques based on classical and operant conditioning for behavior modification: systematic desensitization, flooding, shaping, aversion, punishment, assertive training etc. [12]

Humanistic & Existential Approach: Carl Rogers Clint centered therapy, Rollo May and Victor Frankls therapy. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.
3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). Therapeutic Psychology : Fundamentals of Counselling Psychotherapy. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) Career Counselling Techniques, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) Handbook Emotional and Behavioral Difficulties. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) Career Counselling a Developmental Approach, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 642 Areas of Counselling Psychology 4-0-0-4

School Counselling: Developmental, Preventive and curative aspects of counselling at elementary, middle and secondary school, role of counselling in promoting academic excellence and personality development of the students. [10]

Career Counselling: Career as a way of life, concept of career choice, measurement of career choices, role of personality, interest and values in career choice, major theories of career counselling: Holland theory. [10]

Crisis Intervention counselling: Introduction, types of crisis, typical response to crisis, process and principles for crisis intervention. [10]

Counselling across the life span: Counselling before planning the pregnancy, during and after the pregnancy, counselling for parents, child and adolescent counselling, counselling for adults and old-age people. [12]

Emerging fields and trends in Counselling: Multi-cultural, homosexual, marriage, rehabilitation, mental health, substance abuse, [10]

HIV and Health counselling, computers, feminist prospective, group work etc.

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). *Introduction to Counselling*. W.G. : Brown Publishers.
3. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy* : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) *Career Counselling Techniques*, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) *Career Counselling a Developmental Approach*, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 652 Practical of Guidance & Counselling-II 0-0-8-4

Assignments are based on the courses PL 632 Interventions in Guidance & Counselling, PL 642 Areas of Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 662 Engineering Psychology 4-0-0-4

Human engineering: Scope and origin of engineering psychology**,** Importance of engineering psychology**,** Aim of engineering psychology. [10]

Man-machine system: Meaning of man-machine system**,** Design, display, control and action**,** Application of man-machine system. [10]

Working Conditions: Concept of efficiency and Work curve**,** Physical enviorment; noise, illumination, atmospheric conditions, music, rest pauses**,** Working conditions and performance. [10]

Accidents and Safety: Definition of accident, risk taking behavior and accident proneness**,** Human and economics cost of accidents**,** Causes of accidents**,** Individual, situational, organizational factors related to accident reduction; safety measures. [12]

Work and Fatigue: Concept of work and fatigue**,** Work schedule**,** Methods of design**,** Monotony and boredom, Way to reduce monotony and boredom. Industrial morale. [10]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975.*Industrial Psychology*, Prentice Hall, 6th Ed.
2. McCormick D.J. 1976. *Human Factors Engineering and Design*. McGraw Hill 4th Edition.
3. Glimer. *Industrial Psychology*.
4. Ghiseli and Brown. *Personnel and Industrial Psychology*.
5. Dunnette, M.D. *Handbook of Industrial and Organizational Psychology.*
6. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
7. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
8. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co.

PL 672 Dynamics of Organizational Behaviour-II 4-0-0-4

Organizational Structure: Meaning and issues in organizational structure**,** Work specialization, departmentalization, chain of command, span of control, centralization v/s Decentralization**,** Traditional organizational structure; The team structure, the virtual organization, the boundary less organization. [12]

Organizational culture: Organizational culture meaning and definition and related concepts**,** Perspective and topologies of organizational culture**,** Creating and sustaining culture. [10]

Organizational Change and development: Nature and perspective of change**,** Levels of change, structure, technology and leadership**,** Types of change; organizational change as growth, transformation and as turn [10]

around, Resistance to change, Strategies to overcome resistance to change, Nature and importance of organizational development, Role, values and ethics of organizational development practitioners.

Group Dynamics: Meaning, nature and types of group, concept of group dynamics and theories of group formation, group role, norms, decision making. Group cohesiveness and group conformity. [10]

Conflict and stress: Meaning and types of conflict, Interpersonal and Intergroup conflict, Work-family conflict, Strategies for conflict resolution, Work stress; sources, consequences, managing stress: individual and organizational coping strategies. [10]

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour*, Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
5. Nelson, D.B. and Quick J.C. (2005) Understanding Organizational Behavior (2nd Edition) South Western Thomson Learning.

PL 682 Practical of Industrial & Organizational Psychology -II 0-0-8-4

Assignments are based on the courses PL 662 Engineering Psychology, PL 672 Dynamics of Organizational Behaviour-II. That also accompany by field visit, and practical's related to compulsory papers

PL 692 Dissertation 0-0-0-4

The student has to submit two copies of dissertation by the first week of May in the department. It will be followed by presentation and viva-voce.

MA English 2017-2018
M. A. (English)

EL 551 Modern English Grammar and Usage 4-0-0-4

Basic Sentence Types: Subject, Predicate, Object, Adjunct	[10]
Coordination and Subordination: Simple Sentence and Complex Sentence	[6]
Different Concepts and Notions: Request, Order, Question, Condition, Purpose, Suggestion, Wish, Hope, Intention, Obligation, Contrast, Commission	[7]
Theme Writing: Development of thoughts, Consistency in writing, Vocabulary	[6]
Fallacies	[6]
Literary Appreciation	[5]
Précis Writing	[5]
Critical Reading Skills	[7]

Suggested Readings:

1. A.S. Hornby: A Guide to Patterns and Usage, (Oxford 1984).
2. CIEFL - Material on Morphology and Phonology from the Distance Education Dept.1992.
3. George Yule: The Study of Language, CUP (ELBS, 2002)
4. Geoffery Leech: English Grammar for Today (Longman, 2004)
5. Praveen K Thaker: Appreciating English Poetry: A Practical Course and Anthology, Orient Lognman,1999
6. Effective English Communication, Krishna Mohan and Meenakshi Rama, Tata McGraw Hill, 2001.
7. Spoken English, V. Sasi Kumar and P.V. Dhamija, Tata McGraw Hill, 2001.

EL 513 Middle Ages to the Seventeenth Century English Literature-I 4-0-0-4

Geoffrey Chaucer: General Prologue to the Canterbury Tales	[10]
Christopher Marlowe: Doctor Faustus	[8]
William Shakespeare: As You Like It, King Lear	[10]
Francis Bacon: Of Envy, Of Love, Of Adversity	[6]
John Donne: The Extasie, The Relique, The Flea	[7]
John Milton: Paradise Lost, Book I	[11]

Suggested Readings:

1.Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd, 1995.
2.Daiches, David: A Critical History of English Literature (vol. I), Delhi, Allied Publishers, 1998.

EL 571 Eighteenth Century to the Twentieth Century English Literature-I 4-0-0-4

John Dryden: Absalom and Achitophel	[9]
Jonathan Swift: The Battle of the Books	[4]
Alexander Pope: The Rape of the Lock	[9]
William Wordsworth: The Prelude, Book I	[8]
S.T. Coleridge : The Rime of Ancient Mariner	[4]
Percy Byssey Shelley: Adonais	[4]
Robert Browning: My Last Duchess	[5]
Gerard Manley Hopkins: The Windhover, Felix Randal.	[5]
Thomas Stearns Eliot: The Four Quarters	[4]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5.A,R, Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.1994.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.1964.

EL 523 American Literature 4-0-0-4

Ralph Waldo Emerson: The American Scholar	[4]
Walt Whitman: Crossing Brooklyn Ferry, Passage to India, I Hear It Charged Against Me	[8]
Sojourner Truth : Ar‟n‟t I a Woman?- Speech to the Women‟s Rights Convention in Akron, Ohio, 1851	[4]
Robert Frost: Birches, Mending Wall	[6]
Wallace Stevens : Thirteen Ways of looking at a Blackbird	[4]
Eugene O'Neill: Emperor Jones	[8]
N. Hawthorne: The Scarlet Letter	[8]
Tony Morrison: The Bluest Eye	[10]

Suggested Readings:

1.Bloom, Harold. ed. EuqueneO‟neill. New York, Chelsea, 1987.
2.Bentley, Eric. in Search of Theatre. New York, Knop, 1953.
3.Baqohee, Shymal. ed. Perspectives on O‟Neil:New Essays. New york:University of Victoria,1988
4.Lewis, Allan. American Plays and Playwrights of the Contemporary Theatre. New York:Crown, 1965.
5.Mukharjee, Sujit, and D.V.K. Raghara-Charyulu eds. Indian Essays in American Literature. 1969.
6.Ford, Boris. ed. The New Pelican Guide to English Literature, Vol. 9.1994.
7. Morrison, Toni. Playing in the Dark, I Chapter.2004.
8. Robert Spiller: Literary History of the United States, (Amerind Publishing Co.2006)
9.Marcus Cunliffe : American Literature to 1900, (Sphere Reference)
10.F.O.Matthiessen. American Renaissance, 1992.
11. George McMichel : Concise Anthology of American Literature.2000.
12. SD Palwekar, Literature and Environment:A Select Study of British, American and Indian Writings, Lambert Academic Publishing, Germany, 2012.

EL 591 Indian Writing in English 4-0-0-4

Raja Rao : Kanthapura	[8]
Anita Desai : Clear Light of Day	[8]
Salman Rushdie: Midnight‟s Children	[10]
A. K. Ramanujan : Is There an Indian Way of Thinking: An Informal Essay	[4]
Toru Dutt : Savitri- Part I	[4]
Nissim Ezekiel : "Goodbye Party for Ms Pushpa T.S., Background, Casually, Night of the Scorpion	[5]
JayantaMahapatra : Evening Landscape by the River, From Temple	[5]
Mahesh Dattani: Tara	[8]

Suggested Readings:

1. Ahmad, Aijaz. In Theory: Classes, Nations, Literatures.1994
2. Devy, G. N. After Amnesia: Tradition and Change in Indian Literary Criticism, 1992.
3. Gopal, Priyamvada. Indian English Novel: Nation,History and Narration, 2005.
4. Guha, Ranajit, ed. The Subaltern Studies Reader (Selected Essays), Delhi: OUP.2006
5. Iyenger, K. R. Srinivasa. Indian Writing in English.1998.
6. King, Bruce. Modern Indian Poetry in English.2002.
7. Khair, Tabish. Babu Fictions: Alienation in Contemporary Indian English Novels.2008.
8. Mukherjee, Meenakshi. The Twice Born Fiction, 2nd edn, 2001.
9. Naik, M. K. A History of Indian English Literature.2000.
10. Naik, M.K. and Shyamala A. Narayan. Indian English Literature 1980-2000: A Critical Survey. 2001.
11. Suleri, Sara. The Rhetoric of English India. 1992.
12. Vishwanathan, Gauri, Masks of Conquest: Literary Study and British Rule in India.1984.

EL 562 Introduction to Linguistics and Phonetics 4-0-0-4

Introduction: Linguistics and its Scope, Branches of Linguistics, Some Basic Concepts in Linguistics	[7]
Language and Communication, Language Variation and Language Change.	[6]
Phonetics and Phonology: Phoneme, Allophone, Human Speech Mechanism, Vowels and Consonants in English	[11]
Syllable structure, Supra-segmental features; GIE, Phonemic Transcription.	[14]
Morphology and Syntax; Morpheme, Word Formation Processes in English	[8]
IC Analysis, Phrase Structure Grammar, Transformation-Generative Grammar	[6]

Suggested Readings:

1.Abercrombie, D. Elements of General Phonetics (Edinburgh University Press, 1967).
2.Balasubramaniam, T. A Textbook of English Phonetics for Indian Students (Macmillan1981).
3.Chomsky, Noam. Aspects of the Theory of Syntax (Cambridge, Mass: MIT Press, 1965).
4.Crystal, David. Linguistics (Penguin, 1971).
5.Hockett, C.F. A Course on Modern Linguistics (New York: Macmillan, 1958).
6.Katamba, F. Morphology (Basingstoke: Macmillan, 1993).
7.Lyons J. 1968. Introduction to Theoretical Linguistics (CUP, 1981).
8.O'Connor, J.D. Phonetics (Penguin, 1973).
9.Robins, R.H. General Linguistics (Longman, 3rd Edition 1980).
10. Saussure, Ferdinand de. A Course in General Linguistics, Trans. Wade Baskin (New York: McGraw Hill), 1998.
11. Verma, S.K. and N. Krishnaswamy. Introduction to Modern Linguistics (OUP, 1993).

EL 572 Middle Ages to the Seventeenth Century English Literature-II 4-0-0-4

Geoffrey Chaucer: The Squire‟s Tale	[10]
Ben Jonson: Every Man in His Humour	[10]
Shakespeare: Othello	[7]
Edmund Spenser: Epithalamion	[8]
John Donne: Forbidding Mourning, Forbidding Weeping.	[6]
John Milton: Paradise Lost, Book II	[11]

Suggested Readings:

1. Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.1995.
2. Daiches, David:A Critical History of English Literature (vol. I), Delhi, Allied Publishers.1998.
3. Grose, M. W.: Chaucer: Literature in Perspective.2002.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Comedy.1988.
5. Rudram, Alan: A Critical Commentary on Milton‟s Paradise Lost.1978.

EL 582 Eighteenth Century to the Twentieth Century English Literature-II 4-0-0-4

William Collins: Ode to Simplicity, Ode to Music, Ode to Evening	[9]
Thomas Gray: Distant Prospects of Eton College, Death of a Favourite Cat, Elegy Written in a Country Churchyard	[11]
W. B. Yeats: When You Are Old, A Bronze Head, Lapis Lazuli, Sailing to Byzantium	[9]
W. H. Auden: Sir, No Man‟s Enemy, September 1, 1939, In Memory of W. B. Yeats	[11]
James Joyce: A Portrait of the Artist as a Young Man	[12]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5. A.R. Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.2004.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953.
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harvard University Press.1964.

EL 592 Creative and Technical Writing 4-0-0-4

Study of Literary Works in progress: Analysis of the Creative Writing Components (Poem, Novel, Short Story, Drama, Diary)	[8]
Craft of poetry: Subject matter, theme, rhythm, metre, stanza forms, sub-genres of Poetry	[8]
Fundamental Norms of Writing	[5]
Tools of Technical Writing: Feature Writing and Technical Writing	[5]
Editing & Proof Reading	[5]
Business Correspondence	[5]
Writing for various media: Learning to write scripts for Publishers and Copy Writing, Writing for Radio, Theatre, Television and Films	[8]
Assignment in Creative Writing: Poetry/Fiction/Drama	[8]

Suggested Readings:

1.Corbeff, Edward P. J. The little Rhetorica, Handbook. New York; John Wiley Sons, (1977).
2.Watkins, F. C. and Knight, K. E. Write to Write: Readings on the Craft of Writing. Bouston, HoughtounMifelin, (1966).
3.Mullins, Carolyne J. A Guide to writing and Publishing, New York; John Wiley & Sons, (1987).
4.The Writer‟s Manual, Califirnia; ETC Publications, (1977)
5. Baker, Sheridial. The Practical Stylistics, New York; Harper and Raw, (1977).
6. Vrooman Alan. Good writing An informal Mannual of Style. Athemeum: New York, 1972
7. Belcher, Diane D. (ED.) English for Specific Purposes in Theory and Practice. (University of Michigan Press, 2009).

EL 592 Comparative Literature 4-0-0-4

History of Development of Schools of Comparative Literature (French, American, British & Indian)	[8]
Influence and Reception Study	[8]
Genology, Literary History (Period and Movement Study)	[5]
Thematology	[5]
Comparative Literature and Intercultural Studies	[5]
Comparative Literature and Other Disciplines	[5]
The Future of Comparative Literature	[8]
Assignment in Comparative Literature	[8]

Suggested Readings:

1.Jost, Francois, Introduction to Comparative Literature. (Penguin, 2002).
2.Prawer, S.S. Comparative Literary Studies: An Introduction. (Allied, 1999).
3.Brandt, Corstius J. Introduction to the Comparative Study of Literature. (OUP, 2002).
4.Wellek,Rane & Warren, Austin. Theory of Literature. (OUP, 1998).
5.Weisstein, Ulrich (Ed.) Comparative Literature and Literary Theory: Survey and Introduction, Cambridge, 2002.
6.Susan Bassanett. Comparative Literature: Introduction, (Routledge, 2002).
7.Nagendra, Comparative Literature. Delhi, University of Delhi, OUP, 2004.

EL 661 Principles of Criticism-I 4-0-0-4

Aristotle: Poetics	[9]
Horace: Ars Poetica	[6]
John Dryden: Essay on Dramatic Poesy	[6]
Alexander Pope: Essay on Criticism	[4]
Dr. Samuel Johnson: Preface to Shakespeare	[5]
Samuel Taylor Coleridge: Biographia Literaria	[8]
Thomas Love Peacock: Four Ages of Poetry	[8]
T. S. Eliot: Metaphysical Poets	[6]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. "The Genetic-Structuralist Method in the History of Literature".
4. Gramsci, Antonio. "Hegemony".1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. "Crisis in Orientalism". 1987.
8. Sedgwick, Eve Kosofsky. "Introduction: Axiomatic" from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984.
10. Thiong'o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 671 Literature and Society-I 4-0-0-4

The Middle English Period: Norman Conquest of England	[5]
Manorial System of the Normans	[4]
Crusades in the Middle Ages	[4]
Hundred Years War	[4]
Social Life of England	[4]
England in the Sixteenth to the Eighteenth Century: Reformation and Renaissance in England	[6]
University Wits, Social Life in the Age of Milton	[5]
Puritan Revolution, Glorious Revolution of 1688	[4]
Industrial Revolution	[4]
Main Literary Trends in Poetry and Drama	[4]
Emergence of Novel	[4]
Humanism	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, Gale publication, 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2004.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism, Blackwell, 2013
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2000.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 681 Commonwealth Literature-I 4-0-0-4

Dom Moraes: A Letter	[5]
Gopal Honnalgere: The Donkeys	[5]
Kenneth Slessor: Country Towns	[5]
A.D. Hope: Australia	[5]
Les Murray: The Wilderness	[6]
Gabriel Okara: Were I to Choose	[5]
David Rubadiri: A Negro Labourer in Liverpool	[5]
Wole Soyinka: Death and the King's Horseman	[5]
Ngugi' wa Thiong'O:A Grain of Wheat	[6]
Chinua Achebe: Things Fall Apart	[5]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).
4. Césaire, Aimé. Discourse on Colonialism (1950).
5. Fanon, Frantz. The Wretched of the Earth (1961).
6. Gilbert, Helen and Joanne Tompkins. Post-Colonial Drama: Theory, Practice, Politics (London: Routledge, 1996).
7. Memmi, Albert. The Colonizer and the Colonized (1965).
8. Rushdie, Salman. Imaginary Homelands: Essays and Criticism,1981-1991 (London: Granta, 1991).
9. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
10. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984
11. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 691 Translation Studies 4-0-0-4

Concept of Translation in the West and in the Indian Tradition	[7]
Types of translation – intra-lingual and inter-semiotic; „word for word‟ or „sense for sense‟; decoding and recoding	[7]
Equivalence – linguistic and cultural; formal and dynamic; Equivalent Effect	[5]
Language and Culture	[5]
Translators' Invisibility – Domestication and Foreignization	[5]
Self-translation (Auto Translation), Transcreation	[5]
Translation of an actual text: a short story / excerpts from a novel or play / poems	[5]
Philosophical Theories of Translation – Steiner‟s Hermeneutic Motion; Ezra Pound and the Energy of Language; The Task of the translator; Walter Benjamin; Deconstruction	[5]
Literary Translation in Nineteenth Century India	[4]
Postcolonial Translation Theory	[4]

Suggested Readings:

1.Bassnett, Susan. Translation Studies (Revised ed 2000).
2.Catford, J.C. A Linguistic Theory of Translation.2002
3.Mukherjee, Sujit. Translation as Discovery and Other Essays, and Translation as Recovery.2004
4.Susan Bassnett and Harish Trivedi, eds. Post-Colonial Translation: Theory and Practice (London & New York: Routledge, 1999).
5.Venuti, Lawrence. Translation‟s Invisibility: A History of Translation.2009.

EL 613 Indian Writing in Translation 4-0-0-4

Munshi Premchand: Godan	[10]
Mohan Rakesh: Aadhe Adhure	[8]
U. R. Ananthamurthy: Samskara	[8]
Saadat Hasan Manto: Toba Tek Singh	[5]
Mahasweta Devi: Draupadi	[5]
Vijay Tendulkar: Kanyadan	[8]
Baby Kamble: The Prisons We Broke	[8]

Suggested Readings:

1. A.K. Mehrotra, The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008.
2. The Norton Anthology of World Literature. Volume F, 2009.
3. P.France, The Oxford Guide to Literature in English Translation (Oxford, 2000).
4. E Grossman, Why Translation Matters, Orient black swan Pvt. Ltd, 2007.
5. The Oxford India Premchand. OUP:Delhi, 1999.
6. Ananthmurthy. Samskara. OUP: Delhi.2000.
7. Collected Stories of Saadat Hasan Manto.2003.
8. Draupadi. Translated by Gayatri Spivak, 2001.
9. Baby Kamble. The Prisons We Broke. Orient Blackswan, Hyderabad.2004.
10. Tendulkar, Vijay. Kanyadaan. Trans. Gouri Ramnarayan. Delhi: Oxford U P, 1996

EL 623 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Autumn Semester of Second year shall be between 5,000 words and 8,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

EL 662 Principles of Criticism-II 4-0-0-4

Northrop Frye : The Archetypes of Literature	[8]
Ferdinand de Saussure : The Object of Study	[8]
Jacques Derrida : Structure, Sign and Play in the Discourse of the Human Sciences	[8]
Elaine Showalter: Towards a Feminist Poetics	[4]
Jean-François Lyotard : Answering the Question: What is Postmodernism?	[5]
Michel Foucault : What is an Author?	[5]
Roland Barthes : From Work to Text	[4]
Homi K. Bhabha : Cultural Diversity and Cultural Difference	[5]
Jacques Lacan : The Agency of the Letter in the Unconscious or Reason since Freud	[5]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. “The Genetic-Structuralist Method in the History of Literature”.
4. Gramsci, Antonio. “Hegemony”.1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. “Crisis in Orientalism”. 1987.
8. Sedgwick, Eve Kosofsky. “Introduction: Axiomatic” from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
10. Thiong‘o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 672 Literature and Society-II 4-0-0-4

England in the Nineteenth Century: Social and Religious tendencies of the Victorian Age	[6]
Oxford Movement	[5]
Feminist Movement	[5]
The Naughty Nineties	[5]
England in the Twentieth Century: Social and Literary Tendencies of the Early Twentieth Century	[5]
Emergence of the Labour Party	[5]
The Rise of the Problem Plays	[4]
The Stream of Consciousness Technique in Fiction	[5]
Main Trends in Poetry, Drama and Fiction	[8]
Cultural Studies	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, gale publication , 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2002.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism , Blackwell, 2004.
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2003.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 682 Commonwealth Literature-II 4-0-0-4

George Frederick Cameron: The Future	[5]
J. M. Smith: Ode on the Death of William Butler Yeats	[5]
Margaret Atwood: Journey to the Interior	[5]
Edward Brathwaite: Tizzic	[5]
Edwin Thumboo: Gods Can Die	[5]
Yasmine Goooneratne: There was a Country	[5]
Katherine Mansfield: The Man with the Wooden Leg	[4]
Pankaj Mishra: The Romantics	[9]
Kiran Desai: The Inheritance of Loss	[9]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).

1991).
4. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
5. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
6. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 692 Women Studies 4-0-0-4

Rokeya Sakhawat Hussain: Sultana‟s Dream	[8]
Katherine Mansfield: A Cup of Tea	[6]
Charlotte Perkins Gilman: If I were a Man	[6]
Ernest Hemingway: The Short Happy Life of Francis Macomber	[6]
Coventry Patmore: Angel in the House	[6]
Imtiaz Dharker: Purdah, Battle Line, She Must Be From Another Country	[6]
Virginia Woolf: A Room of One‟s Own	[6]
Suniti Namjoshi: The Mothers of Maya Diip	[8]

Suggested Readings:

1. Butler, Judith. Gender Trouble (1990).
2. de Beauvoir, Simone. The Second Sex (1949).
3. Freidan, Betty. The Feminine Mystique (1963).
4. Gardener, Judith Kegan, ed. Masculinity Studies and Feminist Theory: New Directions (Columbia University Press, 2002).
5. Greer, Germaine. The Female Eunuch (1970).
6. Lal, Malashri. The Law of the Threshold (Shimla: Indian Institute of Advanced Study, 1995)
7. Mill, John Stuart. The Subjection of Woman (1869).
8. Sedgwick, Eve Kosofsky. Gender Criticism: What Isn‟t Gender.2002.
9.Tharu, Susie and K.S. Lalita, eds. Introduction Women Writing in India (New Delhi: O.U.P., 1993)
10. Wolf, Naomi. The Beauty Myth (1991).
11. Wollstonecraft, Mary. A Vindication of the Rights of Woman (1792).
12. Woolf, Virginia. Shakespeare‟s Sister from A Room of One‟s Own (1929).

EL 614 World Literature(s) 4-0-0-4

Ibsen: A Doll‟s House	[8]
Brecht: Mother Courage	[8]
Dario Fo: Accidental Death of an Anarchist	[7]
Rabindranath Tagore: Gitanjali	[7]
Albert Camus: The Outsider	[8]
Pablo Neruda: Everyday You Play, I‟m Explaining a Few Things, Ode to a Tomato	[7]

Rainer Maria Rilke: Fear of the Inexplicable, Falling Stars, You Who Never Arrived [7]

Suggested Readings:

1. Kahns, Richards. Tragedy: Contradictions and Repression. Chicago: Chicago University Press, 1993.
2. Ellmann, Richard (ed.). The Modern Tradition: Backgrounds of Modern Literature. New York: Oxford University Press, 1992.
3. Parkar, Emmett. Albert Camus: the Artist in the Arena. New York: Routledge and Kegan Paul, 1965.
4. Northam, John. Ibsen: A Critical Study. London: Everyman, 1970.
5. Hirst, David. Dario Fo and Franca Rame. Hampshire: Macmillan, 1989.
6. Bloom, Harold. Modern Critical Views: Gabriel Garcia Marquez. New York: Chelsea House Publishers, 1989.
7. Metzger, Erika A. & Metzger, Michael M. (eds.). A Companion to the Works of Rainer Maria Rilke (Studies in German Literature Linguistics and Culture). New York: Camden House, 2004.
8. Raymond Williams. Drama from Ibsen to Brecht. London: Chatto and Windus,1968.

EL624 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Spring Semester of Second year shall be between 8,000 words and 10,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The Dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

Session 2018-2019

BJMC 2018-2019

JM 111 **Introduction To Communication & Media (A)** **3-0-0-3**

Communication & Media: Definition, meaning & concept, Different types of communication: Verbal and written, Scope and Process of Communication, Mass Communication: Concept & Characteristics.	[10]
History of Mass Media: Mass Media: Meaning & Concept, Introduction to Indian Press, Brief account of the origin and development of newspaper and magazine in India, History of the development of electronic media in India: Radio & TV.	[10]
Mass media & Mass Culture: Role, objectives functions & achievements of Mass Media, Relation between Mass Media and Mass Culture and their development, Media as fourth pillar of democracy, Mass Media in Rural-Urban divide.	[10]
Media, Market and Technology: Changing trends of Mass Communication under the process of globalization, Private and Public Media,Technology in the development of Media, Media and Market: Nature, Relation & Expansion.	[9]

Text Book:

1. Kumar, Kewal J, Mass Communication in India, Jaico Books, New Delhi

Reference Books:

1. J.S. Yadava & Pradeep Mathur, Issues in Mass Communication: The Basic Concepts, Kanishka Publishers, Delhi
2. Shymali Bhattacharjee., Media and Mass Communication: An Introduction, Kanishka Publishers, Delhi

JM 121 **3-0-0-3**

Introduction to Journalism (A)

Introduction to News: News: Meaning & definition, Sources and elements of news, Characteristics of news, Different styles of news writing, Headline: Importance & types.	[9]
Different Types of writing: Writing for newspaper and magazines-Nature & Difference, Feature writing: Meaning, definition & nature, Editorial: Importance & art of writing, Writing column, Reportage, analysis etc.	[10]
Reporting for Print Media: Definition, scope, concept & principles of news reporting, Types & techniques of news reporting, Functions of reporting: Interview, collection of data, research, Qualities & Responsibilities of a reporter, Introduction to different types of reporting: Investigative, Cultural, Political, Seminar & civic issues.	[10]
Editing for Print Media: Theories and Principles of Editing, Preparing good copies for Newspaper, Magazine & others, Introduction to editing symbol, proof reading symbols & Copy desk, Role, functions and responsibilities of Copy editor	[10]

Text Books:

1. Natrajan J, History of Indian Journalism, Publications Division, Ministry of Information & Broadcasting, Govt. of India, 1997
2. Ambrish Saxena., Fundamentals of Reporting & Editing, Kanishka Publishers, Delhi,

Reference Books:

1. Parthasarthy, Rangaswami., Journalism in India, Sterling Publishers Pvt. Ltd., New Delhi,
2. Aruna Zachariah., Print Media, Communication and Management : Elements, Dimensions and Images, Kanishka Publishers, Delhi
3. George A. Hough., News Writing, Kanishka Publishers, Delhi
4. Suhas Chakravarty.,News Reporting & Editing : An Overview, Kanishka Publishers, Delhi,
5. Wynford Hicks.,Writing for Journalist, Routledge, London

JM 131 **Writing For Media** **3-0-0-3**

Writing News for Newspaper: Hard News vs. Soft News, 5W's & 1H Formula, Basic components of a news story- Brevity, Dateline, Credit Line, Byline. [10]

Newspaper Writing: News writing vs. Opinion writing, Reading and reviewing Newspapers and Magazine. [09]

Feature Writing: Human interest, Backgrounder, Sports, Entertainment feature writing. Editorial, Article writing. [10]

Writing for Electronoc Media: Format of TV news writing. Writing for Radio & TV- Interviews, news, discussion. [10]

Text Books:

1. Bruce D. Itule and Douglas A. Anderson. *News writing and reporting for today's media;* McGraw Hill Publication, 2000.
2. George Rodmann. *Mass Media in a Changing World*; Mcgraw Hill Publication,2007.

Refrence Books:

1. Richard Keeble. *The Newspaper's Handbook*; Routledge Publication,2006.

JM 141 **Project & Presentation for Print** **3-0-0-3**

Themes for the Project: Newspaper & Magazine. Critical and analytical review of issues and trend in Media, Collection of information and data relating to the topic and analysis of the same. [10]

Steps of Project Report: Selection of the topic, Suitability of the topic, Relevance of the topic, comparative study of the topic. [06]

Presentation: Make a presentation based on project followed by question answer session. [10]

JM 151 **News & Contemporary Issues** **3-0-0-3**

National News: Daily national news, Background to the news items, Important bills, acts and Constitutional amendments passed by Indian Parliament, Important Supreme Court rulings. [10]

International News: Daily international news, Background to the daily news Thumbnail sketches of chief personalities figuring in current news reports Relevance of these reports to India and the world community or why they are considered to be important, Important actions taken under the UN umbrella, Regions of conflict in the world [09]

Economic News: Regional economic groupings of the world and their functioning, The European Union and its expansion, The World Bank [10]

The Asian Development Bank, World Economic Forum, Profile of the Indian economy (industry, agriculture, infrastructure, growth rates, world ranking, role of planning, budgets and government policies), The world's top 10 economies

Issues for Discussion: Globalisation, The environment, US dominated world order – politically, culturally and economically, Parliamentary versus Presidential government, Indian Constitution – does it need a change? Naxalism and Marxism, Clash of civilizations, Should the nuclear club remain exclusive? Criminalisation of politics, Reservation, Restructuring the UN [10]

Refrences:

1. Daily News Paper & Magazine.
2. Prime time TV News Bulletin

JM 161 **Practical- Computer Application for Mass Media** **2-0-0-2**

Exercises and Assignment: PageMaker/Quark express
Describe DTP softwares used for design and layout.
Design and create layout using DTP softwares.
Design a visiting card, postcard, poster, brochure.
Design a magazine.
Prepare front page of newspaper.

JM 112 **Theory of communication (A)** **3-0-0-3**

Communication: Definition, meaning, concept, elements, process, functions and scope, Types and forms of communication, Barriers to communication, 7 C's of communication. [10]

Communication theory: Need & importance, Two Step and Multi Step Theory, Hypodermic needle theory. [10]

Communication model: Need & importance, SMCR Model, Shannon and Weaver Model, Harold D. Lasswell Model. [09]

Normative Theory and Seibert Theory of Communication: Authoritarian Theory, Libertarian Theory Social Responsibility Theory, Developmental Theory, Democratic Participant Theory. [10]

Text Book:

1. De Fleur, M ,Theories of Mass Communication, 2nd Edition, New York; David Mc Kay

Reference Books:

1. Dan Laughey Key ,Themes in Media Theories, Rawat Publication.
2. Taylor, Rosegrant, Meyrs Communicating, Prentice Hall
3. Allan and Barbara Pease, The Definitive Book of Body Language, Munjal Publishing House
4. D.M. Silviera, Personal Growth Companion, Classic Publishing

JM 122 **3-0-0-3**

Writing for media (A)

Essentials of Good Writing: Art of Writing, Kinds of Media Writing: Inform, Describe & Persuade, The ABCD of Media Writing: Accuracy, Brevity, Clarity & Discernment. [10]

Writing for Print Media: Basic principles of writing for print, Elements and Importance of News writing, Steps & elements of writing : editorial, features & review. [09]

Writing for Electronic Media: Basic principles of writing for electronic media: Radio & TV, Elements and Importance of News writing for Radio & TV, Steps & elements of writing for Radio & TV: editorial, features & review. [10]

Translation in Media: Concept & Definition of Translation, Nature & Norms of Translation, Types of Translation: Word to Word Translation, Literal Translation, Summarised Translation, The need and importance of Translation in Journalism, Guidelines for Translation. [10]

Text Books:

1. K.K. Rattu, Translation through media in New Millennium, Surubhi Publication, Jaipur.
2. Thomas S. Kane, Oxford Essentials Guide To Writing.

Reference Books:

1. Pal Rajenda and J.S Koriahalli. Essentials of English and Business Communication, S. Chand.
2. Robey, L Cora New Handbook of Basic Writing Skills, Hardcourt College Pb. Orlando.
3. Wren & Martin High School English Grammar & Composition, S.Chand.
4. George.A.,Hough News Writing , Kanishka press.
5. Robert Mc. Lesh, Radio Production , Focal Press.
6. Jitendra Gupt and Priyadarshan Patrakarita Mein Anuvaad, Radha Krishna Prakashan, N.Delhi.
7. Laxmikant Pandey, Translation, Objects and Methods.

JM 231 **Practical- Reporting & Editing (A)** **2-0-0-2**

Exercises and Assignment:

Basics of Reporting: principles of reporting, functions and responsibilities, reporting techniques.

JM 142 **News & Contemporary Issues - II** **3-0-0-3**

National News: Daily national news, Background to the news items, Important bills, acts and Constitutional amendments passed by Indian Parliament, Important Supreme Court rulings. [10]

International News: Daily international news, Background to the daily news Thumbnail sketches of chief personalities figuring in current news reports Relevance of these reports to India and the world community or why they are considered to be important, Important actions taken under the UN umbrella, Regions of conflict in the world [09]

Economic News: Regional economic groupings of the world and their functioning, The European Union and its expansion, The World Bank The Asian Development Bank, World Economic Forum, Profile of the Indian economy (industry, agriculture, infrastructure, growth rates, world ranking, role of planning, budgets and government policies), The world's top 10 economies [10]

Issues for Discussion: Globalisation, The environment, US dominated world order – politically, culturally and economically, Parliamentary versus Presidential government, [10]

Indian Constitution – does it need a change?
Naxalism and Marxism, Clash of civilizations, Should the nuclear club remain exclusive? Criminalisation of politics, Reservation, Restructuring the UN

Refrences:

1. Daily News Paper & Magazine.
2. Prime time TV News Bulletin

JM 152 **Basics Of Design & Graphics** **3-0-0-3**

Principles of Design & Graphics: Basics of Design and Graphics, Element of principles of design. Typography: physical form, aesthetics and classifications. Colour: physical forms, psychology, colour scheme and production. [10]

Layout: Components of layout and layout planning, advertisement layout, broadcast and tabloid layout, magazine and book layout. [10]

Visual and Design: Visuals: Physical forms, functions and editing, poster design, logo design, brochure design. [10]

DTP & Printing: Basics of desktop publishing, printing process, Printing methods: letter press, screen, offset. Paper and finishing. [9]

Text Books:

1. N.N. Sarkar, Art and Production, Sagar Publishers, new Delhi 2001
2. N.N. Sarkar, Designing Print Communication, Sagar Publishers, new Delhi 1998

Refrences Books:

1. A.K. Dhar, Printing and Publishing

JM 162 **Practical- Design and Graphics Lab** **2-0-0-2**

Exercises and Assignment:

To work with different textures, colour schemes and other elements on different topics/themes.
To work on various types of signographic, calligraphic and typographic letterforms.
Design a logo.
Design flash cards.
Design and develop a booklet (story/rhymes/play/comic or any other)
Visit a printing press

JM 211 **Reporting & Editing (A)** **3-0-0-3**

Basics of Reporting: Basics of Reporting: principles of reporting, functions and responsibilities. Writing news: Lead- types of lead, body. Reporting: Newspapers, News Agencies and Magazines. Techniques of re writing news agency copy, reporting technique [10]

Reporters: Qualities and Responsibilities. Reporting for different beats. Reporting for Newspapers – Reporting the expected & unexpected. Reporting Skills- Nose for News, Observation (listening & seeing) Taking notes finding, checking, verifying, [10]

analyzing & interpreting information.

Types of Reporting: Reporting- crime, courts, society, culture, education, politics, sports, commerce and business and life style. Extracting Stories from outside sources: Citizens, Press releases, Institutional sources, Ministers & Govt. Departments etc. Pitfalls and problems in reporting. [10]

Editing: Nature and need for editing, Principles of editing. Functions of editorial desk. Copy editing. Preparation of copy for press, style sheet. Editing symbols, proof reading symbols and their significance. [09]

Text Books:

1. Kamat, M. V. **(1980).** *The Professional Journalism.* New Delhi: Vikas Publishing.
2. Kamat, M. V. **(1995).** *The Journalist 's Handbook* . New Delhi: Vikas Publishing.

Reference Books:

1. Hough, G. (1995). *News Writing*. New Delhi: Kanishka Publishers
2. Robey, L Cora. (1992). *New Handbook of Basic Writing Skills.* Orlando: Harcourt College Publication.

JM 221 **Media Laws & Ethics (A)** **3-0-0-3**

Introduction of Indian Constitution: Indian Constitution and freedom of press, reasonable restrictions, privileges, laws defamation, contempt of legislature, and court, censorship, need for a free press in a democracy. [10]

Media Ethics: What is Media Ethics? Why Media Ethics? Media's ethical problems including privacy, right to reply, sting operations, media ownership, paid news, Accountability and Independence of Media – Self Regulation. [10]

Acts and Laws: The Press Council Acts, Functions of Press commission and Press Commissions, Copyright Act 1957, Official Secrets Act 1923, Right to Information Act 2005, 66A of IT Act, Press Registration of Books Act. 1867. Cable Television Act and Rules, Cinematography Act, Cyber Laws etc. [10]

Official Secrets: Official secrets – sedition – Drugs and Magic Remedies (Objectionable) Advertisements Act, 1954, obscenity, copyright, monopolies and restrictive trade practices, Press Council, ombudsman, right to information, right to reply, codes of ethics, confidentiality of sources of information [09]

Text Books:

1. Rayudu, C. S. and Nageshwar Rao, S. B. (2014). *Mass Media Laws & Regulations Himalaya Publishing House*. Bombay: Himalaya Publishing House.
2. Ravindran, R. K. (1997). *Press in the Indian Constitution.* New Delhi*:* Indian Publishers Distributors.
3. Thakurta, P.G. *Media Ethics-Making and Breaking News.* New Delhi: Oxford University Press.

Reference Book:

1. Hakemuldar, J.R., Jouge, F. A.C. D. and Singh, P. P. (1998) *Principles & Ethics of Journalism*. New Delhi: Anmol Publications.

JM 231 **Practical - Reporting & Editing for Print** **3-0-0-3**

Beat Reporting: Covering of Beats- crime, courts, city reporting, local reporting, hospitals, health, education, sports. Covering speeches, meetings and press conferences, Political. [10]

Interviewing: Interviewing- Research, Setting up the interview, conducting the interview, writing news leads, writing news story, inverted pyramid, body of the story, attribution, verification. [09]

Feature Writing: Understanding features, writing types of feature, leads for features, writing article on current issues, writing headlines for various pieces of stories, clicking pictures for news. [10]

Case Studies: Case studies of understanding media and news, trial by media [10]

Text Books:

1. Bruce D. Itule and Douglas A. Anderson. *News writing and reporting for today's media;* McGraw Hill Publication, 2000.
2. George Rodmann. *Mass Media in a Changing World*; Mcgraw Hill Publication,2007.

Refrences Books:

1. Richard Keeble. *The Newspaper's Handbook*; Routledge Publication,2006.

JM 241 **Introduction to Broadcast Media** **3-0-0-3**

Audio: Characteristics of Radio as a medium, Basics of Sound, Types of Sound- Sync, Non Sync, Natural Sound, Ambience Sound, Sound Desigen-Its meaning with example from different forms, Sound recording techniques, Introduction and types of microphones. [10]

Visual: Characteristics of Television as a Medium, Still Image, Television image, Digital image, Edited image, Changing ecology of images today, Visual perspective, Visual grammar, Camera movement, Types of shots, Concept of continuity, Imaginary line. [09]

Camera: Structure of camera, Single & 3 CCD, Camera Basics; Viewfinder, Camera Lens systems and control, White balance, Handling the Camera; Contrast ratio, aspect ratio, Exposure and Zebra, Shutter Speed, Focus; Selective Focus, Follow Focus, Rack Focus, Depth-of-field. [10]

Production Format: Single camera shoot, Multi camera shoot, Elements of a TV news story; Gathering, Writing, Reporting, Elements of a TV news bulletins, Basics of editing; Basic software and its techniques, Basics of Recording and editing sounds. [10]

Text Books:

1. P.C. Chatterjee, Broadcasting in India, New Delhi, Sage Publication

Reference Books:

2. Zettl Herbert, Television Production Handbook. Pgenos.
3. Carrol Fleming, The Radio handbook

JM 251 **Film Appreciation** **3-0-0-3**

Language of Cinema I: Focus on Visual Language, Shot scene, Deep focus, Continuity editing, Montage, Watching films and understanding the concept practically. [10]

Language of Cinema II: Focus on sound and colour, Diegetic and Non Diegetic sound, Off scree sound, sync sound, use of color as a stylistic element, Difference between story plot, screenplay, watching relevant film. [09]

Alternative Vision: Third cinema and non fiction cinema, Introduction to Feminist film theory, special focus on Satyajit Ray and Guru Dutt, watching relevant film, hindi cinema in 1950s, New wave of cinema. [10]

Globalisation: Globalization and Indian Cinema, The multiplex era, Film culture, watching relevant film [10]

Screening:

1. Rear Window by Alfred Hichock (Language of Cinema)
2. Battelship, Potempkinby Sergei Eisenstin (Language of Cinema)
3. Man with a Movie Camera by Dziga Vertov
4. Germany Year Zero directed by oberto Rosselini
5. Pather Panchali by Satyajit Ray
6. The hour of the Furnaces by Fernando Solanas

7. Nishant by Shyam Benegal
8. Askrosh by Govind Nihlani
9. Pyaasa by Gurudatt

PS 211 **Indian Government and Politics - I** **3-0-0-3**

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement. [08]

Framing of the Indian Constitution: Major Acts, Morley – Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947. [08]

Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Pollicy, Fundamental Duties, Secularism, Unitary and Federal Features. [13]

Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism. [10]

JM 212 **Introduction to Television Journalism & Production** **3-0-0-3**

Reporting for TV: Nature and Language of TV, TV News script format, Fundamentals of TV reporting: Reporting skills, Ethics for TV reporting and sting oprations. Writing and Reporting for TV: Finding the story and developing the sources, gathering the facts (getting right visuals, facts and figures) [10]

Packaging for TV: Types of TV Programs, Conceot of Breaking News, Scripting for Fiction/Non Fiction Formats. Talk Show, Panel discussion, Recorded Programs. Interview – types of news interview, art of conducting a good interview, Packaging, Anchoring. [10]

TV Programme Production: Stages of production- pre-production, production and post-production. The production personnel, Single camera and Multi camera production, use of graphics and special effects, basics of editing. [10]

TV Programme Editing: Types of editing- linear and nonlinear editing, online and offline editing. Editing on different software. Process of visualization and its importance. Visual grammar and language. [09]

Text Book:

1. Zettl, H. (2011). *Handbook of Television Production*. Cengage Learning.
2. Shook, F., Larson, J. and DeTarsio, J. (2016). *Television Field Production and Reporting*. New York: Routledge.
3. Gormly, E.. K. (2005). *Writing and Producing Television News.* Wiley.
4. Bhat, S.C. (1993). *Broadcast Journalism: Basic Principles*. Delhi: Haranand Publications

Reference Books:

1. De Fleur, M. (1982). *Theories of Mass Communication*. New York: David Mc Kay.
2. Jan, R. H., Ray A.C de Jonge and Singh, P.P. *Broadcast Journalism.* New Delhi: Anmol Publication.
3. Donald, R. and Spann, T. (2000). *Fundamentals of Television Production*. New Delhi: Surjeet Publication.
4. Burrows, T. D. and Gross, L. S. *Video Production*. New York: Mc Graw Hill.

JM 222 **Photo Journalism (A)** **3-0-0-3**

Introduction to Photography: Introduction to Photography, Brief History of photography, what is photography. The role & importance of photography. Principles of Photographic composition. Various types of photography: Portrait, Wildlife, Nature, Photo Journalism, Advertising and Night Photography. [13]

Camera: Basic Parts of film & digital camera:- Lens, Aperture, Shutter, View finder, Memory. Camera formats. Photographic lenses – prime & zoom lens, angle of view. Aperture, Depth of focus, Depth of Field and how they work. Lens perspective, film speed, flash gun, light meter, Exposure Control – relationship between shutter speed and aperture. [13]

Light for Camera : Principles of Light, Various equipment's of lighting, Sources of light : Natural & artificial, different types of lighting used in videography. Nature and physical properties of light direction and angle of light: front, side and back. Lighting contrast and its control by fill in lights: One, two & three point lighting. Key, fill and back light, use of filter and reflectors. [13]

Text Book:

1. Sharma, O.P. *Practical Photography*. (2003). New Delhi: Hind Pocket Books.
2. Langford, M. (2000). *Basic Photography*. New Delhi: Focal Press.

Refrence Book:

3. Folts, J. A. and Lovell, R. P. *Handbook of Photography*.

JM 232 **Practical- Camera & Light (A)** **2-0-0-2**

Exercises and Assignment: Different types of Camera and lighting aspects and their impact on photography.

JM 242 **Practical- Photography** **2-0-0-2**

Exercises and Assignment:

Understanding the mechanisms of camera, Types of still cameras and their structure (Pin hole, SLR, DSLR, Mirrorless), types of lenses.
Aperture (f-stop), shutter, light meter, focus and depth of field.
Understanding light and shadow.
Shadow and silhouettes, lighting equipment.
Digital Photography; Sensor (CCD, CMOS), Formats and storage.
Basics of Photoshop
Photo editing.

JM 252 **Development Communication** **3-0-0-3**

Concept of Growth & Development: Measurement of development- PQLI and HDI, Nehruvian Model, Gandhian Model of development, UN millennium development goal. [10]

Development Communication: Concept and approaches, sustainable development, participatory development and inclusive development. Development support communication; definition, genesis, Wood's Triangle. [09]

Role of Media: Role of Print, TV, Radio and traditional media in development, Role of developmental agencies and NGO's. Cyber media and e-governance, e-choupal, national knowledge network and Niti Aayog [10]

Development Journalism & Rural Reporting: Information needs in rural areas, use of traditional media for development in rural areas, community newspaper and radio. Critical appraisal of mainstream media's reportage on rural problem and issues, Panchayati Raj in India. [10]

Text Books:

1. Rogers Everett M : Communication and Development- Critical Perspective,Sage, New Delhi, 2000
2. SrinivasR.Melkote& H. Leslie Steeves: Communication For Development In The Third World, Sage Publications.
3. Dr. Anil Kumar : Mass Media and Development Issues, BhartiPrakashan Upadhyay Varanasi, 2007.
4. D V R Murthy : Development Journalism, What Next? Kanishka Publication, New Delhi, 2007.
5. Ghosh&Pramanik : Panchayat System in India, Kanishka Publication, NewDelhi, 2007.
6. Modern Media in Social Development: Harish Khanna.Everybody Loves a Good Drought : P. Sainath, 2000 by Penguin India
7. ShivaniDharmarajan : NGOs as Prime Movers, Kanishka Publication, NewDelhi, 2007.

Reference Books:

8. What Do We Mean By Development: An Article by Nora C Quebral in International Development Review, Feb, 1973, P-25.
9. UNDP : Human Development Report (published every year), Oxford University Press, New Delhi.
10. World Bank : World Development Report (published every year) Oxford University Press, New Delhi.
11. Yojna & Kurukshetra Magazine (Monthly published by Niti Aayog, New Delhi)
12. Wilbur Schramm : Mass Media and National Development- the role of information in developing countries, UNESCO/ Stanford University Press, 1964.
13. AmartyaSen : Development as freedom, Alfred A Knopf, New York.

JM 262 **Practical- Documentary Production** **3-0-0-3**

Understanding the Documentary: Six modes of Documentary Representation- Participatory, Expository, Observational, Performative, Reflexive and Poetic. Introduction to shooting styles. Introduction to Editing styles, structure and scripting the documentary. [09]

Pre Production: Documentary production, pre-production, researching the documentary- library, archives, locations, life stories, ethnography. Writing a concept- telling a story, treatment, writing a proposal and budgeting. [10]

Production Phase: Planning and managing crew, lighting- natural and artificial, understanding use of microphones, sound recording, voice over. Shooting schedule- shot breakdown and call list, production team, meetings, checklist, crowd management. [10]

Post Production: Grammar of editing, rough cut, transitions, scenic realism and sound effect and visual effect, finalizing the film, graphic and title, distribution and exhibition spaces (Traditional and online) [10]

References:

1. Charles Musser " Documentary" in Geoffrey Nowell Smith, the oxford of world cinema, oxford university prees, 1996
2. Trisha Das, How to write a Documentary.
3. Double take by PSBT

Screenings:

4. Films by PSBT
5. City of Photos by Nishth Jain
6. Bombay our city by Anand Patardhan
7. Web series

JM 272 **Advanced Broadcast Media** **3-0-0-3**

Video and Broadcast Technology: Analogue and Digital technology, Frame and field, Scanning process, Interlaced and progressive scanning, composite video signal, component video signal, Resolution, Aspect ratio, CCU, colour bars, Vectroscope, Waveform monitor, broadcast monitor, broadcast standards – NTSC, PAL, SECM, HDTV, Telecine. [09]

Transmission Technologies: Terrestrial transmission, Satellite and cabkle broadcasting, up linking and downlinking, conditional access system, DTH, IPTV. [06]

Introduction to Lighting: Why do we need light, mandatory light, creative light, characteristics of light, quality, quantity, colour temperature, three point lighting, natural lighting, sunlight and the realities, cyclodrama, soft and hard light sources. [06]

Production: Production personnel and their role and responsibilities in Radio and TV. Motion picture production. Three phases preparation of budget for various types of radio and TV programme, preparation of script breakdown, artiste, location/ setting, preparation of shooting schedule. Linear and non-linear editing, matching tone, cut in, cut away, jump out, compression and expression of time, cross cutting, circular and non- linear cutting, axial cut. [18]

Text Books:

1. Television Production Handbook, Herbert Zettl, Akash Press 2007, Delhi
2. Facilitating Community Radio in India:- Profiles of NGO's and their Community Radio Initiatives Other Voices. F. Vinod Pavarala, Kanchan K Malik, Sage 2007, New Delhi.
3. Radio in New Avatar- AM to FM, Ambrish Saxena, Kanishka Publication, New Delhi

Reference Books:

4. Glen Creeber, Toby Miller and John Tulloch, The Television Genre Book (London: British Film Institute, 2009)
5. Robert B Musburger and Gorham Kindmen, Introduction to Media Production, (Elsevier, Focal Press)
6. Mc Leash, Robert, Radio Production (US: Taylor & Francis)

PS 212 **Indian Government and Politics -II** **3-0-0-3**

Legislature: US Congress, British Parliament, French Parliament, Swiss Fedral [11]

Assembly, Chinese People's Congress.

Executive: President of US, Monarchy and Prime Minister in Britain, President and Prime Minister in Britain, President and Prime Minister of France, Fedral Council of Switzerland, President and Premier of China. [14]

Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China. [13]

JM 311 **Radio Journalism (A)** **3-0-0-3**

Radio: As a medium of mass communication in today's context, Characteristics of radio, Limitations of radio, Three Modes of transmission: AM, SW and FM. Commercial, community and educational radio. [10]

Radio Writing: Writing for the Ear; Introduction, Characteristics of spoken word, Knowing your audience, Developing your style, Writing for different formats and messages. [10]

Radio Formats: Why formats, Simple announcements, Radio talks/commentaries/comments, interviews, panel discussions. Radio ads/commercials. Music on radio, fiction Phone in programmes, Radio News-Radio News defined, Main characteristics of Radio News as against news in other media, Non-fiction Phone-in Programs. [10]

Radio Production: Introduction, Elements of radio productions- Acoustics, Perspective, Sound effects, Music. Distort/Filter. Different types of microphones, Recording and Editing. [09]

Text Books:

1. Liesh, R. M. (2005). *Radio Production*. New Delhi: Focal Press.
2. Radio in New Avatar- AM to FM, Ambrish Saxena, Kanishka Publication, New Delhi
3. Alburger, J. R. *The Art of Voice Acting*. New Delhi: Focal Press

Reference Books:

4. Luthra, H.R. (1986). *Indian Broadcasting*. New Delhi: Publication Division.

JM 321 **Public Relation & Advertising (A)** **3-0-0-3**

Basics of PR: Concepts and Definitions, Persuasion and Public Opinion, Employee communication, PR as distinguished from Marketing, Sales Promotion and Advertising and PR Techniques. [10]

Role of PR: Relationship and duties of the PR Practitioner. Functions of PR Department. Exhibition PR and its Planning, Uses and kinds of Exhibition PR. PR in Developing Countries, PR for NGOs, PR for Govt. organizations and communications. [10]

Writing For PR: Press Relation and its principles, The News Release-Seven point formula & its importance, Writing techniques, Press Events and organizing them. [09]

Advertising definition, historical development, social and economic benefits of advertising, mass media and advertising. Copy writing and advertising production techniques, print, radio, television, films, outdoor, ideation, visualization. Creativity, media selection, newspapers, magazines, radio, television, outdoor, strategy, planning, media budget, campaign planning, adverting agencies and their functions. [10]

Text Books:

1. Scott M. C., Genter, A.H. and Broom, G.M. (). *Effective Public Relations*. New Jersey: Pearson Education.
2. Seital, F. P. (2016). *The Practice of Public Relations*. New Delhi: Pearson Education.
3. Roy, S.K. *Corporate image of India*.

Reference Books:

4. Broom, G. M. and Dozier, D. M. (1990). *Using research in Public Relations*. New Delhi: Prentice-Hall.

JM 331 **Summer Training Report** **3-0-0-3**

Assignment - Students have to prepare a project report on the basis of training followed by presentation and viva

JM 341 **Practical- Public Relation** **2-0-0-2**

Assignment on the usage of tools of Public Relations.
PR campaign-planning, execution, evaluation.
Presenting slides show on PR and Crisis Management.
Publications – Developing Press Releases and detailed report for variety of events.
Case Studies- Public and Private ventures.

JM 351 **Practical- Radio Programme Production** **2-0-0-2**

Exercises and Assignment:
Use different types of microphones for radio/audio productions.
Recording and editing exercise in the studio.
Writing exercises
Interviews – simulated and actuality.
Research and scripting of radio documentary/feature/drama.
Production of radio discussion.
Production of social messages.
Preparation of audience profile.
End product.

JM 361 **Media Gender & Human Rights** **3-0-0-3**

Media and the Social World: Media impact on individual and society. Democratic polity and mass media, media and cultural change, grass root media. [10]

Gender: Conceptual frameworks in Gender studies, Feminist Theory. History of Media and Gender debates in India (case studies), Media and Gender – Theoretical concerns. Media and Masculinity. [08]

Media – Power and Contestation: Public sphere and its critique. Media and Social difference: class, gender, race etc. Genres- Romance, Television, Soap opera, sports. (Case Studies – watch a Indian TV soap opera/reality show for a week and for [13]

representation of family)

Media and Human Rights: Human Rights: Theoretical perspective, Critique. Universal Declaration of Human Rights. Human rights and media. (Case Studies: Human right issues and violations in national & international media) [10]

Text Books:

1. 1. Ninan, Sevanti. *Headlines from the heartland: Reinventing the Hindi public sphere*. SAGE Publications Pvt. Limited, 2007.
2. . Curran, James. "Rethinking mass communication." *Cultural studies and communications. London: Arnold* (1996).

Reference Books:

1. Street, John. *Mass media, politics and democracy*. Palgrave Macmillan, 2011.
2. Balnaves, Mark, Stephanie Donald, and Brian Shoesmith. *Media theories and approaches: A global perspective*. Palgrave-Macmillan. 2009 (Pg No. 3-10, 11-34, 35-53)
3. Mackay, Hugh, and Tim O'Sullivan, eds. *The media reader: continuity and transformation*. SAGE Publications Limited, 1999. 13-28, 43-73, 287-305.
4. McQuail, Denis. *Mass communication theory: An introduction*. Barcelona, 1991.
5. Berger, Arthur Asa. *Media and society: A critical perspective*. Rowman& Littlefield,

JM 371 **Practical- Advanced Broadcast Media** **3-0-0-3**

Pre - Production: TV News Bulletin, Developing Run Down Sheet. Preparing a Package – Script writing, Chroma set up, Lighting setup and editing setup. Script Design, Script formatting, Shooting script, script elements, writing dialogues, point of view, use of sound in script, screenplay and storyboard. [13]

Production Phase: Preparing Talk show, Talk show formats, techniques of talk show, content development for talk show, camera set up, multi camera set up, Framing, Movement, lighting set up and editing. [13]

Assigmaent:- Students will be given at least one script and one practical exercise to be performed.

JM 381 **Practical- Advanced Media Software** **2-0-0-2**

Exercises and Assignment:
Video Editing Software (FCP latest version)
Audio Editing Software
Montage Cutting
Visual effects
Promo Cutting
Students have to prepare 30 sec Montage/ Promo on any subject.

JM 312 **Cyber Journalism** **3-0-0-3**

Cyber Space: Meaning; Information Super Highway; Internet and Information Revolution, Fundamentals of Cyber Media, Cyber Media Vs Print, TV and Radio. [10]

Cyber Journalism: Advantages and Disadvantages of Cyber Journalism, Web advertising, Circulation of Web Newspapers, Future of Web Journalism, Analysis of important Indian News-Based Web-sites. [10]

Cyber Reporting: Trends in Cyber Reporting & Editing, Impact of globalization on Web Journalism, Cyber Laws and Concept of e-governance. [10]

Web Writing: Writing for Web Media: Basic rules Do's and Don'ts, Writing News stories, Features and Articles on the Web, Interviewing on the Web, Why Print and Electronic Media networks are going on the Net? Impact of Web Journalism and Recent Trends. [10]

Text Books

1. Bharihoke, D. (2009). *Fundamentals of Information Technology.* New Delhi: Excel Books.
2. D'souza, Y. K. *Electronic Media & the Internet*.

Reference Books

3. Gleick, J. (2011). *The Information: A History, a Theory, a Flood.* New York: HarperCollins Publishers.

JM 322 **Practical- Media Lab** **3-0-0-3**

Exercises: Conversation between two students recorded on camera- To be self-critiqued. Presentation on TV programmes watched on the previous day Rewriting Headlines of Newspapers (Hindi & English) on the display boards. Reading of day's newspapers followed by discussions. Writing exercises to inform report and persuade. Interview and Group Discussion sessions for Radio and TV. Effective Presentation/talks/features using various audio – visual aids Practice of Radio news presentations, Radio Ads and Jingle, Vox-Pops etc. [13]

JM 332 **Communication Research & Method** **3-0-0-3**

Introduction To Research: Definition, Role, Function, Types, Scientific Approach, Role of Theory in Research, Steps of Research. [09]

Methods of Media Research: Qualitative, Quantitative techniques, Content Analysis, Survey Methods: Observation Methods, Experimental Studies, Case Studies. [10]

Sampling: Sampling Methods, Representativeness of the sample, Sampling Error, Tools of data collection: Primary and Secondary data: Questionnaire, Focus Group, Surveys, Online Polls, Published work. [10]

Research Design: Methods of analysis and report writing, Data Analysis Techniques: Coding and Tabulation, Working with Internet as a source, Writing the Citations, writing the research report, Bibliography. Readership and Audience Surveys. [10]

Text Books:

1.Wimmer, Roger, D and Dominick, Joseph, R. Mass Media Research, Thomson Wadsworth 2006.

Reference Books:

2. Arthur Asa Berger, Media Research Techniques, Sage Publication, 1998
3. John Fiske, Introduction to Communication Studies, Routledge Publication, 1982

JM 342 **Global Media & Politics** **3-0-0-3**

Media & International Communication: Communication Debates: NWICO, McBride Commission, UNESCO, UN, NHRC & SAARC, ASEAN, BRICS [10]

Media & Super Power Rivalry: Unequal development and Third world concern: North-South, Rich-Poor, CNN, Al Jazeera and others. Advent of popular media- a brief overview. [09]

Global Conflict and Global Media: Rise of embedded Journalism. Study of Vietnam, Iraq & Afghanistan war and role of media. Media as a force multiplier. [10]

Media & Cultural Globalisation: Cultural homogenization, cultural Imperialism, Media Hegemony and global culture. Discourses of Globalization; Barrier free economy, multinationals technological developments, digital divide, media conglomerates and monopolies in India. [10]

Text Books:

1. DayaKishanThussu. *International Communication: Continuity and Change*, Oxford University Press, 2003.
2. Yahya R. Kamalipour and Nancy Snow. *War, Media and Propaganda-A Global Perspective*, Rowman and Littlefield Publishing Group, 2004.
3. Communication and Society, Today and Tomorrow *" Many Voices One*
4. DayaKishanThussu .*War and the media : Reporting conflict 24x7*, Sage Publications, 2003.
5. Stuart Allan and Barbie Zelizer. *Reporting war: Journalism in war time*, Routledge Publication, 2004.

Reference Books:

6. Lee Artz and Yahya R. Kamalipor. *The Globalization of Corporate Media Hegemony*, New York Press, 2003.
7. ZahidaHussain and Vanita Ray. *Media and communications in the third world countries*,Gyan Publications,2007.

JM 352 **Practical- New Media** **2-0-0-2**

Analysis of News, features, articles in various media and make a comparative study.
Making rough layout for blog, selecting the themes
Designing and developing blog (writing articles, features, opinion)
Making rough layout for website, selecting the theme, color combination.
Designing and developing website.

JM 362 **Professional Project** **3-0-0-3**

Projects: All Students have to prepare a final project or show reel professionally. [13]
Format:- Talk Show, Short Documentary, News Reel, Magazine format, Profile.

BA Honours English 2018-19
B. A. (Hons.) in English

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]

W S Maugham: The Verger [4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct) [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative) [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most) [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation [4]

Reading Comprehension: Efficient reading and note taking [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

Suggested Books:

1. Approach to Life, Kolkata, Orient Longman Ltd.
2. Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press.
3. Lascelles, Abercrombie, Thomas Hardy: A Critical Study, New York, Russel & Russel.

4. Cecil, David, Hardy, the Novelist, London, Constable & Co.

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers [13]

V.S. Naipaul: A House for Mr. Biswas [13]

Khushwant Singh: A Train to Pakistan [13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry	[9]
Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists	[7]
Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening	[9]
Sylvia Plath: Morning Song, Death and Company	[5]
R.W. Emerson: Brahma	[4]
Edgar Allan Poe: The Fall of the House of Usher	[5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree	[4]
Sarojini Naidu: Indian Weaver, The Song of Radha.	[4]
Rabindranath Tagore: Where the Mind is Without Fear	[4]
Sri Aurobindo: Transformation	[3]
Kamala Das: An Introduction as a Writer	[4]
Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S.	[4]
A K Ramanujan: Love Poem for a Wife	[4]
Arun Kolatkar: Chaitanya	[4]
Chinua Achebe: Refugee Mother and Child	[4]
Wole Soyinka: Agbor Dancer	[4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.

5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 331 Modern English Language and Phonetics-I 3-0-0-3

Basic Sentence Types – Subject, Verb, Object, Complement, Adverbials [5]

Coordination and Subordination Clauses [5]

Different Notions and Concepts (Request, Order, Purpose, Wish, Suggestion, Obligation, Concession, Condition) [5]

Morphology and Phonology (Various morphs and phonemes) [4]

Word Substitutions and Idioms [3]

Synonyms and Antonyms [3]

Theme Writing [4]

Literary Appreciation [4]

Advanced Comprehension [5]

Suggested Books:

7. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
8. Leech Geoffery: English Grammar for today, Longman, Delhi.
9. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
10. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
11. Quirk & Greenbaum: University English Grammar, Longman Publications.
12. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 341 English Literature : Pre and Post Elizabethans 3-0-0-3

Geoffrey Chaucer : General Prologue to Canterbury Tales (Line1-100) [6]

John Milton : Paradise Lost BK – I (Line 1-49, 94- 124) [10]

John Dryden : Absalom and Achitophel (Line 1-70) [10]

Alexander Pope : Rape of the Lock (Canto I & V) [13]

Suggested Books:

1. Chaucer, Geoffrey, The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.
2. Daiches, David, A Critical History of English Literature (vol. I), Delhi, Allied Publishers.
3. Grose, M. W.: Chaucer: Literature in Perspective.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Tragedy.
5. Rudram, Alan: A Critical Commentary on Milton's Paradise Lost.
6. Pope, Alexander: Rape of the Lock.
7. Dryden, John: Absalom and Achitophel.

EL 351 English Literature: Pre- romantics & Romantics-I 3-0-0-3

Thomas Gray : Elegy Written in a Country Churchyard	[6]
William Collins : Ode to Evening	[6]
William Wordsworth : Ode on the Intimation of Immortality	[5]
John Keats : Ode to Grecian Urn, Ode to Autumn, La Belle Dam Sans Merci	[7]
William Hazlitt : On the Ignorance of the Learned	[7]
Jane Austen : Mansfield Park (Non-detailed)	[8]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Ausen, Jane: Mansfield Park.
6. Hazlitt, William: On the Ignorance of the Learned.

EL 361 Twentieth Century English Literature-I 3-0-0-3

W B Yeats : When you are Old, The Second Coming, Byzantium, Lapis Lazuli	[9]
W H Auden : In Memory of W B Yeats	[4]
T S Eliot : The Wasteland	[13]
Samuel Backett : Waiting for Godot (detailed)	[13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).
4. Beckett, Samuel: Waiting for Godot.
5. Eliot, T S : The Wasteland
6. Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers.
7. Smith, Grover: T. S. Eliot's Poetry and Plays.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

EL 332 Modern English Language and Phonetics-II 3-0-0-3

Question Tags	[4]
Transformation : Active-Passive voice, Direct-Indirect Narration, Assertive into Negatives and Interrogatives	[5]
Punctuations	[4]
Translations (English to Hindi, Hindi to English)	[6]
Phonemic Symbols for Sounds of English, practice of Phonetic transcription	[5]
Word Structure and word Stress	[5]
Fallacies (Hasty Generalisation, *Petipio Principi*, Non-Sequitur, Composition, Division, *Post Hoc Ergo Propter Hoc*)	[5]
Common Errors in English	[3]
Word Power and Vocabulary	[2]

Suggested Books:

1. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
2. Leech Geoffery: English Grammar for today, Longman, Delhi.
3. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
5. Quirk & Greenbaum: University English Grammar, Longman Publications.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 342 English Literature: Pre- romantics & Romantics-II 3-0-0-3

S T Coleridge : Kubla Khan	[6]
P B Shelley : Ode to Skylark, To Night	[6]
A. Tennyson : The Lotus Eaters	[5]
Charles Lamb : Imperfect Sympathies, All Fools' Day	[9]
Charles Dickens : A Tale of Two Cities (non-detailed)	[13]

EL 352 Victorian Literature 3-0-0-3

Robert Browning : My Last Duchess, Porphyria's Lover, Andrea Del Sarto [10]

G M Hopkins : Spring and Fall, Windhover, Felix Randal [10]

Emily Bronte : Wuthering Heights (non- detailed) [10]

Thomas Hardy : Far From the Madding Crowd (non- detailed) [9]

Suggested Books:

1. Pick, John: Gerard Manley Hopkins: Priest and Poet, Delhi, Oxford University Press
2. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books
3. Rhys, E.: Robert Browning and His Poetry.
4. De Vane, W. C.: A Browning Handbook.
5. Bronte, Emily: Wuthering Heights.
6. Hardy, Thomas. Far From the Madding Crowd.

EL 362 Twentieth Century English Literature-II 3-0-0-3

Ted Hughes : Pike, View of a Pig, Thought Fox [7]

Philip Larkin : Toad, Coming, At Grass [6]

James Joyce : A Portrait of the Artist as a Youngman (non- detailed) [13]

Virginia Woolf : To the Lighthouse (non- detailed) [13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).
4. Joyce, James:A Portrait of the Artist as a Youngman.
5. Woolf, Virginia: To the Lighthouse.
6. Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers.
7. Smith, Grover: T. S. Eliot's Poetry and Plays.

BA Honours Political Science 2018-19

B. A. (Hons.) in Political Science

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya [12]

Bal Gangadhar Tilak, Gopal Krishna Gokhale [15]

Raja Ram Mohan Roy, Dayanand Saraswati [12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement [8]

Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947 [8]

Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features [13]

Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism [10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha [8]

Executive: President, Prime Minister and Cabinet [8]

Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation [12]

Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups [11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress [11]

Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China [14]

Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China [14]

PS 331 Western Political Thought: From Plato to Bodin 3-0-0-3

Plato: ideal state, philosopher King, theory of education, theory of justice, theory of communism and its comparison with modern communism. [9]

Aristotle: father of political science, views on state, classification of states, justice, citizenship, slavery, revolution [9]

St. Augustine: political philosophy [3]

St. Aquinas: Christianized Aristotle, nature and functions of government, theory of law and justice [6]

Machiavelli: Father of modern political science, the child of his times, views on state and Prince [8]

Jean Bodin: political ideas, theory of sovereignty [4]

PS 341 International Relations-I 3-0-0-3

International relations: meaning, nature and scope. [3]

Theories in international relations: Idealism, Realism, Neo-realism, System theory, Functionalist [8]

Approaches: Decision making, Game theory and Bargaining theory [7]

National Interest and national power: meaning and elements. [4]

Balance of power: meaning and features. [2]

World War I: Causes and impacts [3]

World War II: Causes and impacts [3]

Cold war and détente: features and major events, post-cold war era [9]

PS 351 Contemporary Political Thought 3-0-0-3

Lenin: changes introduced into Marxism, Views on party organization and Imperialism [4]

Laski: On state & sovereignty [4]

F.A.Hayek: Concept of freedom [4]

Jean Paul Sartre: Existentialism [4]

Milton Friedman: Concept of freedom [4]

Herbert Marcuse: Critical Theory [4]

John Rawls: theory of Justice [4]

Robert Nozick: entitlement theory [4]

Samuel P. Huntington: Clash of civilizations [4]

Amartya Sen: views on justice [3]

PS 361 Public Policy-I 3-0-0-3

Public Policy: Introduction,Nature and scope, Concepts of public and policy [4]

Policy Analysis: Introduction, Meaning and issues of policy analysis, Stages in policy analysis [4]

Models of Policy analysis: System Model, Institutional approach, Rational Policy making model, Public choice approach, Political Public policy approach, Mixed approach by Hogwood and Gunn [16]

Forces in Policy making approach: Electorate power, Policy agenda, Influence of media, Pressure groups, Political parties [6]

Official policy maker (with reference to India): Legislature, Executive, Bureaucracy, Judiciary [9]

PS 371 Principles of Public Administration-I 3-0-0-3

Public Administration: Meaning, Nature and Scope [6]

Types of administration: Public and Private Administration [5]

New Public Administration and New Public Management: meaning and implications [4]

Theories of Organization: Classical, Scientific Management, Human Relations.[12]

Line Staff relationship: Hierarchy, Delegation, Coordination and Supervision. [12]

PS 381 Indian Administration 3-0-0-3

Evolution of Administration in India: The British legacies, the constitutional and Political system in Indian and its implications. The nature of administrative problems in India. Organization and working of Union Ministers of Home, Finance and Foreign Affairs. [12]

State Administration: role of Chief Secretary, Police administration in the state. [6]

District Administration: Divisional Commissioner, Role of Collector and its changing patterns. [8]

Role of Bureaucracy: the problem of Generalist and specialist in Public Services. Ministers-Civil Services relationship. [6]

Financial Administration in India: Budget- its formulation and execution, role of Public Accounts and Estimate Committee, Comptroller and auditor General in India. [7]

PS 332 Western Political Thought from Hobbes to Marx 3-0-0-3

Thomas Hobbes: human nature, state of nature, social contract, sovereignty and individualism [5]

John Locke: human nature, state of nature, social contract, sovereignty and individualism[5]

J.J.Rousseau: social contract theory, General Will, comparison with theory of Hobbes and Locke [5]

Jeremy Bentham: Utilitarianism, political philosophy [5]

J.S.Mill: Revision of Bentham's utilitarianism, views on liberty and representative government [6]

Hegel: views on state, dialectical idealism [5]

Karl Marx: dialectical materialism, class struggle, historical materialism, surplus value, communism [8]

PS 342 International Relations-II 3-0-0-3

United Nations: organs and functions, Reforms and Relevance. [13]

Nuclear Issues and disarmament: NPT, CTBT and India's nuclear policy. [6]

Foreign policy of major countries: United States, United Kingdom, Russia and China [8]

Regional organizations: SAARC, ASEAN, NAM and BRICS [8]

New International Economic Order: North- South Dialogue, South-South Cooperation [4]

PS 352 Indian Foreign Policy 3-0-0-3

Determinants and Principles of India's Foreign Policy: [6]

a) Domestic and International sources of India's Foreign Policy
b) Objectives and Principles

India and the Global Economic and Political Regimes – Main Issues [8]

a) India and World Trade Organization (WTO)
b) India at the United Nations: Security Council Reforms

India and South Asian States [8]

a) Pakistan: Challenges and Prospects
b) Afghanistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives: Main Issues

Changing Relations with the US and Russia from Cold War to Post Cold War [8]

India China Relations: Challenges and Prospects [4]

Security Challenges of India: An Appraisal [5]
a) Terrorism
b) Energy Security

PS 362 Public Policy-II 3-0-0-3

Policy implementation: Meaning, Elements in implementation, Techniques of implementation, Conditions for successful implementation [5]

Approaches to policy implementation: Top-down model, Bottom-up model, Policy action model, Managerial approach [10]

Policy Evaluation: Forms of policy evaluation, Criteria for evaluation, Techniques of evaluation, Problems in evaluation [6]

Policy change and continuity: Policy cycle approach, Organizational approach, Policy learning models [9]

Globalization of National policy making: an international perspective: Impacts of global events on national policy making, Need for a global perspective, Policy agenda in global context [9]

PS 372 Principles of Public Administration-II 3-0-0-3

Administrative Behaviour: Leadership, Decision Making and Communication. [6]

Management of Public Enterprises: with Special reference to the problem of Public Corporation. [5]

Control over Public Administration: Legislative, Judicial and Popular Nature, Limits and role of these controls. [10]

Personnel Administration: Recruitment, Training and Discipline. [8]

Financial Administration: Budget Formulation and Execution, Parliamentary control. [10]

PS 382 Local Self Government in India 3-0-0-3

Local Self Government: nature and scope [2]

Committees on Democratic Decentralization: Balwant Rai Mehta & Ashok Mehta Committee [2]

Rural Local Government: 73rd Amendment Act, 1992

a) Main features [2]

b) **Structural Facets of the Rural Local Government**: Gram Sabha, Panchayat, Panchayat Samiti, Zila Parishad. [6]

Urban Local Government: 74th Amendment Act 1992

a) Main features [2]

b) **Structural Facets of the Municipal Government**: Municipal Councils , Municipal committee and Corporations [6]

Election and Finance: Composition and Functions of State Election Commission and State Finance Commission [4]

Evaluation:
Regional Variations: Experience from the Indian States since the 73rd and 74th Amendment Acts. [5]

Critical Evaluation: SWOT (Strengths, Weaknesses, Opportunities & Threats) Analysis of Rural and Urban Local Institutions. [6]

Important Issues and Themes in Local Government in India: An Overview. [4]

BA Honours Psychology 2018-19
COURSE DESCRIPTION
B. A. (Hons.) in Psychology

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages. [8]

Determinants of Development: Biological and Socio- Cultural. [6]

Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing. [9]

Prenatal Development: Stages and Factors Affecting Prenatal Development. [8]

The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities. [8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology.	[8]
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services.	[7]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling.	[6]
Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.	[9]
Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.	[9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PL 311	**Social Psychology - I**	**3-0-0-3**
	Social Psychology: Nature and Subject Matter; Relationship with other social sciences.	[3]
	Methods: Experimental, Observation, and Sociometry.	[5]
	Socialization: Nature, Process and Agents of Socialization.	[4]
	Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.	[8]
	Social Norms: Meaning, Characteristics and Formation	[5]
	Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants	[6]
	Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional	[8]

PL 321	**Biological Basis of Behaviour**	**3-0-0-3**
	Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical.	[6]
	Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters.	[7]
	Nervous System: Central nervous system and Peripheral nervous system –Structure and Functions. Endocrine system and its behavioral implications.	[9]
	Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention.	[6]
	Motivation: Neural mechanism of Hunger, Thirst and Sex	[5]
	Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory.	[6]

PL 331 Systems of Psychology 3-0-0-3

Nature and scope of Psychology: Psychology as science; Historical Origins: Preexperimental period- Science Among Greeks, British Empiricism, German Nativism.	[4]
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status	[5]
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner.	[7]
Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.	[6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).	[6]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.	[5]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.	[6]

PL 341 Psychopathology-I 3-0-0-3

Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.	[3]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.	[7]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.	[3]
Diagnostic Assessment: Case History, Interview, Projective Techniques	[5]
Anxiety Based Disorders: Nature, Symptoms and Etiology- Generalized Anxiety Disorders, Phobia, O.C.D, Somatoform and Dissociative Disorders	[12]
Psycho physiological Disorders: Nature, Symptoms and Etiology –Asthma, Peptic Ulcer, CHD, Hypertension	[5]
Mental Retardation: Nature, Types, Causes and its Management	[4]

PL 351	**Industrial and Organizational Psychology-I**	**3-0-0-3**
	Industrial/Organizational Psychology: Nature, historical development and scope.	[5]
	Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.	[9]
	Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme	[9]
	Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal	[10]
	Work environment: Noise, atmospheric conditions. Illumination and performance	[6]

PL 361 Psychological Testing-I 3-0-0-3

Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.	[9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.	[9]
Validity: meaning, validation procedures, and special problems.	[9]
Construction and Standardization of Psychological Tests General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.	[12]

PL 312	**Social Psychology-II**	**3-0-0-3**
	Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.	[6]
	Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects. .	[6]
	Attribution process Nature and theories: Kelly and Weiner.	[6]
	Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies	[5]
	Propaganda: Nature, Tools and Techniques	[5]
	Aggression and Violence: Nature, Determinants and Management.	[5]
	Social Change: Nature, Factors and Theories.	[6]

PL 322 Guidance and Counseling 3-0-0-3

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational.	[5]
Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.	[5]
Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.	[9]
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.	[9]
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling.	[7]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.	[4]

PL 332	**Experimental Psychology**	**3-0-0-3**

Experimental Psychology: Nature and History, Experimental Method	[4]
Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. **Perception:** Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.	[9]
Psychophysics: Problems and Methods of Classical Psychophysics.	[8]
Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.	[6]
Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning	[5]
Verbal Learning: Methods, Materials, Organizational Processes.	[3]
Discrimination Learning: Phenomena, Procedures and paradigms	[4]

PL 342 Psychopathology-II **3-0-0-3**

Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation.	[6]
Mood Disorders: Unipolar and Bipolar Symptoms and Etiology	[10]
Schizophrenia: Nature , Symptoms , Types and Etiology	[11]
Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT	[12]

PL 352	**Industrial and Organizational Psychology-II**	**3-0-0-3**
	Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory.	[7]
	Job Satisfaction: Concept, determinants and measurement.	[5]
	Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.	[6]
	Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.	[6]
	Human engineering: Man-machine system. Designs, displays, controls and action.	[6]
	Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions.	[9]

PL 362	**Psychological Testing-II**	**3-0-0-3**
	Personality Tests: Purpose and Types, **Inventories**-Cattell's 16 PF, MMPI and Neo-five factors.	[9]
	Projective- Rorschach and TAT.	[9]
	Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.	[8]
	Measurement of aptitude and Interest	[6]
	Measurement of Creativity- Torrance Test	[7]
	Anxiety and Depression,	

Pass Course 2018-19

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]
W S Maugham: The Verger	[4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct)	[4]
Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	[4]
Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most)	[6]
Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing	[4]
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	[4]
Reading Comprehension: Efficient reading and note taking	[4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

SO 111 Introduction to Sociology-I 3-0-0-3

Sociology: The Meaning of Sociology, Nature of Sociology, Scope of Sociology-Formalistic and Synthetic School, Sociology and other Social Sciences [10]

Basic Concepts: Society, Community, Social Group, Status and Role [10]

Socialisation: Meaning of Socialisation, Agencies of Socialisation, Theories of Socialisation [9]

Culture: Meaning and Characteristics of Culture, Theory of Cultural Lag, Civilisation, Interrelationship and distinction between Culture and Civilisation [10]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 121 Social Thinkers-I 3-0-0-3

Auguste Comte: Positivism, Law of Three Stages, Social Statics and Social Dynamics [14]

Herbert Spencer: The Evolutionary Doctrine, The Organic Theory [10]

Talcott Parsons: Social Action, AGIL, Pattern Variables [15]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 111 Textile Science and Care 3-0-0-3

Introduction to Textile: basic terminology and classification of textile fibres	[2]
General Properties of Textile Fibres: physical, chemical and other properties of textile fibres	[2]
Properties of different textile fibres and their importance: Cotton, Wool, Silk and other natural fibres Rayon, Acetate, Nylon, Polyester, Acrylic, Glass and other manmade fibres	[4]
Preparation and manufacturing of different textile fibres: Cotton, wool and silk, rayon, acetate, nylon, polyester and acrylic	[10]
Yarn and fabric construction: Spinning methods- mechanical and chemical, yarn classification, methods of fabric construction	[7]
Laundry agents: water, detergents, soaps and other agents	[6]
Stain removal: classification and methods of stain removal	[4]
Care and storage of textiles-care of textiles with reference to service, appearance and economy	[4]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Dantyagi, S.: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
4. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
5. Mullick, P.: Textbook of Home science, Kalyani Publication.
6. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
7. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.

GM 121 Textile Science and care Laboratory 0-0-4-2

Suggested Experiments: Identification of textile fibres- burning, microscopic and solubility tests; Removal of stains from fabrics; Washing, ironing and finishing of textile articles

Suggested Books:

1. Dantyagi, S: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
2. Deulkar, D: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
3. Hollen, N. and Saddler, J: Textiles, New York, Mac millan company.
4. Tortora, P.G: Understanding Textiles, New York, Mac millan company.

GM 131 Apparel Industrial Management 2-0-0-2

Textile Industry: Overview of textile industry, globalization and its impact on textile industry [6]

Status of garment industry in India: Production, marketing, distribution, consumption and export trends over the last five years [4]

Organization and association related to garment industry:

Problems of apparel industry and remedial measures, government role in promoting the growth of garment industry [13]

Sales promotion techniques [3]

Suggested Books:

1. Soundarapandian, M: Textile Industry Under Globalization, New Delhi, Vedams Books (P) Ltd.
2. Gurumurthy, G: A book on Textile Industry's 6-decade Journey, Coimbatore, The Hindu Business Line.
3. The Textile Industry and Trade Journal, Baroda, Comput –Media Services.
4. The Indian Textile Journal. Chennai, IPFonline limited.
5. Textile Trends. Kolkata, Eastland Publications Pvt. Ltd.
6. Textile Research Journal. New Jersey, Textile Research Institute.
7. Textile magazine, Chennai, Gopali and CO.

Note: The Students are advised to refer recent Journals of textiles.

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

Suggested Books:

1. Approach to Life, Kolkata, Orient Longman Ltd.
2. Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press.
3. Lascelles, Abercrombie, Thomas Hardy: A Critical Study, New York, Russel & Russel.
4. Cecil, David, Hardy, the Novelist, London, Constable & Co.
5. Kettle, Arnold (ed), Hardy, the Novelist: A reconsideration in the Nineteenth Century Novel, London, Heinemann.
6. Walker, Hugh: The English Essay and the Essayists.

SO 112 Introduction to Sociology-II 3-0-0-3

Family: Meaning and Characteristics of Family, Functions, Types of Family, Changing Family Patterns	[10]
Marriage: Meaning and Functions of Marriage, Types of Marriage	[6]
Social Change: Meaning and Characteristics of Social Change, Causes of Social Change	[7]
Social Stratification: Meaning and Characteristics of Social Stratification, Caste and Class	[8]
Social Control: Meaning and Nature of Social Control, Process and Means of Social Control	[8]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 122 Social Thinkers - II 3-0-0-3

Karl Marx: Historical Materialism, Class and Theory of Class Struggle	[10]
Max Weber: Social Action, Ideal Type, Protestant Ethics and Spirit of Capitalism	[15]
Emile Durkheim: Social Fact, Suicide, Division of Labour	[14]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 112 Fundamentals of Textile Designing 2-0-0-2

Types of designs: structural and decorative	[2]
Elements of design: line, form, shape, colour and texture	[3]
Principles of design: proportion, rhythm, balance, emphasis and harmony	[3]
Weaving: history of weaving, looms and its parts, different types of weaves	[5]
Knitting: terminology, principles of knitting	[2]
Dyeing: types of dyes, different techniques of dyeing	[6]
Printing: styles and techniques of printing	[5]

Suggested Books:

1. Vastala, R.: Textbook of Clothing and Textiles, Indian Council of Agriculture and Research Publication.
2. Yadla,Vijay Lakshmi and Jasrai, Sucheta: UGC Guide to Home Science.
3. Smith, J. L.: Textiles Processing Printing Dyeing Finishing, Chandigarh, Abhishek Publications.
4. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
5. Tortora, P.G. : Understanding Textiles, New York, Mac millan company.

GM 122 Clothing Construction-I 1-0-0-1

Sewing equipment: Tools required for clothing construction	[3]
Sewing machine: parts of machine their use and care, common machine problems	[3]
Fabric terms and definition	[1]
Preparation of fabric before cutting, placing, marking and cutting patterns	[2]
Taking body measurements	[1]
Simple stitches, seam and seam finish, Disposal of fullness in a garment	[3]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction, Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.

GM 132 Fundamentals of Textile Designing Laboratory 0-0-4-2

Suggested Experiments: Preparation of different types of weave; Preparation of samples of knitting; Dyeing-tie and dye technique; Printing- direct, discharge and resist style

Suggested Books:

1. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.
2. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.

GM 142 Clothing Construction-I Laboratory 0-0-4-2

Suggested Experiments: Sewing tools and handling of sewing machine; Taking body measurements; Construction of following samples: stitches, seams, disposal of fullness, plackets, fasteners and binding

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. The Complete Guide to Sewing: Readers Digest, DK publishing.

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

SO 211 Methodology of Social Research-I 3-0-0-3

Social Research: Meaning, Scope and Significance of Social Research, Scientific Method, Difference between Social Research and Social Survey [12]

Research Design: Meaning and Purpose of Research Design, Types – Exploratory, Descriptive and Experimental Research Design [10]

Sampling: Meaning and Characteristics of Sampling, Steps in Sampling Design, Types of Sampling - Random, Stratified, Cluster and Multi-stage Sampling [12]

Hypothesis: Meaning and Procedure of Hypothesis, Types of Hypothesis. [5]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 221 Sociological Theories-I 3-0-0-3

Structure-functionalism: Radcliffe-Brown – The idea of Social Structure, Malinowski - Functional Analysis [12]

Empirical Functionalism: Merton – Theory of Middle Range, Merton's critique and reformulation of Functional analysis [11]

Conflict Theory: Marx – Conflict Theory, Coser – Functional Analysis of Conflict [11]

Sociology of Knowledge: Karl Mannheim [5]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

GM 211 Textile Finishes 2-0-0-2

Finishes: meaning and its classification	[3]
Basic finishes: singeing, stiffening, mercerization and others	[6]
Surface finishes: delustering, flocking, napping, calendaring and others	[7]
Functional finishes: fireproof, water proof, wrinkle resistance, mothproof and other finishes	[7]
Consumer problems and care labels	[3]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill International Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
4. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
5. Tortora, P.G.: Understanding Textiles, New York, Mac millan publishing company.

GM 221 Clothing Construction-II 1-0-0-1

Importance of clothing	[2]
Application of elements and principles of design for clothing construction	[3]
Factors affecting clothing: Social, psychological and economic	[3]
Wardrobe planning: Principles of wardrobe planning and wardrobe planning for different age groups	[3]
Consumer rights and responsibilities	[2]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Carson, B.: How You Look and Dress, Webster Division, Mc Graw-Hill Book company.
3. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
4. Erwin, M.D and Kinchen, A.L.: Clothing for Moderns, Mac millan Publishing, New York.
5. The Complete Guide to Sewing-Readers Digest, DK publishing.
6. Brocknam, H.L. The Theory of Fashion Design, John Wiley and Sons Inc., New York.

GM 231 Textile Finishes Laboratory 0-0-2-1

Suggested Experiments: Study and identification of finishes; Market survey for collection of fabric samples of different types of weaves; Laboratory tests for different fabric finish; Collection of care labels

GM 241 Clothing Construction-II Laboratory 0-0-4-2

Suggested Experiments: Construction of garments for different age groups

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers	[13]
V.S. Naipaul: A House for Mr. Biswas	[13]
Khushwant Singh: A Train to Pakistan	[13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

SO 212 Methodology of Social Research-II 3-0-0-3

Observation Method: Meaning and Characteristics of Observation Method, Types- Participant, Non- participant and Quasi- participant Observation [10]

Interview Method: Meaning, Objectives and Techniques of Interview Method, Types- Structured, Unstructured and Focused Interview [10]

Questionnaire and Schedule: Meaning, Construction and Application [08]

Analysis of Data and Report Writing: Tabulation, Interpretation of Data and Steps in writing Report [11]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 222 Sociological Theories-II 3-0-0-3

Phenomenology and Ethnomethodology: A. Schutz- Phenomenological Sociology, H.Ganfinkel- Ethnomethodology [11]

Interactionalist Perspective: G.H. Mead and H. Blumer- Symbolic Interactionism [11]

***Verstehen* Approach:** Max Weber [6]

Exchange Theory: Homans - Psychological Exchange Perspective, Blau - Structural Exchange Theory [11]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

CA 111 Fundamentals of Computers and Information Technology 3-0-0-3

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing: Data, Information, Knowledge and Wisdom [8]

Data representation: Representation of Data, Bits and Bytes, Number System; Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Number, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language; Machine Language, Assembly Language, High Level Language, Generation of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 212 Clothing Construction-III 1-0-0-1

Basic pattern: definition and methods of making pattern [2]

Pattern making: Principles of pattern making and process of designing by flat pattern method [4]

Figure irregularities: Types and methods of changing garment according to it [2]

Pattern making: different types of collars, sleeves and skirts [5]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.
4. Hollen, Norma R. and Carolyn J. Kundel: Pattern Making by the Flat Pattern Method. Prentice Hall
5. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

CA 141 Application Software Laboratory 0-0-4-2

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 222 Clothing Construction-III Laboratory 0-0-4-2

Suggested Experiments: Construction of different types of collars, sleeves and skirts by flat pattern method

Suggested Books:

1. The Complete Guide to Sewing.: Readers Digest, DK publishing.
2. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry [9]

Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists [7]

Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening [9]

Sylvia Plath: Morning Song, Death and Company [5]

R.W. Emerson: Brahma [4]

Edgar Allan Poe: The Fall of the House of Usher [5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree	[4]
Sarojini Naidu: Indian Weaver, The Song of Radha.	[4]
Rabindranath Tagore: Where the Mind is Without Fear	[4]
Sri Aurobindo: Transformation	[3]
Kamala Das: An Introduction as a Writer	[4]
Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S.	[4]
A K Ramanujan: Love Poem for a Wife	[4]
Arun Kolatkar: Chaitanya	[4]
Chinua Achebe: Refugee Mother and Child	[4]
Wole Soyinka: Agbor Dancer	[4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.
5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

Suggested Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press.
2. Hutcheun, Linda, Theorizing the Postmodern in K. M. Newton edited Twentieth Century Literary Theory, London, Macmillan,
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press.
4. Chandra, Naresh, New Criticism: An Appraisal, New Delhi, Doaba Publishing House.
5. Aristotle, Poetics, translated by S. H. Butcher.
6. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press.
7. Wright, Elizabeth, Psychoanalytic Criticism: Theory in Practice, Metheun,
8. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Oxford University Press.
9. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan.

SO 311 Gender and Society-I 3-0-0-3

Social Construction of Gender: Gender vs. Biology, Equality vs. Difference, Women in the Family, Gender roles, Development and Women's Empowerment. [9]

Emergence of Feminist Thought: Socio-historical perspective, Mapping various Women's movements. [11]

Gender and Sociological Analysis: Feminist critiques of Sociological Theories, Emergence of Women's Studies. [11]

Gender based Division of Labour: Production vs. Reproduction, Household work, Invisible work, Women's work and technology. [8]

SO 321 Society in India-I 3-0-0-3

Social Change in India: Sanskritisation, Westernisation and Modernisation.	[10]
Marriage in India: *Hindu Marriage- a sacrament, Types and changing patterns; Muslim Marriage- a contact, Types and changing patterns, Divorce among Muslims, Differences between Hindu and Muslim Marriages.*	[9]
Kinship in India: Meaning and Types of Kinship, Kinship Behaviour and Usages, Classificatory Terminology of Kinship.	[7]
Varna and Jati: Origin and changing dimensions.	[7]
Jajmani System: Functions, Roles and Changes in Jajmani System.	[6]

SO 312 Gender and Society-II 3-0-0-3

Women in India: Changing profile, The changing status of women in India—pre-colonial, colonial and post-colonial. [8]

Demographic profile: Sex ratio, Child Sex ratio. [8]

Gender and Society in India: Economy: Marginalisation of Women and Sexual Division of Labour, Polity — Reservation for Women, Religion and Culture, Marriage, Dowry and Property. [15]

Issues affecting the Quality of Life of Women: Health, Education, and Domestic Violence. [8]

SO 322 Society in India-II 3-0-0-3

Indian Society: *Hindu View of Life- Ashramas and Purusharthas*	[9]
India as a Plural Society: *Religion, Language and Region.*	[6]
Challenges of Unity in Diversity: Problems of Communalism, Religionalism, Casteism, Regionalism.	[10]
Tribal Life in India: Religious beliefs and practices, Tribal problems in India.	[5]
Population Problems and Society in India: Population explosion, causes and its remedies, Population Policy, Population and Sustainable Development.	[9]

FR 111 Grammar and Composition-I 3-0-0-3

Articles (definite, indefinite and partitive, contracted)-le,la,les,un,une des and du,de la,des,de l',au,a la,a l',aux.	[6]
Gender: The formation of feminine, The Formation of the Plural, Collective noun. Numbers (coordinal and ordinal).	
Conjugation of different regular and irregular verbs.	[5]
Verb: Regular conjugation, standard spelling irregularities, reflexive verbs, impersonal verbs.	[8]
The sentence, word order, negative expression, direct questions, answers.	[6]
Introduction of Adjectives and their uses in different sentences, Agreement of adjectives, position of adjectives. Affirmative, Interrogative and Negative Sentences.	[5]
Adjectives: demonstrative and possessive	[5]
Plural of adjectives, comparatives and superlatives of adjectives.	[4]
Audio Visual Programme	

FR 121 Written Expression-I 3-0-0-3

Greeting someone in formal and informal situation, Knowledge of etiquettes through telephonic conversation.	[4]
Introducing oneself / speaking of oneself, Giving the time/ giving one's telephone number.	[4]
Introducing someone/ describing a person (indicating one's nationality, saying where one lives, revealing one's profession, saying what one likes or does not like).	[4]
Fixing an appointment over the phone, Expressing one's agreement and disagreement.	[4]
Describing about one's daily activities, Seeking clarification on something.	[3]
Asking and giving information, Describing an action.	[4]
Making hypotheses**,** Solution to problem.	[2]
Study of monuments and different public places	[6]
Study of different geographical/historical/political regions of France.	[8]
Audio Visual Programme	

FR 211 Comprehension, Grammar and Translation-I 3-0-0-3

Adverbs: Adverbs of manner, Adverbs of time. Adverbs of place, Adverbs of intensity and quantity.	[7]
Pronoun relative, interrogative, demonstrative, possessive.	[4]
Pronoun: (emphatic, disjunctive, indefinite pronouns, personal pronoun).	[4]
Present indicative and recent past.	[5]
Questions based on seen or unseen passages	[9]
Passive form, subjunctive, impersonal form, translation from English to French	[6]
Possessive adjectives and pronouns.	[4]
Audio Visual Programme	

FR 221 Letter Writing, Composition, Culture and Civilization-I 3-0-0-3

Current important French personalities and events after World War Second in France	[8]
Function of national and regional institution of France.	[7]
History of France (Medieval era & 16th to 18th century)	[8]
Writing of paragraphs and Dialogues, Letter writing (Formal Letters)	[8]

[8]

FR 222 Letter Writing, Composition, Culture and Civilization-II 3-0-0-3

Simple translation, applied translation, skills and techniques in translation.	[8]
Writing resume, application.	[8]
Report writing (formal and informal).	[7]
Translation of passage from French to English and English to French.	[10]
History of France (19th & 20th century).	[6]
Audio Visual Programme	

FR 311 **History of French literature-I** **3-0-0-3**

History of French Literature: Middle age to 17th century.	[5]
Renaissance in France, its origin and significance.	[5]
French revolution: its impact on social and religious philosophy, politics & literature.	[6]
Writer and poets: life & work.	[7]
Classical Literature in 17th century	[8]
General idea of 16th, & 17th century	[8]

FR 312	**History of French literature-II**	**3-0-0-3**

L’histoire de la littérature française : moyen âge au 17ème siècle.	[5]
La renaissance en France, son origine et signification.	[5]
La révolution française : son impact sur philosophie sociale et religieuse, politique et littérature.	[6]
Les écrivains et les poètes : leurs vies et leurs travails.	[7]
La littérature Classique au 17e siècle	[8]
L’idée générale de 16e et le 17e siècle	[8]

FR 312	**History of French literature-III**	**3-0-0-3**

History of French Literature: 18th century.	[5]
History of French Literature: 19th century.	[5]
History of French Literature: 20th century.	[6]
Romantic movement.	[7]
Realism, realistic, symbolisms periods in France.	[8]
Music cinema, theater in 20th century.	[8]

FR 322	**History of French literature-IV**	**3-0-0-3**

L’histoire de la littérature française : le 18ème siècle.	[5]
L’histoire de la littérature française : le 19ème siècle.	[5]
L’histoire de la littérature française : le 20ème siècle.	[6]
Le mouvement romantique	[7]
Les périodes de réalisme, réaliste et symbolismes en France.	[8]
La musique, le cinéma, et le théâtre au 20ème siècle.	[8]

SN 131 Origin and Development of Sanskrit 3-0-0-3

Evolution of Sanskrit: Nomenclature of Sanskrit, Vedic Sanskrit and Classical Sanskrit, Prakrita, Pali, Apabhransha, Modern Indian Languages [9]

Vedic Sanskrit: Origin of the word veda, Vedic hymns, division of Vedic hymns, branches, content of the Samhitas, women vedic seers [11]

Post Vedic Literature: Brahmana, Aranyaka, Upanishad [8]

Classical Sanskrit: Epics, Mahabharata, Ramayana, Gita, Purana, Poetry, Prose, Champoo, Modern Sanskrit Literature [11]

Suggested Books:

1. Keith, A.B.; History of Sanskrit Literature, MLBD, Delhi
2. Krishnamachariar; History of Classical Sanskrit Literature, MLBD, Delhi
3. Macdonell, A.A.; History of Sanskrit Literature, MLBD, Delhi
4. Shastri, Gaurinath; A Concise History of Sanskrit Literature, MLBD, Delhi
5. Winternitz, Maurice; History of Indian Literature (Vol. I & II), MLBD, Delhi
6. Warder, A.K.; Indian Kavya Literature, MLBD, Delhi
7. Gairola, Vachaspati; Sanskrit Sahitya Ka Itihas, Chaukhamba Vidyabhawan, Varanasi
8. Tripathi, Radhavallabha; Sanskrit Sahitya Ka Abhinav Itihas, Vishvavidyalaya Prakashan, Varanasi
9. Dasgupta, S.N.; A History of Sanskrit Literature: Classical Period, University of Calcutta
10. Burrow, T.; Sanskrit Language (also Trans. into Hindi by Bholashankar Vyas), Chaukhamba Vidya Bhawan, Varanasi
11. Altekar,A.S.; Education in Ancient India, Delhi
12. Altekar,A.S.; Position of Women in Hindu Civilization, MLBD, Delhi
13. Basham, A.L.,; The Wonder that was India, London
14. Dandekar, R.N.; Vedic Religion & Mythology: A Survey of the Works of Some Western Scholars, University of Poona, Poona
15. Vaidya,C.V.; Epic India, Delhi

SN 141 Self Management in the Bhagavad Gita 3-0-0-3

Mind and its Functions- Nature of Mind-7.4-6,15.7,15.9,3.42,10.20,10.22, Mental Conflict-1.1, 2.60, 67,3.36-38,40,16.21, Factors responsible for Mental Conflict-16.21, 2.62-63, Factors responsible for *Karma* & *Swabhava*- 18.13-16	[9]
Infirmity of Mind and Quandary of Intelligence- Sense control and Importance of Intellect- 2.3,2.49,52,55,62,65,67, 4.38,39,42, 18.63,18.3.-32, Versatility of Mind and restraint- 6.11-14, 25-26,34,36, Factors for Perfection in Yoga- 3.8, 6.3, 16-17, 17.8-10, 3.12-13, 17.14-19, 6.36	[7]
Importance of Karma-Nature of soul and its difference from the material world- 2.19-26 , *Karma-yoga* :as a means to attain the knowledge – 2.40-44, 47-50, *Bhakti-yoga*: as a means to facilitate *Nishkaam karmayoga*- 12.19-20, Concept of *Lokasangraha*- 3.18-25	[16]
Relationship between consciousness and divine-13.31-32, 10.41, 7.12, 10.4,18.51-66,78	[7]

SN 132 Grammar and Composition-I 3-0-0-3

Inititialising Sanskrit Language through conversation -Diclension (Shabdaroopa), Conjugation (Dhaturoopa), Avayay with their applications in simple sentences	[10]
Laghusiddhanta Kaumudi- Maheshvara Sutra and concept of Pratyahara, Sanjna and Sandhi (Only essential rules based on application in the texts to be taught)	[12]
Elementary Knowledge of Case (Karaka) – Meaning, Numbers, Vibhakti	[5]
Translation -From English into Sanskrit, From Sanskrit into English	[12]

SN 142 Classical Sanskrit Literature-I 3-0-0-3

Panchatantram of Vishnu Sharman- Fifth Episode- Aparikshitakarakam	[15]
NitiShatakam of Bhartrihari (selected verses only) - Mangalacharan, Moorkhapaddhati, Vidwatpaddhati, Manshauryapaddhati	[9]
Raghuvansham of Kalidasa- 1st Canto (Verse 1-35)	[15]

SN 231 भारतीय-वैज्ञानिक-निधिः (Indian Scientific Heritage) 3-0-0-3

13. D. D. Kosambi; Bhartrihari's Shatakatrayam (with the Oldest Commentary of Jain Scholar Dhanasaragani) , Bharatiya Vidya Bhavan, Mumbai

Text Books:

संस्कृत साहित्ये प्रतिबिम्बित-वैज्ञानिक-भिज्ञता (Scientific Awareness reflected in Sanskrit Literature),वैदिकसाहित्ये ऋतुविज्ञानम्(Rituvigyana in Vedic Literature),संवत्सरचक्रम्(Samvatsarchakra),वृष्टिविज्ञानम्(Vristhivigyana),वराहमिहिरमते प्राचीनभारते जलवायुविज्ञानस्यावधारणा (Concept of Climatology in Ancient India-according to Varahmihira), बृहत्-संहिता 21.1-2,28.1-5(Brihatsamhita-21.1-2,28.1-5), भद्रबाहुसंहिता-9.1-15(Bhadrabahusamhita-9.1-15) ,प्राचीनभारते जलसंसाधनप्रबन्धस्य इतिहासः (History of Water Resource Management in Ancient India)-ऋग्वेद-10.9 (Rigveda-10.9),अर्थशास्त्रम्(Arthashastra(2.1.20-24,3.9.29-38,7.12.4-5), बृहत्संहिता(Brihatsamhita-54.1-10),महाभारत-आदिपर्वः(Mahabharata -Adi Parva-96) [10]

पातञ्जलयोगसूत्रसंदर्भे तनाव-प्रबन्धनम् (Stress Management: In context of PatanjaliYogasutra)समाधिपादः(Samadhipad 1.1,1.2,1.5,1.12,1.13,1.15,1.23, 1.30,1.30-37),साधनपादः(Sadhanapada (2.1, 2.3 ,2.11, 2.16, 2.27, 2.29) [20]

वैदिकजीवनचर्या आसनं प्राणायामः च –सिद्धान्तमात्रं (Vedic Life Style- Aasana and Pranayama (theory only), यौगिक-षट्कर्मः(Yogic Satkarma), ऋतुचर्या (Ritucharya),आहार: विहार:(Ahaara-Vihaara),आयुर्वेदतः प्राकृतिकचिकित्सा (Naturopathy from Ayurveda) [09]

SN 241 व्याकरणं रचना च- द्वितीयः भागः (Grammar and Composition-II) 3-0-0-3

सिद्धान्तकौमुद्यानुसारं कारकम् **(Case)-** Based on Siddhantakaumudi) [15]

लघुसिद्धान्तकौमुद्यानुसारं समासः**(Compound)-**Based on Laghusiddhantakaumudi) [14]

वाच्यम् (Voice) [10]

Text Books:

1. Kale, M.R. (2011). *Higher Sanskrit Grammar*. Delhi: MLBD.
2. Apte, V.S. (1996). *The Students' Guide to Sanskrit Composition*. Varanasi Chowkhambha Sanskrit Series.

Reference Books:

3. Kanshiram (2009). *Laghusiddhantakaumudi (Vol. 1-2)*. Delhi: MLBD.
4. Shastri, B. (2008). *Laghusiddhantakaumudi- Bhaimivyakhya* (Vol. 3-6). Delhi: Bhaimi Prakashan.
5. Shastri, C. (1960).*Vyakaranchandrodaya* (Vol. 1-3). Delhi: MLBD.

SN 232 लौकिकसंस्कृतसाहित्यम्- द्वितीयः भागः (Classical Sanskrit Literature-II) 3-0-0-3

कालिदासविरचितम् अभिज्ञानशाकुन्तलम् –चतुर्थाङ्कः पञ्चमाङ्कः च (Abhigyana-Shakuntalam of Kalidasa- 4th & 5th Act) [24]

बाणभटविरचितम् कादंबरी(शुकनासोपदेशः)- (Shukanasopadesha –Kadambari- of Banabhatta) [15]

Text Books:

1. Kale, M.R. (2010). *Abhigyana-Shakuntalam of Kalidasa*. Delhi:MLBD.
2. Kumar, P. (1974). *Shukanasopadesha (Kadambari).* Delhi: Meharchand Lachchmandas.

Reference Books:

3. Pant, S.C. (1992). *Abhigyana-Shakuntalam*. Delhi: MLBD.
4. Dwivedi, K. (1989). *Abhigyana-Shakuntalam*. Allahabad: Ramnarayan Lal Benimadhav Press.
5. Tiwari, R. (2005). *Natakakar Kalidasa aur Kavyakar Kalidas*. Delhi: Parimal Publication.
6. Macdonell, A.A. (1970). *History of Sanskrit Literature*. Delhi: MLBD.
7. Saxena, R. (1990). *Shukanasopadesha (Banabhatta).* Indore: Bharati Publication.
8. Karmarkar, R.D. (1980). *Bana*. Dharwar: Karnataka University.
9. Dwivedi, H. (1976). *Kalidas ki Lalitya Yojana*. Delhi: Rajkamal Prakashan.

SN 242 राष्ट्रवादः भारतीय-राजशास्त्रं च (Nationalism and Indian Polity) 3-0-0-3

संस्कृतसाहित्यम् राष्ट्रवादः च (**Sanskrit Literature and Nationalism**)- शुक्लयजुर्वेदः 22.22(Shuklayajurveda (22.22),अथर्ववेदः-12.1.1-2(Atharvaveda (12.1.1-2), रामायण कृ.कि. काण्डम् .46-48 (Ramayana (KK 46-48), विष्णुपुराणम्2.3 (Vishnupurana (2.3), अम्बिकादत्तव्यासः, Ambikadutt Vyas, प.क्षमारावः Pt. Kshama Rao,मथुराप्रसाददीक्षितः (Mathura Prasad Dixit), चारुदेवशास्त्री (Charudev Shashtri)	[24]
भारतीयराजशास्त्रम्- स्वरूपम्,महत्त्वम्,सैद्धान्तिकविकासः च Indian Polity: Nature, Importance and Development- कौटिल्यः(Kautilya),भीष्मः(Bhishma),मनुः (Manu), शुक्राचार्यः (Shukracharya),सोमदेवसूरी(Somdev Suri),कमंदकः(Kamandaka)	[7]
भारतीयराजशास्त्रस्य प्रमुखग्रन्थानि (Important Texts on Indian Polity)-ऋग्वेदः-10.173,10.174 (Rigveda -10.173,10.174), अथर्ववेदः-6.87,7.13 (Atharvaveda 6.87,7.13),शतपथब्राह्मण 5.1.1.8-13,9.4.1.1-5(Shatapath Brahmana -5.1.1.8-13, 9.4.1.1-5),अर्थशास्त्रम् -1.4.1-19 (Arthashastra 1.4.1-19), महाभारत-शान्तिपर्वः-120.1-35(Mahabharata- Shantiparva 120.1-35),मनुस्मृतिः-7.1-35(Manusmriti 7.1-35),गान्धीगीता-सत्याग्रहनिरुपणम् 5.1-25 (Gandhigita- Satyagraha Nirupana - 5.1-25)	[8]

SN 311 वैदिकसाहित्यम् (Vedic Literature) 3-0-0-3

ऋग्वेद: - अग्नि: 1.1 (**Rigveda-** Agni-1.1), इन्द्र:-1.18(Indra-1.18), उषस् 3.61 (Ushas- 3.61), विष्णु: -1.154 (Vishnu- 1.154), हिरण्यगर्भ: 10.121(Hiranyagarbha-10.121),संज्ञानम्(Sangyana-10.191),**यजुर्वेद**:-शिवसङ्कल्प: -34.१-6 (**Yajurveda-** Shivasankalpa- 34.1-6), **अथर्ववेद**: -सामनस्य 3.30 (**Atharvaveda-** Sammanasya-3.30),भूमि: -12.1-12 (Bhoomi- 12.1-12) [20]

उपनिषद् -कठोपनिषद्, **1-2** (**Upanishad-** Kathopanishad (1st and 2nd Chapter) [19]

Text Books:

1. Velankar, H.D. (1965). *Riksuktashati*. Pune: Vaidika Samshodhana Mandal.
2. Bandhu, V. (1960). *Atharvaveda (Shaunakiya)* Hoshiyarpur: VVRI.

Reference Books:

3. Upadhyay, G.P. (2001). *Shatapatha Brahmana.* Delhi: S.L.B.S.Rastriya SanskritVidyapeetha.
4. Shashtri, J. L. (1978).*Shuklayajurveda-Samhita(Vajasneyi-Madhyandina).* Delhi: MLBD.
5. Trivedi, R. (1996). *Rigveda Samhita*. Delhi: Chaukhambha Sanskrit Pratishthan.
6. Shashtri, S. D. (1986). *Kathopanishad(Shankarbhashya*). Delhi: Chaukhambha Sanskrit Pratishthana.
7. Krishnalal (1998).*Vaidiksangraha.* Delhi:Eastern Book Linkers.
8. Tripathi,V.N. (1986).*Vedachayanam.*Varanasi:Vishwavidyalaya Prakashan.
9. Velankar, H.D. (1970). *Riksuktavaijayani.* Mumbai:Bharatiya Vidya Bhawana.

SN 321 सौन्दर्यशास्त्रम् भारतीयनाट्यशाला च (Aesthetics and Indian Theatre) 3-0-0-3

सौन्दर्यशास्त्रम्(**Aesthetics**)-काव्यप्रकाशः-4.27-28 (Kavyaprakasha-4.27-28), सहित्यदर्पणः-दशमपरिच्छेदः (Sahityadarpana -Dashamparichcheda)	[12]
छन्दशास्त्रम्-(**Chhandashastr**a)- अनुष्टुपः(Anushtupa), आर्या(Arya), इन्द्रवज्रा(Indravajra), उपेन्द्रवज्रा(Upendravajra), उपजातिः(Upajati), वन्शस्थ:(Vanshastha), द्रुतविलंबित:(Drutavilambita), पुष्पिताग्रा(Pushpitagra), वसन्ततिलका(Vasantatilaka), मालिनी(Malini), मन्दाक्रान्ता(Mandakranta), शिखरिणी(Shikharini), शार्दूलविक्रिडीतं (Shardulavikridita),स्रग्धरा(Sragdhara)	[15]
नाट्यशास्त्रम्- द्वितीय अध्यायः (**Natyashastra (2nd Chapter)**परम्परागतभारतीय आधुनिकनाट्यशाला च (Traditional Indian and Modern Theatre), नाट्यमण्डपम् (Natyamandapa),रङ्गशीर्ष(Rangashirsha),रङ्गपीठम् (Rangapeetha), रङ्गमञ्चः (Rangamancha) स्वरूपम् विकासश्च (Features and Developments)	[12]

Text Books:

1. Nagendra (1996). *Kavyaprakash of Mammata with Vishveshwar Vyakhya*. Varanasi: Gyanmandal Ltd.
2. Nagar, R. (1994). Natyashashtra of Bharata. Delhi: Parimal Publication.

Reference Books:

1. Shastri, S. (1978). *Sahityadarpana*. Delhi: MLBD.
2. Bakshi, M.C. (1971). *The Concept of Ancient Theatre*. Delhi: Munsiram Manoharlal.

3. Ghosh, M.M. (2007). *Natyashastra of Bharat,* Delhi: Chaukhambha Publication.
4. Gupta, C.B. (1987). *Indian Theatre*. Delhi: Munshiram Manoharlal.
5. Mankad, D.R. (1996). *Ancient Indian Theatre*. Delhi: MLBD
6. Warder, A.K. (2004). *Indian Kavya Literature*. Delhi: MLBD

SN 312 संस्कृतव्याकरणम् भारतीयतर्कपद्धतिः च **3-0-0-3**
Sanskrit Grammar and Indian System of Reasoning

वरदराजाचार्यविरचितलघुसिद्धान्तकौमुदी- अच्-सन्धिःसूत्रबोधसहितः- - 6.1.47,1.1.65,1.149,6.1.75,1.3.10,1.1.2,1.1.69,6.1.84,1.3.2,1.1.50,1.1.1,6.1.85,6.1.91,6.1.97 (**Laghusiddhantakaumudi of Varadaraja** (Achsandhi with sutrabodha)- 6.1.47, 1.1.65, 1.149, 6.1.75, 1.3.10, 1.1.2, 1.1.69, 6.1.84, 1.3.2, 1.1.50, 1.1.1, 6.1.85, 6.1.91, 6.1.97 [20]

अन्नम्भट्टप्रणीतः तर्कसंग्रहः (**Tarkasangraha of Annambhatta**) [19]

SN 322 **वैदिकगणितम् खगोलविद्या च** **3-0-0-3**

(Vedic Mathematics and Astronomy)

Text Books:

भारतीयगणितस्य खगोलविद्यायाः च संक्षिप्त-इतिहासः (A Brief History of Vedic Mathematics & Astronomy- वेदाङ्ग-ज्योतिषम्(Vedanga Jyotisha), शुल्बसूत्रं (Shulbasutra),पञ्चसिद्धान्तिका(Panchasiddhantika),सूर्यसिद्धान्तः Suryasiddhanta, आर्यभट्टः-I(Aryabhatta-I),गणेशदैवज्ञः(Ganesh Daivagya),कमलाकरः Kamalakara, जयसिंहः Jay Singh, सुधाकरद्विवेदी (Sudhakar Dwivedi)	[8]
वैदिकगणितम्-लगध्-ज्योतिषम्(4&42) **Vedic Mathematics-** Selected section of LagadhJyotish(4&42),लीलावती(21श्लोकाः)),Lilawati(21Verses),श्रीभारतीकृष्णतीर्थः(5 सूत्राणि), Shri Bharati Krishna Teertha(5 Aphorism)	[12]
खगोलविद्या (लगधज्योतिषं -1-3&43)**Astronomy-** Selected section of Lagadh Jyotisha(1-3&43),सूर्यसिद्धान्तः(चतुर्दश-अध्यायः)Suryasiddhanta(14thChapter), आर्यभटीयम(गोलपद-1-22)Aryabhatiyam (Golapada- 1-22)	[12]
वेधशाला अथ च खगोलीयगणनार्थं प्रमुखप्राचीनयन्त्राणि (Observatories and Important Ancient Instruments for Astronomical Calculations)	[7]

GY 111 **Physical Geography-I** **3-0-0-3**

Solar System and origin of planets: Introduction to Solar system, Theories regarding origin of planets- hypothesis by Kant, Nebular hypothesis by Laplace, Planetesimal hypothesis of Chamberlin, Tidal hypothesis of James Jeans, Binary Star hypothesis of Russell and Big-bang.	**[15]**
Earth & Its components: Rotation, revolution of the earth and its consequences, Axis of the earth, Longitude and Latitude of the earth, Shape of the earth, Local time and standard time, Time zone and International Date line, Internal structure of the earth, Distribution of land and water on the earth.	**[7]**
Rocks, Earth movements, Volcanoes & Earth quake: Mode of occurrences of rocks: Igneous, Metamorphic and Sedimentary, Earth movements-folding and faulting of rocks, Earth quake: causes and consequences, Volcanoes: causes and consequences.	**[8]**
Work of different agents and resulted landforms: Weathering: Physical, Chemical and Biological, Work of River, Wind, Glacier, Sea wave and Karst: erosion, transportation, deposition and resulted landforms, Groundwater, springs and artesian wells.	**[9]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 121 **Bio-Geography-1** **3-0-0-3**

Biogeography: Introduction: Biogeography: Meaning, Definitions, Concept, importance and relevance, Ecology and Ecosystem: Definitions and principles, Dimensions in Ecology: Definition of Ecotope, Ecotone and Habitat, Biosphere, food chain, food web and ecological pyramid.	**[14]**
Biogeochemical Cycles and Soil: Biogeochemical cycles- Carbon cycle, Nitrogen cycle, Oxygen cycle and Phosphorus cycle, Soil: forming processes, factors responsible. Soil profile.	**[7]**
Distribution of Flora and fauna: Distribution of flora and fauna over geographical space, Factors affecting plant ecology: light, temperature, moisture etc.	**[5]**
Introduction to Biome, Biodiversity and Issues: Biome: meaning, concept and importance, Introduction to Bio-diversity-meaning and concept, Major bio-diversity hotspots in India, Issues related to the bio-diversity with special reference to India, Human induced changes in the ecosystem: causes and consequences.	**[13]**

Text Books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998) Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones, G.R. (eds) (1966) Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.

GY 112 **Physical Geography-II** **3-0-0-3**

Isostasy, Processes and Mountain building: Theories of Isostasy: Models of Pratt & Airy, Brief understanding of Geological time, Endogenetic and Exogenetic processes, Concept of geosynclines and orogenic processes, Mountains: types and their formations, Mountain building theories: theories by Kober, Joly, Holmes, Daly **[18]**

Concept of Scale, Cycles and landform evolution: Concept of scale in physical geography: spatial and temporal, Cyclic and non-cyclic concept of erosion, Normal cycle of erosion by W.M. Davis, Landscape evolution theory by W. Penk **[14]**

Evolution of drainage network on different topography: Development of drainage network on uniclinal structure, Development of drainage network on folded structure, Development of drainage network on faulted structure **[7]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 122 **Bio-Geography-2** **3-0-0-3**

Introduction to Community: Concept of community, Factors affecting community: Succession, vegetation climax, Effects of human interventions in the community (with special reference to India), Effects of industrial effluents on the community with special reference to India, management practices **[10]**

Spatial distribution of Biomes: Description of major biomes of the world in reference to the location, extension, climate, soil, flora, fauna, succession and human activates **[12]**

Soil formation, erosion and management: Mechanism of formation of podzol, laterite, chernozem and saline alkaline soils, Soil erosion and land degradation: Types and factors, their impacts on soil fertility and their management, Major ecological regions of India: Tropical rain forest, Desert, Mountain, aquatic ecosystem, mangrove and deciduous forest **[17]**

Text books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998): Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography: An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones G.R. (eds) (1966): Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.
4. Barry C. (1993) Biogeography, Blackwell Scientific Publication, Oxford, London.
5. Huggett R.J. (2004) Fundamentals of Biogeography, Psychology Press.

GY 132 **Practical Geography-1** **0-0-4-2**

Scale and Maps: Introduction and Types: Introduction of Practical Geography, Concept of Maps and their importance in Geography, Concept of Scales and their importance in Geography, Type of Scales: Construction of Linear, Diagonal and Vernier scales **[16]**

Projections and Contours, Types and representation: Concept of projection in their importance, types and uses in Geography, Construction of projection in graphical method: polar, conical and cylindrical cases, Contours: Concept and representation **[14]**

Text Books:

1. Singh R. L., Singh R. P. B. (1999) Elements of Practical Geography, Kalyani Publishers.
2. Sarkar A. (1997) Practical Geography, A systematic Approach, Orient Longman Ltd.

Reference Books:

1. Anson R., Ormelling F. J. (1994) International Cartographic Association: Basic Cartographic Vol. Pregmen Press.
2. Gupta K.K., Tyagi, V. C. (1992) Working with Map, Survey of India, DST, New Delhi.
3. Loxton J. (1980) Practical Map Production, John Wiley.
4. Mishra R.P., Ramesh A. (1989) Fundamentals of Cartography, Concept, New
5. Delhi.
6. Monkhouse F. J., Wilkinson H. R., (1973) Maps and Diagrams, Methuen, London.
7. Rhind D. W., Taylor D. R. F. (eds.) (1989) Cartography: Past, Present and Future, Elsevier, International Cartographic Association.
8. Robinson A. H. (2009) Elements of Cartography, John Wiley and Sons, New York.
9. Sharma J. P. (2010) Prayogic Bhugol, Rastogi Publishers, Meerut.
10. Steers J. A. (1965) An Introduction to the Study of Map Projections, London.

GY 211 Geography of India 3-0-0-3

Physiography and brief Geology of India: India: location, shape, size, boundaries and extent; Major physiographic divisions of India: Northern Hills, Northern plains, Peninsular Plateau, Coastal plains, Indian deserts and the islands, Brief understanding of major Geological structures of India. **[8]**

Drainage and Climate of India: Drainage of India: Himalayan drainage and Peninsular drainage, National Water grid., Characteristics of Indian climate and seasons (Temperature, Humidity and Precipitation), Indian Monsoon: mechanism and consequences and its relation to Indian agriculture. **[8]**

Soils and Vegetation of India: Distribution of Soils of India, Distribution of Vegetation of India, Problem of flood and drought in India. **[4]**

Demographic Aspects of India:
Population distribution, density, sex ratio and literacy pattern of India. **[8]**

Cultural and Social Aspects of India:
Schedule tribes and scheduled tribes, Religious diversity in India, Linguistic diversity in India, Distribution of different races in India, Contemporary Issues: Poverty, Population explosion, globalization and its impact on the environment, regional disparity. **[11]**

GY 221 Human Geography 3-0-0-3

Basic concepts and Theory of Population: Introduction to the Human Geography: meaning, definitions and concept, Relation of Human geography with other fields of sciences, Population resource relationship: concept of over population, optimum population and under population, Population transition theory. **[15]**

Adaptation and Distribution of Population: Human adaptation in different parts of the world: Equatorial, Tropical, Temperate, and Polar area; Settlements: meaning and concept; Rural and Urban settlements: types and pattern, Elements of the environment and their impact on the Habitat, economy and Society of Eskimos, Pygmies, Bushman, Distribution of Population - World patterns, Factors influencing spatial patterns of population distribution – physical, economic and social aspects. **[15]**

Migration, Urbanization and Globalization: Migration of population: causes and consequences, brain drain, World population problems and policies, Urbanization, problems of urbanization, Globalization: causes and its impact, Concept of a region: types of regions. [9]

GY 212 **Economic Geography** **3-0-0-3**

Introduction to Different Economic Sectors: Introduction to economic geography: definition, meaning and concept, Economic geography and its relation to human geography, Classification of economic activities of the world: Primary, Secondary and tertiary activities (Hunting and food gathering, agriculture, industries and market economy). **[11]**

Agricultural Resources: an Introduction to Primary activities: Agriculture systems: Intensive subsistence agriculture (Rice) and plantation agriculture (Tea), Commercial grain farming (Wheat), Horticulture and mixed farming. **[8]**

Industrial locations and Manufacturing Industries: Industrial activities: an introduction, Factors Affecting location of Economic Activity with special reference to Industry; Secondary Activities: Manufacturing (Cotton Textile, Iron and Steel) (World pattern). **[10]**

Manufacturing Regions: Concept of Manufacturing Regions, Special Economic Zones and Technology Parks., Tertiary activities: Transport, Trade and Services. **[10]**

Text books:

1. Bagchi-Sen, S. & Smith, H.L. (2006). *Economic Geography: Past, Present and Future*. U.K., Taylor and Francis.
2. Sharma, T.C. & Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Publication.

Reference Books:

1. Alexander, J. W. (1963). *Economic Geography*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
2. Clark Gordon, L., Feldman, M.P. & Gertler, M.S., (eds.) (2000). *The Oxford Handbook of Economic Geography*. N.Y., Oxford University Press.
3. Coe, N. M., Kelly, P. F. & Yeung, H. W. (2007). *Economic Geography: A Contemporary Introduction*. U.K., Wiley-Blackwell.
4. Combes, P., Mayer, T. and Thisse, J. F. (2008). *Economic Geography: The Integration of Regions and Nations*. U.S., Princeton University Press.
5. Hodder, B.W. & Lee, R. (1974). *Economic Geography*. U.K., Taylor and Francis.
6. Leong, G.C. & Morgan, G.C. (1979). *Human & Economic Geography*. N.Y., Oxford University Press, Oxford.
7. Wheeler, J. O. (1998). *Economic Geography*. U.S., Wiley.
8. Willington, D. E. (2008). *Economic Geography*. U.K., Husband Press.

GY 222 **Geography of Resources** **3-0-0-3**

Distribution of Mineral Resources: Resources: meaning, concept and Definitions; Mineral resources: Uses and distribution: Iron ore, Coal, Bauxite, Zinc, Gold, Silver, Mica. **[8]**

Energy Resources: Renewable energy resource: Wind energy and Solar energy, Non-renewable energy resource: Petroleum, Natural Gas. **[5]**

Distribution of Agricultural Resources and Agricultural Infrastructure: Rice, wheat, Millet, Cotton, Sugarcane, Tea and Coffee; HYV seeds, Irrigation, Fertilizers and Pesticides. **[13]**

Concept of Industry, industrial resources and Industrial Regions: Iron and steel industry, Cotton textile industry, Aluminum industry, Cement Industry; Free trade zones and Special Economic Zones, Concept of Human Resource. **[13]**

Text books:

1. Roy, P. (2007). *Economic Geography, A Study of Resources.* New Delhi, New Central Book Agency Pvt. Ltd.

Reference Books:

1. Gautam, A. (2009). *Advanced Geography of India*. Allahabad, Sharda Pustak Bha.
2. Khullar, D.R. (2000). *India: A Comprehensive Geography*. New Delhi, Kalyani Publishers.
3. Krishnaswamy, K. (1972). *India's Mineral Resources*. New Delhi, Oxford IBM.
4. Rao, K.L. (1975). *India's Water Wealth*. New Delhi, Orient Longman.
5. Sharma, T.C. and Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Pub.
6. Singh, G. (1988). *Geography of India*. New Delhi, Atmaram & Sons.

GY 232 **Practical Geography-II** **0-0-4-2**

Cartographic techniques and Introduction to the topographical Maps: Construction of one dimensional, two dimensional and three dimensional graphs and diagrams, Topographical maps and their interpretation.

Basics of Field Survey and Chain and Tape Survey: Introduction to the field survey, Chain and tape surveying and plotting.

Introduction of Remote Sensing: Mechanism of remote sensing, Different platforms of Remote sensing, Spectral signature and its application in remote sensing, Introduction to GPS and GIS, Applications of GIS.

Text books:

1. Joseph, G. (2005). *Fundamentals of Remote Sensing*. India, United Press India.
2. King, L.S. (1969). *Statistical Analysis in Geography*. U.S., Prentice-Hall.
3. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2004). *Remote Sensing and Image Interpretation*. U.S., Wiley. (Wiley Student Edition).
4. Mishra, R.P. and Ramesh, A. (1989). *Fundamentals of Cartography.* New Delhi, Concept.
5. Monkhouse, F.J. and Wilkinson H.R. (1973). *Maps and Diagrams*. London, Methuen.

Reference Books:

1. Gupta, K.K. and Tyagi, V.C. (1992). *Working with Map*. Survey of India, New Delhi, DST.
2. Hammond, P. and Mc. Cullagh, P.S. (1978). *Quantitative Techniques in Geography: An Introduction*. U.K., Oxford University Press.
3. Loxton, J. (1980). *Practical Map Production*. U.K., John Wiley.
4. Rhino, D.W. and Taylor, D.R.F. (eds.) (1989). *Cartography: Past, Present and Future*. Elsevier, Amsterdam, International Cartographic Association.
5. Robinson, A. H. (2009). *Elements of Cartography*. New York, John Wiley and Sons.
6. Sharma, J. P. (2010). *Prayogic Bhugol.* Meerut, Rastogi Publishers.

GY 311 Climatology and Oceanography 3-0-0-3

Basic Components of atmosphere: Atmosphere, Climate and Seasons: concept and meaning; Structure and composition of atmosphere, Humidity; Distribution of Temperature. **[6]**

Circulation of atmosphere: Pressure and wind and their broad pattern, General circulation of atmosphere, jet streams. **[5]**

Atmospheric Disturbances and Winds: Different types of atmospheric disturbances: Tropical cyclone, Extra-tropical cyclone and Hurricane, Winds: planetary, seasonal and local, Climatic classification, climate change: causes and consequences. **[8]**

Geography of Ocean Basins: Ocean basin relief (Indian ocean, Atlantic ocean and pacific ocean). **[4]**

Salinity and Temperature of ocean water: Salinity: causes, determinants and distribution, Distribution of temperature and salinity. **[5]**

Dynamics of Ocean water:
Waves, Currents and Tide: formation and types. **[6]**

Coral Reefs and Ocean Deposits:
Coral reefs: types and theories; Ocean deposits. **[5]**

Text books:

1. Lal, D.S. (2011). *Climatology*. India, Sharda Pustak Bhawan.
2. Sharma, R.C. and Vatal, M.(1980). *Oceanography for Geographers*. Allahabad, Chaitanya Publishing House.

Reference Books:

1. Anthes, R.A., Panofsky, H.A., Cahir, J.J. & Rango, A. (1978). *The Atmosphere*. SRA, Columbus.
2. Barry, R.G. & Carleton, A.M. (2001). *Synoptic and Dynamic Climatology*. U.K., Routledge.
3. Barry, R.G. & Corley, R.J. (1998). *Atmosphere, Weather and Climate*. N.Y., Routledge.
4. Batten, L.J. (1979). *Fundamentals of Meteorology*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
5. Pinet, P.R. (2008). *Invitation to Oceanography (Fifth Edition)*. USA, UK and Canada, Jones and Barlett Publishers.
6. Stowe, K. (1987). *Essentials of Ocean Science*. New York, John Wiley &Sons.
7. Sverdrup, K.A. & Armbrust. E.V. (2008). *An Introduction to the World Ocean*. Boston, McGraw Hill,
8. Thurman, H.V. (1996). *Essentials of Oceanography*. New Jersey, Prentice-Hall.
9. Tikka, R.N. (1989). *Physical Geography*. Meerut, Kedarnath Ramnath & Co.

GY 321 **Man and Environment** **3-0-0-3**

Basics of Environment: Environment: meaning, concept, definitions and types; Components of physical and cultural environment.

Relationship between Man and Environment:
Man and environmental relationship of time and space; Approaches in understanding the man and environment relation-Deterministic approach, Possibilistic approach and neo determinism, Geography and geographers: association with man and environment.

Changing relationship of Man and Environment and Issues:
Population explosion, technology and environment: changing relationship.

Environmental Issues: Environmental issues in Tropical, Temperate and Polar areas; Environmental hazards: natural and manmade.

Environmental Management: Environmental policies, Management, Concept of Sustainability.

Text Book:

1. Singh, S. (2015): *Environmental Geography*. Allahabad, Pravalika Publications.

Reference Books:

1. Chandna, R.C. (2002). *Environmental Geography*. Ludhiana, Kalyani.
2. Cunninghum, W.P. and Cunninghum M.A. (2004). *Principals of Environmental Science: Inquiry and Applications*. New Delhi, Tata Macgraw Hill.
3. Goudie, A. (2001). *The Nature of the Environment*. U.K., Blackwell, Oxford.
4. Miller, G.T. (2004). *Environmental Science: Working with the Earth*. Singapore, Thomson Brooks Cole,

GY 312 **Geography of Settlement** **3-0-0-3**

Basics of Settlement: Introduction: Nature and Scope; Basic Concepts: Rural and Urban Settlements, Hamlet, Village, Town, City, Metropolis, Megalopolis, Conurbation, Rural-Urban Fringe. **[9]**

Rural Settlements: Types and Patterns, Determinants. **[4]**

Theories of Settlement: Regional Settlement Hierarchy: Central Place Theory, Rank-Size Rule, Primate City. **[10]**

Urban Land use: Models; Types – Residential, Commercial, Industrial, Institutional, Recreational, Heritage, Public and Green Spaces, and Transport. **[9]**

Site and situation: Concept of Site and Situation, and Landuse, Services and Infrastructure; Problems and their prospects. **[7]**

Text Books:

1. Ghosh, S. (1999). A Geography of Settlements. Kolkata, Orient Longman.
2. Singh, R.Y. (1994). The Geography of Settlement. New Delhi, Rawat Publication.

Reference Books:

1. Chishlom, M. (2007). Rural Settlement and Land Use. U.S., Transaction Publishers.
2. Daniel, P. (2002). Geography of Settlement. Jaipur & New Delhi, Rawat publication.
3. Kaplan, D.H., Wheeler J.O. & Holloway S.R. (2008). Urban Geography. John U.S., Wiley.
4.Misra, R.P. and Misra, K. eds. (1998). Million Cities of India. New Delhi, Sustainable Development Foundation.
5. Pacione, M. (2009). Urban Geography: A Global Perspective. U.K., Taylor and Francis.
6. Ramachandran, R. (1989). Urbanisation and Urban Systems in India. India, Oxford University Press, India.
7. Ramachandran, R. (1992). The Study of Urbanisation. New Delhi, Oxford University Press.

GY 322 Spatial Dimensions of Development 3-0-0-3

Introduction to Development: Concept of Development; Measures of Development (Economic, Social and Environmental); Efficiency- Equity Debate. [8]

Regional Development: Concept of Region and Regional Development; Intral and Inter-regional Development pattern. [6]

Theories of development: Myrdal, Hirschman and Friedmann. [10]

Impact of Development: Interrelationship between environment and development; Impact on physical environment in terms soil erosion, land degradation, deforestation. [8]

Different Issues in Developed and Developing Countries: Pollution and issues in developed and developing countries of the world; Human development: International, interstate comparison of India. [7]

Text Books:

1. Claval, P.L. (1998). An Introduction to Regional Geography. Oxford and Massachusetts, Blackwell Publishers.
2. Gore, C.G. (1984). Regions in Question: Space, Development Theory and Regional Policy. London, Methuen.

Reference Books:

1. Abler, R., Adams, J. S., & Gould, P. R. (1971). Spatial Organization: A geographer's View of the World. Prentice-Hall, Englewood Cliffs.
2. Blij, H. J. (1971). Geography: Regions and Concepts. N.Y., John Wiley and Sons.
3. Friedmann, J. & Alonso, W. (1975). Regional Policy - Readings in Theory and Applications. Massachusetts, MIT Press.
4. Gore, C. G., Köhler, G., Reich, U-P. & Ziesemer, T. (1996). Questioning Development: Essays on the Theory, Policies and Practice of Development Intervention. Marburg, Metropolis-Verlag.
5. Haynes, J. (2008). Development Studies. U.K., Polity Short Introduction Series.
6. Peet, R. (1999). Theories of Development. N. Y., The Guilford Press.

GY 332 **Practical Geography-III** **0-0-4-2**

Basics of Survey: An introduction to survey and different instruments.

Prismatic Compass and Plane Table Survey: Prismatic compass survey and Plane Table Surveying

Weather instruments, Weather Maps and graphs: Introduction to weather instruments, Interpretation of weather maps, Hythergraph and climograph: uses and applications. 26

Introduction to Statistical Techniques: Frequency distribution, central tendency: mean, median and mode, measures of dispersions.

Text Books:

1. Hussain, S.K. & Nagaraj, M.S. (1992). Textbook of Surveying. New Delhi, S. Chand and Co. Ltd.
2. Pal, S. K. (1998). Statistics for Geoscientists. New Delhi, Tata McGraw Hill.
3. Sarkar, A. (1997). Practical Geography: A Systematic Approach. Hydrabad, Orient Longman Ltd.

Reference Books:

1. Elfic, M.H., Fryer, J.G. Brinkner, R.C. & Wolf, P.R. (1994). Elementary Surveying. London, Harper Collins Publishers.
2. Kanitkar, T.P. & Kulkarni, S.B. (1988). Surveying and Leveling, Part 1. Pune, Pune Vidyarathi Griha Prakashan,
3. Mahmood, A. (1977). Statistical Methods in Geographical Studies. New Delhi, Concept.
4. Monkhouse, F.J. & Wilkinson, R. (1971). Map and Diagrams: there compilation and construction. New Delhi, B.I. Publications Private Ltd.
5. Silk, J. (1979). Statistical Concepts in Geography. London, Allen and Unwin.
6. Singh, R.L. & Singh, R.P.B. (1991). Elements of Practical Geography. New Delhi, Kalyani Pub.
7. Venkatramaiah, C. (1996). A textbook of Surveying. Hydrabad, University Press/Orient Longman Ltd.

HY 111 Ancient Indian History– I

Objectives: The course intends to provide an extensive survey of early Indian history to the students of the history honors course. It also familiarizes them with the tools of studying ancient Indian history. It further aims empowers the students not only with the significance of sources in history writing but make them aware with the importance of environmental factors in the study of history

Unit1. Sources: Literary/written sources - Vedic/Hindu canonical literature: Buddhist Canonical Literature, Jain Canonical Literature, Secular Literary Sources - Sangam Literature. Foreign Accounts - The Greeks and Romans, Chinese. Material/Archaeological sources –Inscriptions, Epigraphs, Coins, and Monuments.

Unit 2. The Pre-Historic Period: Paleolithic Cultures – Sequence and geographical distribution, evolution and uses of stone industries. Mesolithic Cultures – regional and chronological distribution. Neolithic Age and Chalcolithic Age.

Unit 3. The Harappan Civilization: Origin, distribution, morphology of major sites (Mohanjodaro, Harappa, Kalibangan, Lothal, Dholavira). Society, economy, polity and religion as reflected in Vedic literature. Religious beliefs and practices and art and architecture.

Unit 4. Vedic age to 6th Century B.C: The origin of Aryans, geographical background, Political, Social, Economic and religious conditions of the Aryans in the Rig Vedic and Later Vedic Period. Rise of Territorial States in Northern India: Urbanisation of the Ganga Valley, Sixteen Mahajanapadas, Ascendency of Magadha. Iranian and Macedonian Invasion: Significance; Religious Movements in 6th Century B.C Buddhism and Jainism: Rise, Growth and Contribution to Indian History.

HY 121 Ancient River Civilization- I

Objectives: To offer a historical survey of human evolution. It details the features of material culture of early humankind by tracing the transitions from the hunting-gathering subsistence pattern to more advanced human subsistence patterns involving domestication of animals and food production. The paper highlights how such changes were gradual and did not unfold uniformly in all parts of the world; thereby allowing for coexistence of different subsistence forms.

Unit 1. Cradle of civilization Mesopotamia: Origin of Fertile Crescent, Geography, Early civilization of Sumerian, Akkadian, Babylonian and Assyrians, Religious Beliefs, Rituals and practices, Social Levels, Classification, Priest, King, Upper class, Nobles, Lower Class, Slavery, Medicines, Astronomy, Astrology, Time, Inventions, Mummification, Tools and Methods, Script on Tablets, Seals , Mode of warfare, Strategies, Government, Polity, Administrative units Law Code, Justice, Causes of Decline of Civilization.

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units, Social stratification in society, food, Dress, Social Classes, Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization, Contribution of Civilization

HY 112 Ancient Indian History–I

Objectives: This course is about early historical developments taking place in Indian history especially post-Harappan period, that is Vedic and later Vedic periods. Highlighting the features of early historic times , the course tries to trace the emergence of state system from proto-state stage and at the same time seeks to underline the important development in the arena of economy, society and culture.

Unit 1. The Age of Maurya: Sources of Mauryan History: Kautilyas Arthasastras and Meghsthenes Indica and Ashokan Inscriptions. Chandragupta Maurya, Bindusara and Asoka- Foundation and Consolidation of Empire, Administrative system. Ashoka's policy and reforms, Dhamma, Art and architecture: Decline of Mouryan Empire.

Unit 2. Post Mauryan Polity: Post Mouryan Polity in India: Ruling dynasties in Northern and Southern India: Sungas, Satavahanas and Kushanas. Rise of Kharavela in Kalinga. Sangam age- Literature, Economy and Society.

Unit 3. Age of the Guptas and Post-Gupta period (to c. 750): Political history of northern and southern India. Samanta system and Changes in political structure. Economy and Social structure. Culture and Religion.

Unit 4. Themes in early Indian cultural history: Languages and texts, Major stages in the evolution of art and architecture, Major philosophical thinkers and schools.

HY 122 Ancient River Civilization- II

Objectives: This paper traces the changing political formations, economic and social structures in the ancient Greek and Roman empires because ancient history of these two regions explain in great detail about Europe owes to the development of civilization to these particular regions in large measure**.**

Unit 1. Classical Greece civilization: Mythologies in ancient Greek, Social structure and stratification, Classes, Athens Olympics in ancient Greece, Art and Architecture in ancient Greece

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units Social stratification in society, food, Dress, Social Classes Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization Contribution of Civilization

HY 211 History of Medieval India (750-1526 A.D.)-I

Objectives: The purpose of this paper is to introduce to students the idea of major transition in early medieval India in the wake of disintegrating power at the Centre. It aims to guide students as to how the corresponding rise and rapid spread of Islam marks the advent of Islam in India through various channels**.**

Unit 1. Early Medieval India, 750-1200: Polity: Major political developments in Northern India and the Peninsula, Origin and the rise of Rajputs, The Cholas: administration, village economy and society -"Indian Feudalism" Agrarian economy and urban settlements, Trade and commerce, Society, Science and technology.

Unit 2. Cultural Traditions in India, 750- 1200: Philosophy: Skankaracharya and Vedanta, Ramanuja and Vishishtadvaita, Madhva and Brahma Mimansa, Religion, Tamil devotional cult, Growth of Bhakti, Islam and its arrival in India Sufism, Literature, Growth of Tamil literature, Kalhan's Rajtarangini, Alberuni's, Art and Architecture: Temple architecture, Sculpture, Painting.

Unit 3. Establishment of the Delhi Sultanate: The Ghurian invasions, Factors behind Ghurian success, Economic, Social and Cultural consequences, Foundation of Delhi Sultanate and early Turkish Sultans - Consolidation: The rule of Iltutmish and Balban.

Unit 4. "The Khalji Revolution": Alauddin Khalji, Muhammad Tughluq, Firuz Tughluq, Decline of the Sultanate, Foreign contacts and Ibn Battuta's account, Sayyid Dynasty: Khizr Khan, Mubarak Shah, Lodhi Dynasty : Bahlol Lodhi,. Sikander Lodhi, Ibrahim Lodhi, Sultanate administration.

HY 221 Main Outline of World History-I

Objectives: Through discussion of a period in Europe marked by Renaissance, Protestantism, Thirty-Years-War Counter-Reformation, rise of absolutism, this paper seeks to familiarize students with phenomenal movements in Europe in the fields of culture, religion and politics which laid the future roadmap for largerdevelopment in Europe and the world. It covers discussion on famous monarchs and friction between the state and the Church over the issue of power share.

Unit 1. Renaissance: Meaning and Definition, Nature & Impact, The Reformation, Causes, Nature of Reformation, Results, counter reformation.

Unit 2. Rise of National States: Causes Main monarchies and their growth - Ferdinand, Isabella of Spain, Louis XI of France, England - Henry VII, and Holy Roman Empire. Rise and Decline of Spain - Foreign Policy of Charles V, Philip II, Revolt of Netherland, Thirty Years War, Causes of downfall of Spain.

Unit 3. France under Henry IV: Growth of Royal absolutism, Cardinal Richelieu, Cardinal Mazarin, Louis-XIII, The Thirty Years War, Treaty of Westphalia, Louis XIV, Foreign Policy, Religious Policy , Policy of Colbert's.

HY 212 History of Medieval India (1526- 1740 A.D.)-II

Objectives: Teaching of this paper plans to demonstrate political transition with the establishment and consolidation of the Mughal Empire. It introduces students to a new rounds of social-political-cultural-religious and economic developments under the Mughal regime. By covering about a period of over two centuries, this paper covers the arrival of Europeans and takes into account a larger sort of development as a result of industrial development in Europe and its cascading impact all over places including India where it coincides with the downfall of a mighty Mughal empire. Other issues also get covered under this paper like

Unit 1. Mughal state's relation with regional powers (Rajput, Sikhs, Afghans, Marathas, Deccani kingdoms and the like.

Unit 2. Foundation and Expansion of the Mughal Empire: struggle for empire in North India; Babur's invasion; Mughal-Afghan conflict. Shershah Suri and his administrative reforms.

Unit 3. Consolidation of the Empire: Akbar's imperialist agenda—administration, Mansabdari system, Zabt system; Religion and state—Akbar to Aurangzeb; evolution of the nobility under the Mughals.

Unit 4. Mughal Economy, Society and Culture: rural society and agrarian relations; crafts and industries; monetary system; inland and oceanic trade; literature; technology; architecture and painting.

Unit 5. Disintegration of the Mughal Empire: problems of succession and court politics in the reign of Aurangzeb; popular revolts within the Mughal empire—the Jats, Satnamis, Afghans, and the Sikhs; crisis in the Jagirdari system; peasant uprising and agrarian crisis; Bhakti Movement & Prominent saints, Sufism meaning and Sects.

HY 222 Main Outline of World History-II

Objectives: The paper aims to acquaint the students with a brief history of Russia, Prussia and Austria from thematic standpoint of political and economic changes. Moreover, effort is to familiarize students with the development in the field of art and architecture along with the French revolution and further rise and fall of Napoleonic phase.

Unit 1. Rise of Modern Russia: Peter the great, Catherine II their foreign policies, Austrian Empire - War of Austrian succession - Treaty of Aix-La-Chapple, Causes of seven years' war, Foreign policy of Joseph II, The Rise of Prussia, Domestic, foreign and religious policy of Frederick the great.

Unit 2. The Baroque Age: Science and Technology in 17th and 18th Centuries, The Anglo-French Rivalry for overseas Colony, French Revolution, Causes and results.

Unit 3. Napoleon Bonaparte: Continental System, Battle of Waterloo-Fall of Napoleon-Vienna Congress-Concert of Europe .

HY 311 History of Modern India (1740-1857 A.D.)

Objectives: This paper on modern India familiarizes with the strategies of Europeans especially British traders who soon took over entire India under the initial garb of trading. Herein, the discussion encompasses the establishment, consolidation and ultimately dissolution of East India company and transfer of power to the British Queen in 1857-58. All sorts of developments during the stated period are discussed and debated in great detail. The ideas of modernity and modern ideas are also discussed in brief.

Unit 1. Political Condition of India in the 18th Century: Decline of Mughal emperor and its impact, Advent of Europeans in India – Establishment of bases and trading centres of East India Company and other European companies, Rise of Maratha power, Third battle of Panipat, Cause of defeat of Maratha's and impact of Maratha defeat, Early Anglo – French conflict.

Unit 2. Establishment of British rule in India: Causes of Anglo-French rivalry, Conflict in Bengal, Clive as Governor of Bengal, Battle of Plassey and Buxer, Administrative and Judicial Reforms. Consolidation of English Rule in India, Lord Cornwallis and his reforms, Judicial And Commercial reforms, Lord Wellesley, Lord William Bentinck, Lord Dalhousie and the policy of annexation (1848-56).

Unit 3. Relations of Leading Indian States with English powers: Anglo- Mysore relations – Anglo Mysore wars, Haidar Ali and Tipu Sultan, Anglo- Sikh Relations – Anglo-Sikh wars, Raja Ranjit Singh, Anglo- Maratha Relations- Anglo- Maratha wars.

Unit 4. Revolt of 1857: Causes, Nature and Impact, British Policy towards Burma, The British Afghan Policy –Afghan Wars, Policy Towards Sindh and Nepal, The British Social and Economic Policies.

HY 321 History of China and Japan(1840-1949)-I

Objectives. In this paper, focus is on gradual downfall of Chinese political system and gradual transition of power into the hands of Western powers especially Britain with the first and second Opium wars. The rise of regional powers and anti-manchus sentiments, anti-foreign sentiments, rise of Christianity, and occurrence of several rebellions and movements, the Chinese effort to modernize and militarize are planned to be cover under this paper.

Unit 1. Chinese Feudalism: Gentry, Bureaucracy and peasantry; The Confucian value system; Sino centrism; The Canton commercial system, The transformation of China into an 'informal' colony; the Opium Wars; The Unequal Treaties; The 'scramble' for concessions; Finance Imperialism; The 'Open Door' policy.

Unit 2. Agrarian and Popular Movements: Taiping and Yi Ho Tuan, Attempts at 'Self-Strengthening' (Tzu-Chiang): Reforms of 1860-95; 1898; and 1901-08.

Unit 3. The Revolution of 1911: Causes, Nature and significance; The social composition of the Revolution; Sun-Yet-Sen and his contribution; The formation of the Republic; Yuan Shih Kai; Warlordism. May Fourth Movement of 1919: Nature and significance.

HY 312 History of Modern India (1858-1947 A.D.)

Objectives: This paper provides a thematically arranged overview of the history of India from the first major revolt of 1857 to the making of the republic in 1950. The paper tries to bring up discussion about changing nature of leadership and forms of resistance over period of time.

Unit 1. Impact of the rule of British Rule in India: Destruction of village economy and handicrafts, Impact on agriculture and Industries, Social Impact- Social and Religious reform movements.

Unit 2. Early Stages of Emergence of Nationalism: Peasant and tribal revolts, rise of middle class, Formation of Associations and Pressure groups, Birth of the Indian national Congress, Rise of the Extremism in the Indian National Congress, Programs and objectives of moderate and extremist functions, partition of Bengal and Surat split, Swadeshi Movement, Leaders of Extremist and Moderate factors.

Unit 3. Rise of Revolutionary Nationalism: Impact of Bengal partition, Growth of revolutionary ideas and organization in India and abroad, Home Rule movement, Lucknow Pact, Rise of Communal organizations, Gandhian movements, Rowlett Act, Kilafat Movement, Round table conference, Poona Pact, British Response to Indian Demand – Simon Commission, Rise of communal Politics – Policies and Act of Muslim League and other communal bodies, the Jinnah Factor, Partition of India and attainment of freedom, August offer, Cripps mission, cabinet mission, Wavell Plan, Mount Batten Plan, Leaders of Indian National Movement.

Unit 4. Constitutional Development: Queen's Proclamation and Act of 1858, Indian Council Act 1892, Indian Council Act 1909, Govt. of India Act 1919, Govt. of India Acts 1935, 1947

HY 322 History of China and Japan(1840-1949) -II

Objectives: The purpose of this paper is to discuss the end of dynastic rule in China, beginning of new era altogether with contestation between nationalists and communists for Centre stage of politics along with unsuccessful attempt to revive the dynastic and traditional pattern. There is also an effort to situate China in a new global order which was underway. There is particular reference to the rise communism under the leadership of Mao Zedong. In this paper, the rise of Japan as a new force to reckon with in East Asia under the restored Meiji government has been discussed along with the Japanese antagonism with USA and its consequences.

Unit 1. Nationalism and Communism in China (1921-1937): Formation of the CCP, The Kuomintang (Nationalist Party or KMT), The First United Front.

Unit 2. The Communist Movement (1928-1949): The Jiangxi Period and the rise of Mao Tse-Tung, The Second United Front.

Unit 3. Transition from feudalism to capitalism: Crisis of Tokugawa, Bakuhan system, Meiji Restoration, Political Reorganization, Military Reforms, Social, Cultural and Educational reforms (Bunmeikaika), Financial reforms and Economic development in the 'Meiji' era, Meiji Constitution. Japanese Imperialism: China, Korea and Manchuria. Democracy and Militarism/Fascism: Popular/People's Rights Movement, Nature of political parties, Rise of Militarism, Second World War.

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology. [8]

Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services. [7]

Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling. [6]

Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures. [9]

Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures. [9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya	[12]
Bal Gangadhar Tilak, Gopal Krishna Gokhale	[15]
Raja Ram Mohan Roy, Dayanand Saraswati	[12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement	[8]
Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947	[8]
Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features	[13]
Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism	[10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha	[8]
Executive: President, Prime Minister and Cabinet	[8]
Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation	[12]
Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups	[11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress	[11]
Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China	[14]
Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China	[14]

M.A. Psychology 2018-2019

PL 511 Advanced General Psychology-I 4-0-0-4

Introduction to Psychology: Definition, Nature, Scope, Purpose of psychology, Methods of Psychology: Observation, Experimental, Case Study. [6]

Biological Basis of Behaviour : Neuron and its structure, Nervous System; Peripheral & Central Nervous system, Endocrine gland and Personaliy. [12]

Sensory-Perceptual Processes: Visual, Auditory- Structure and function of eye and ear. Attention: Nature of Attention and its determinants, Perceptual organization: Perceptual Constancy, Determinants of perception, Types of perception: Form, Space, Depth. Methods of Psychophysics, Signal Detection theory and Subliminal Perception. [12]

Learning: Classical Conditioning: Procedure, phenomena & related issues **,** Operant Conditioning; Procedure, phenomena & related issues, Cognitive theories of learning: Latent, Insight, Observational**,** Neurophysiology of Learning. [10]

Memory & Forgetting: Models of memory; Atkinson & Shiffrin, Craik & Lockhart, Tulving**,** Sensory, Short term & Long term Memory; Flashbulb memory, Reconstruction and distortion of memory, Biological Basis of Memory, Improving memory strategies**,** Forgetting; Theories of forgetting [12]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology.* Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan.* Motilal Banarasi Das, Varanasi.

PL 521 Applied Psychology-I 4-0-0-4

Introduction: Nature, scope, history, fields, methods and importance of applied psychology. [8]

School Psychology: Role of psychologist in school system, measurement and evaluation, education technology, behavior modifications in classroom. [10]

Guidance & Counselling: Types of guidance and counselling, counselling process, characteristics of a effective counsellor, ethics of counselling, uses of psychological tests in counselling, counselling effectiveness in solving personal, social, educational and career, developmental, preventive and curative aspect of counselling. [12]

Mental Health and Hygiene: Factors affecting mental health, indicators of mental health, role of psychologists in promoting mental health, alternative therapies for promoting mental health. [12]

Neuropsychology: what is neuropsychology, scope, functions of neuropsychologists, techniques of neuropsychology. [10]

Suggested Books:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Singh, A. P. Vyavaharik Manovigyan. Abhishek Publication, Varanasi.
3. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
4. Rao, S. N. *Counselling and Guidance*. Tata McGraw-Hill, New Delhi.
5. Charles, J. G., & Bruce, R. F. *Counseling Psychology: Practices, Issues and Intervention*. CENGAGE Learning, New Delhi.
6. Sue, R., Sue, D., & Sue, S. *Understanding Abnormal Behaviour*. Houghton Mifflin.
7. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
8. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.

PL 531 Systems in Psychology 4-0-0-4

Development of Psychology as a Discipline: History of Psychology, how psychology as evolved as an independent discipline, Structuralism; Wundt and Tichener, Functionalism: Dewy, William James, Galton. [10]

Behaviourism school of psychology: Pavlov, Skinner, Thondike, Watson, Lashley. [10]

Gestalt School of Thought: Max Wertheimer, Kohler and Kofka, Jean Piaget. [10]

Psychoanalytic and Neo- Psychoanalytic Prospective: Freud, Jung, Erikson, Adler, Horney, Eric Fromm. [11]

Humanistic and Existential Perspective: Maslow and Carl Rogers, Victor Frankl, Rollo May. [11]

Suggested Books:

1. Wolman, B.B., *Contemporary theories and systems of Psychology*, Harper and Bors, N.Y.
2. Chaplin, T. Kraweic, T.S. *Systems and Theories of psychology*. Holt Rinehart and Winston.
3. Schiffman, H.R. *Sensation and Perception.* New York : John Wiley and Sons.
4. Hilgard, E.H., and Bower, G.H. *Theories of Learning*. Englewood Cliffs : Prentice Hall.
5. Matlin, M.W. *Cognition*. Bangalore : Prism.
6. Mazur, J.E. *Learning and Behaviour*. Englewood Cliff's : Prentice Hall.
7. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's *Experimental Psychology*. London : Methuen and Co.
8. Marks, M.H. and William, A. Cronan – Hillix, *Systems and Theories in psychology*. McGraw Hill International Editions, Psychology Series.
9. Vygotsky, L.S. *Thought and Language*, Cambridge, mass. MIT Press.
10. Hall C.S. : Lindzey, G. *Theories of Personlaity*. New York : Wiley Eastern Limited.
11. Leahey, Thomas.Hardy, *History of Psychology: main currents in psychological thought*, New Delhi: Peacock Books.

PL 541 Life Span Developmental Psychology 4-0-0-4

Introduction to life span psychology: Meaning, nature, purpose, scope, Methods; Longitudinal, cross-cultural**,** Stages of human development, Difference between growth and development, Types of development; Quantitative and qualitative. [12]

Pre-natal and Neonate development: Conception**,** Stages of pre natal development, types of birth and its impact. [10]

Infancy and Childhood: Developmental milestones, cognitive, motor, moral, social, emotional, language development. [10]

Adolescent: Physical and psychological changes**,** Developmental task of adolescent**,** Problems of adolescent. [10]

Adulthood and old age: Choice of vocation, Adjustment to career, marriage and family, Developmental tasks of adulthood**,** problem of aging**,** Special issues of old age. [10]

Suggested Books:

1. Hurlock, E. *Child Development*. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. *Child Development.* Prentice-Hall of India, New Delhi.
3. Kaluger, G. S., & Kaluger, M. F. *Human Development: The Span of Life*. Times Mirror, St. Louis.
4. Santrock, J. W. *Life-Span Development*. McGraw-Hill, New York.
5. Shaffer, D. R. *Developmental Psychology*. Brooks & Cole, California.

PL 551 Practicum-I 0-0-8-4

Assignments are based on the courses PL 511 Advanced General Psychology-I, PL 521 Applied Psychology-I, PL 531 Systems in psychology, PL 541 Life span development Psychology.

PL 561 Seminar-I 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 512 Advanced General Psychology-II 4-0-0-4

Motivation: Motivational Cycle, Biological & Social Motives, Theories of motivation. [8]

Emotion: Physiological correlates of emotions**,** Theories of emotions, Conflict & Stress management. [8]

Thinking: Language &Thought, Imagination, Theories of thinking**,** Problem Solving, Reasoning, Decision Making & Creative thinking with classroom implication. [10]

Cognition & Meta-cognition: Factor & Process theories, Abilities & achievement- concept & Role of Emotional Intelligence, Classroom implication of Gardner's Multiple Intelligence Theory, Meta-cognition-Concept & Implication. [12]

Personality Approaches of personality- Psychoanalytic, Neo-Freudian, Social Learning, Trait & Type, Cognitive, Existential & Humanistic**,** Personality Assessment- Projective, psychometric & Behavioral measure. [14]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology*. Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan.* Motilal Banarasi Das, Varanasi.

PL 522 Applied Psychology-II 4-0-0-4

Industrial and Organizational Psychology: Principles and dynamics of organizational behavior; Motivation, Job satisfaction, models of leadership, work enviorment, personnel psychology, engineering psychology, role of industrial and organizational psychologists. [12]

Consumer Psychology: Nature and functions, consumer decision making, Black Box model of consumer behavior, factors affecting consumer decision making, e-shopping, virtual mall, Different modes of advertisement, Role of psychological factors in making advertisement**.** [10]

Clinical Psychology: concept of normality and abnormality, characteristic of abnormal behavior, causes of psychopathology, various psychopathological disorders; neurosis, psychosis, assessment and treatment; psychoanalytic, behavioural, cognitive. [12]

Forensic and Law Psychology: Introduction and Historical Perspective, Fields of Forensic Psychology, Criminal Identification techniques, Psychology and judicial process, Eyewitness testimony, role of psychologist in legal judicial system, juvenile delinquency, ethical issues in forensic psychology, Police interrogation and false confession, Legal rights of inmates: Rights to treatment, Right to refuse treatment. [10]

Sports Psychology: What sports psychologists do, role of psychology in motivation, mental health, skills to enhance performance, sport injury and rehabilitation of athletes. [8]

Suggested Book:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. *Industrial Psychology*. Prentice Hall, Englewood Cliffs.
4. Misra, G. *Psychological Perspective on Stress and Health*. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. *Social Psychology*. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. *Psychology in Sports: A Contemporary Perspective*. Friends, New Delhi.

PL 532 Psychometrics and Statistics in Psychology 4-0-0-4

Psychometrics: Measurement in Psychology, History of psychological measurement & testing, Levels of Measurement; Scales, Functions of measurement, General problems of measurement. [10]

Test development: Meaning & Classification of psychological tests, Characteristics of a good test, Ethical issues in psychological testing, Uses and limitation of Psychological tests, General steps of test Construction; Item writing, Item analysis, reliability, validity & norms. [12]

Overview of descriptive statistics and probability: Overview of measures of Central tendency, variability, curves and graphs , Percentiles, percentile ranks and standard scores, Characteristics of normal distribution curve. [10]

Parametric statistics: t-test and ANOVA, Correlation and regression analysis. [10]

Non parametric statistics: Chi-square, Mann-Whitney U test, Rank-difference Method, Coefficient of Concordance, Kruskal –Wallis H test, Friedman test. [10]

Suggested Books:

1. Garrett, H. E. *Statistics in Psychology and Education*. Paragon International Publishers, New Delhi.
   McGuigan, F. J. *Experimental Psychology*. Prentice-Hall of India, New Delhi.
2. Broota, K. D. *Experimental Design in Behavioural Research.* Wiley Eastern, New Delhi.
3. Guilford, J. P., & Fruchter. *Fundamentals of statistics in Psychology and Education*. Kogakusha, Tokyo.
4. Kapil, H. K. *Sankhyiki Ke Mool Tatwa*. Vinod Pustak Mandir, Agra.
5. Anastasi, A. & Urbina, S. (1997). Psychological testing. N.D.: Pearson Education.
6. Singh, A.K. (2006). Tests, Measurements and Research Methods in Behavioural Sciences.Patna: Bharati Bhavan.

PL 542 Research Methodology 4-0-0-4

Research: Meaning and characteristics of research, Stages in Research, Types of Research and Meaning, types and methods of sampling. [8]

Problem and Hypothesis: Meaning and characteristic of a problem, Sources of stating up a problem, Types of problem, Meaning and characteristics of a good hypothesis, Formulating a hypothesis, Sources of hypothesis. [8]

Review of Literature: Purpose of the review, Sources of the review, Types of literature, Writing process of the literature review. [10]

Variables: Types of variables, Methods of measuring dependent variable, Approaches to manipulate variables**,** Techniques of controlling extraneous variables. [10]

Research Design: Meaning and purpose of research design, types of research design, between group and within group design. [10]

Research Report & Research Proposal: purpose, structure and style of writing a research report, preparing a research proposal. [6]

Suggested Books:

1. Guilord J.P. *Psychometric Method*. McGraw Hill. N.Y.
2. Guilford J.P. Fruchter's. *Fundamental Statistics in Psychology Education*. International McGraw Hill Publisher, New York.
3. Kerlinger, F.N. *Foundations of Behavioral Research*. ND : Surjeet.
4. Kothari, C.R. *Research Methodology, Methods and Techniques.* ND : Wiley Eastern Limited.
5. Broota; K.D. *Experimental Design in Behavioral Research*. Wiley Eastern. New Delhi.
6. Singh, A.K. Tests, *Measurements and Research Methods in Behavioural Sciences*.Patna: Bharati Bhavan.

PL 552 Practicum-II 0-0-8-4

Assignments are based on the courses PL 512 Advanced General Psychology-II, PL 522 Applied Psychology-I, PL 532 Psychometrics and Statistics in psychology, PL 542 Research Methodology and Field Study.

PL 562 Seminar-II 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 611 Peace Psychology 4-0-0-4

Introduction: Psychology of peace, Types of peace, Historical perspective of peace psychology, role of individual and society. [8]

Peace and Non-Violence: Indian perspective of peace**,** views of Buddha, Mahaveer, Gandhi, Values of non-corporation and Indian experience. [10]

Violence: what is violence, different types of violence as School, youth, domestic, cultural, structural, direct etc, causes of violence, impact of violence. Role of individual and society in reducing violence. [10]

Life Peace and Culture: role of peace education, colobration, humility and social values in promoting peace in individual and social living [12]

Psychology of specific conflicts and peace efforts: war ethics and Geneva convention, role of organizations promoting peace, accounts and challenges. [12]

Suggested Books:

1. Suryanarayan, N.V.S. Peace Psychology. Discovery Publishing House, Pvt. Ltd.
2. Christie, D. J., Wagner, R.V., and Winter, D.A., Peace, Conflict and Violence: Peace Psychology for the 21st century. Englewood Cliffs, N.J: Prentice Hall.
3. Aber, L.,Brown, J., and Henrich, C.Teaching Conflict Resolution: An Effective School based Approch to Violence Prevention. N.Y.:National Centre for Children for Poverty.

PL 621 Social Psychology 4-0-0-4

Social Psychology: Introduction to social psychology, definition, nature and scope of social Psychology, Methods of social Psychology: Experimental and Non-experimental. [10]

Social Per caption and Social Cognition: Meaning of social perception, Role of non verbal communication in social perception, Role of schemas, heuristics, automatic and controlled processing**,** Potential sources of error in social cognition. [12]

Attitudes: Meaning and Characteristics of attitudes**,** Attitude formation**,** Attitude change**,** Theories of attitude change; cognitive dissonance.

Interpersonal attraction: Meaning and nature of interpersonal [10] attraction, Internal and External determinants of attraction, Theories of attraction.

Stereotype, Prejudices and Discrimination: Meaning and nature [10] of prejudice**,** Formation of norms and prejudice**,** Techniques for countering its affects**,** Difference between prejudice, stereotype and discrimination.

[10]

Suggested Books:

1. Baron, R.A., Byrne, D. *Social Psychology* -Prentice-Hall.
2. Daniel, P, Cozby, P.C. *Social Psychology*, New York: CBS College Publishing Holt, Rinehart and Winston.
3. Lindzey, L., and Aronson, E..*The Handbook of Social Psychology* , Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S . *Social Psychology,* Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. *Handbook of Psychology* (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. *Social Psychology*-Tata McGraw Hill International Editions.
7. Penrod, S. *Social Psychology* ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K. *Samaj Manovigyan Ki Rooprekha*, NewDelhi: Moti Lal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O. *Social Psychology* - Pearson Education.

PL 631 Introduction to Guidance 4-0-0-4

Guidance: Historical Perspective**,** Objectives & Principles of guidance**,** Types of guidance-Educational, Career, Personal and Social. [6]

Guidance and School Education: Guidance and role of teacher, parents, Counsellor and school administration, facilitating learning through guidance. [10]

Pupil Personal Services: Orientation, Evaluation, Individual inventory service, Information service, counselling service, Placement and evaluation and research. [14]

Guidance and School curriculum: Meaning of curriculum, Why guidance and Curriculum is inseparable, role of counselor in curriculum planning, personalization of curriculum, guidance functions through the subject matter areas. [8]

Special Concern for Guidance: Guidance of special group of Children; Cognitive, Physical, Social and Emotional exceptionality**,** Guidance for Drug abuse, delinquent behavior, adult Sex abuse, spouse abuse ,child abuse, HIV, ADHD, Learning disability. [14]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
3. Jones. A.J., *Principal of Guidance*, McGraw Hill, N.Y.
4. Psricha, *Guidance and Counselling in Indian education*, New Delhi, NCERT.
5. Mayers, G.E., *Principles and Techinques of vocational Guidance*, McGraw Hill, N.Y.

PL 641 Introduction to Counselling Psychology 4-0-0-4

Definition and history of counselling: What is counselling, effectiveness of counsellor, ethical and legal aspects of counselling. Individual and Group counselling, Stages of group counselling. [10]

Counseling Process: External Conditions and preparation, Stages of counselling process. [12]

Rapport Building- Building counselling relationship, generic and specific skill for rapport building. [10]

Assessing the Problem: Purpose, component, types of problems, skills required by counsellor for assessing the problem. [10]

Goal Setting: Functions and types of goal, obstacles in setting specific goals, effect of goal setting , skills associated with goal setting. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.

PL 651 Practical of Guidance & Counselling Psychology 0-0-8-4

Assignments are based on the courses PL 631 Introduction to Guidance, PL 641Introduction to Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 661 Advanced Industrial Psychology 4-0-0-4

Introduction to industrial psychology: Definition, role, Nature and scope**,** Origin and History of industrial psychology**,** Contribution of Hugo Munsterberg, Taylor, Gilbreth and Alton Mayo. [10]

Job Analysis: Purpose, importance and uses of job analysis**,** Various methods of job analysis**,** Job design approaches and job enrichment [10]

Recruitment and selection: Purpose and importance of recruitment and selection**,** Recruitment process; external and internal**,** Stages in selection process**,** Selection methods. [10]

Personnel Training: Nature and principals of training**,** Assessing training needs**,** Training methods; on-the job training, of the job apprenticeship, business games, Evaluation of training programme. [10]

Performance appraisal system: Purpose, importance, Uses of Performance appraisal**,** Methods of evaluating Performance appraisal; traditional methods, 360 degree appraisal and management by objectives**,** Issues and biases related to Performance appraisal. [12]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975. *Industrial Psychology*, Prentice Hall, 6th Ed.
2. Glimer. *Industrial Psychology*.
3. Ghiseli and Brown. *Personnel and Industrial Psychology*.
4. Dunnette, M.D. Handbook of Industrial and Organizational Psychology.
5. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
6. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
7. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co

PL 671 Dynamics of Organization Behaviour-I 4-0-0-4

Introduction: Meaning and Importance of OB, Historical overview; Classical and Neo-classical**,** Approaches of OB; contingency and system approach. [10]

Motivation in Organization: Needs theories of motivation**,** Equity theories of motivation**,** Job Design and work motivation**,** Determinants of job satisfaction**,** Organizational commitment, citizenship behavior and organizational justice. [10]

Leadership: Trait Theories, Behavioural Theories, Contingency theories: Fiedler Modal and situational leadership Theory; Path Goal theory, Inspirational Approaches to leadership: Charismatic Leadership; Transformational Leaders**,** Authentic Leadership: Ethic and trust are the foundation of leadership**,** Contemporary Leadership Roles: Mentoring, self Leadership, E-Age. [12]

Organizational Communication: Meaning and functions**,** Directions of communication in organization**,** Directions and methods of improving communications**,** Barriers of effective communication. [10]

Decision Making: Nature of decision Making, Behavioural decision

making: decision rationality, models, decision making techniques: [10] traditional and Modern Participation technique.

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour,* Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
8. Nelson, D.B. and Quick J.C. (2005) *Understanding Organizational Behavior.* South Western Thomson Learning.

PL 681 Practical of Industrial & Organizational Psychology-I 0-0-8-4

Assignments are based on the courses PL 661 Advanced Industrial Psychology, PL 671 Dynamics of Organizational Behaviour-I. That also accompany by field visit, and practical's related to compulsory papers.

PL 691Synopsis 0-0-0-2

The student has to submit two copies of a research proposal by first week of November in the department. It will be followed by presentation for approval.

PL 612 Positive Psychology 4-0-0-4

Introduction to Positive Psychology: Positive Psychology; Goals & Definition, Western & Eastern view of Positive Psychology, Classification and measurement of Human Strengths & Positive outcomes**,** Developing Strength and living well. [10]

Positive Emotional states and processes: Pleasure, positive effect, Happiness & Wellbeing, Emotional intelligence**,** Living well across life stages. [10]

Positive cognitive states and processes: Self efficacy and self acceptance, wisdom, optimism & hope, Mindfulness and flow. [10]

Pro-social behavior and well-being: Empathy, altruism, gratitude, Forgiveness, attachment, Positive experiences in school life. [10]

Spirituality and Positive Psychology: Creativity, giftedness and industry, Religion & spirituality, Emotional and social intelligence. [12]

Suggested Books:

1. Snyder, C.R. & Lopez, S.J., *Positive Psychology*. New Delhi: Sage.
2. Snyder, C.R. & Lopez, S.J., Handbook of Positive Psychology. N.Y.Oxford.
3. Wong.P.T. & Fry. The Human Quest for meaning. Mahwah, New Jersey. Lawrence, Erlbum.
4. Baumgardner, S. & Crothers, M. Positive Psychology, New Delhi, Pearson Education.

PL 622 Health Psychology 4-0-0-4

Physical and Mental Health: what is health, what is physical and mental health, relationship between physical and mental health, different dimensions of mental health, concept of psychological health in india, the development of changed outlook in nature of health and illness, scope of health psychology [10]

Eating Behaviour: what is healthy diet, how does diet affect health, models of eating behavior, weight concern and eating behavior, dieting, overeating, under eating, Body dissatisfaction, causes of body dissatisfaction, obesity; role of psychological factors in obesity, relation of obesity with coronary heart diseases, diabetes and other health problems. [12]

Exercise: what is exercise, why exercise, different forms of exercise including yoga, meditation, pranayam, aerobics etc., physical and psychological benefits of exercise, Relation of exercise with mood, depression, pleasure and good health. [10]

Sex and women's health issues: sex as biological for reproduction, sex as a risk and pregnancy avoidance, use of contraception, sex as a risk to health in context of STDs/HIV and AIDS, Sex education. [10]

Health behaviour and Primary prevention: What is health bhaviour, Barriers to effective health promotion. Factors influencing the practice of health behavior, Modification of health behavior. Changing health behaviours by changing health beliefs, Changing health behaviours through social engineering. [10]

Suggested Books:

1. Ogden, Jane. *Health Psychology*.Mcgraw Hill Education, India.
2. Brannon, Linda. Introduction to Health Psychology, Australia: Thomson, Wadsworth.
3. Baum, A. Revenson, T.A. and Singer, J.E. Handbook of Health Psychology, New Jersey: Lawrence Erlbaum.
4. Dimatteo, M.R., and Martin, L.R. *Health Psychology*. Boston: Allyn and Bacon.
5. Marks, D., Murray, M., Evans, B. and Willing,C. *Health Psychology: Theory, research and practice*. New Delhi: Sage.

PL 632 Intervention in Guidance & Counselling 4-0-0-4

Psychoanalytical Approach: Classical psychoanalytic theory, view of human nature, role of counsellor, goals and techniques of psychoanalytic approach. [10]

Cognitive Approach: Back's cognitive therapy and ELLIs Rational Emotive theory, Transactional analysis. [10]

Gestalt Approach: Fritz Perls therapy, goal, view of human nature and techniques of gestalt therapy. [10]

Behavioural Approach: Techniques based on classical and operant conditioning for behavior modification: systematic desensitization, flooding, shaping, aversion, punishment, assertive training etc. [12]

Humanistic & Existential Approach: Carl Rogers Clint centered therapy, Rollo May and Victor Frankls therapy. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.
3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.

PL 642 Areas of Counselling Psychology 4-0-0-4

School Counselling: Developmental, Preventive and curative aspects of counselling at elementary, middle and secondary school, role of counselling in promoting academic excellence and personality development of the students. [10]

Career Counselling: Career as a way of life, concept of career choice, measurement of career choices, role of personality, interest and values in career choice, major theories of career counselling: Holland theory. [10]

Crisis Intervention counselling: Introduction, types of crisis, typical response to crisis, process and principles for crisis intervention. [10]

Counselling across the life span: Counselling before planning the pregnancy, during and after the pregnancy, counselling for parents, child and adolescent counselling, counselling for adults and old-age people. [12]

Emerging fields and trends in Counselling: Multi-cultural, homosexual, marriage, rehabilitation, mental health, substance abuse, [10]

HIV and Health counselling, computers, feminist prospective, group work etc.

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). *Introduction to Counselling*. W.G. : Brown Publishers.
3. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy* : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) *Career Counselling Techniques*, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) *Career Counselling a Developmental Approach*, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 652 Practical of Guidance & Counselling-II 0-0-8-4

Assignments are based on the courses PL 632 Interventions in Guidance & Counselling, PL 642 Areas of Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 662 Engineering Psychology 4-0-0-4

Human engineering: Scope and origin of engineering psychology**,** Importance of engineering psychology**,** Aim of engineering psychology. [10]

Man-machine system: Meaning of man-machine system**,** Design, display, control and action**,** Application of man-machine system. [10]

Working Conditions: Concept of efficiency and Work curve**,** Physical enviorment; noise, illumination, atmospheric conditions, music, rest pauses**,** Working conditions and performance. [10]

Accidents and Safety: Definition of accident, risk taking behavior and accident proneness**,** Human and economics cost of accidents**,** Causes of accidents**,** Individual, situational, organizational factors related to accident reduction; safety measures. [12]

Work and Fatigue: Concept of work and fatigue**,** Work schedule**,** Methods of design**,** Monotony and boredom, Way to reduce monotony and boredom. Industrial morale. [10]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975.*Industrial Psychology*, Prentice Hall, 6th Ed.
2. McCormick D.J. 1976. *Human Factors Engineering and Design*. McGraw Hill 4th Edition.
3. Glimer. *Industrial Psychology*.
4. Ghiseli and Brown. *Personnel and Industrial Psychology*.
5. Dunnette, M.D. *Handbook of Industrial and Organizational Psychology.*
6. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
7. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
8. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co.

PL 672 Dynamics of Organizational Behaviour-II 4-0-0-4

Organizational Structure: Meaning and issues in organizational structure**,** Work specialization, departmentalization, chain of command, span of control, centralization v/s Decentralization**,** Traditional organizational structure; The team structure, the virtual organization, the boundary less organization. [12]

Organizational culture: Organizational culture meaning and definition and related concepts**,** Perspective and topologies of organizational culture**,** Creating and sustaining culture. [10]

Organizational Change and development: Nature and perspective of change**,** Levels of change, structure, technology and leadership**,** Types of change; organizational change as growth, transformation and as turn [10]

around, Resistance to change, Strategies to overcome resistance to change, Nature and importance of organizational development, Role, values and ethics of organizational development practitioners.

Group Dynamics: Meaning, nature and types of group, concept of group dynamics and theories of group formation, group role, norms, decision making. Group cohesiveness and group conformity. [10]

Conflict and stress: Meaning and types of conflict, Interpersonal and Intergroup conflict, Work-family conflict, Strategies for conflict resolution, Work stress; sources, consequences, managing stress: individual and organizational coping strategies. [10]

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour*, Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
5. Nelson, D.B. and Quick J.C. (2005) Understanding Organizational Behavior (2nd Edition) South Western Thomson Learning.

PL 682 Practical of Industrial & Organizational Psychology -II 0-0-8-4

Assignments are based on the courses PL 662 Engineering Psychology, PL 672 Dynamics of Organizational Behaviour-II. That also accompany by field visit, and practical's related to compulsory papers

PL 692 Dissertation 0-0-0-4

The student has to submit two copies of dissertation by the first week of May in the department. It will be followed by presentation and viva-voce.

MA English 2018-2019
M. A. (English)

EL 551 Modern English Grammar and Usage 4-0-0-4

Basic Sentence Types: Subject, Predicate, Object, Adjunct	[10]
Coordination and Subordination: Simple Sentence and Complex Sentence	[6]
Different Concepts and Notions: Request, Order, Question, Condition, Purpose, Suggestion, Wish, Hope, Intention, Obligation, Contrast, Commission	[7]
Theme Writing: Development of thoughts, Consistency in writing, Vocabulary	[6]
Fallacies	[6]
Literary Appreciation	[5]
Précis Writing	[5]
Critical Reading Skills	[7]

Suggested Readings:

1. A.S. Hornby: A Guide to Patterns and Usage, (Oxford 1984).
2. CIEFL - Material on Morphology and Phonology from the Distance Education Dept.1992.
3. George Yule: The Study of Language, CUP (ELBS, 2002)
4. Geoffery Leech: English Grammar for Today (Longman, 2004)
5. Praveen K Thaker: Appreciating English Poetry: A Practical Course and Anthology, Orient Lognman,1999
6. Effective English Communication, Krishna Mohan and Meenakshi Rama, Tata McGraw Hill, 2001.
7. Spoken English, V. Sasi Kumar and P.V. Dhamija, Tata McGraw Hill, 2001.

EL 513 Middle Ages to the Seventeenth Century English Literature-I 4-0-0-4

Geoffrey Chaucer: General Prologue to the Canterbury Tales	[10]
Christopher Marlowe: Doctor Faustus	[8]
William Shakespeare: As You Like It, King Lear	[10]
Francis Bacon: Of Envy, Of Love, Of Adversity	[6]
John Donne: The Extasie, The Relique, The Flea	[7]
John Milton: Paradise Lost, Book I	[11]

Suggested Readings:

1.Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd, 1995.
2.Daiches, David: A Critical History of English Literature (vol. I), Delhi, Allied Publishers, 1998.

EL 571 Eighteenth Century to the Twentieth Century English Literature-I 4-0-0-4

John Dryden: Absalom and Achitophel	[9]
Jonathan Swift: The Battle of the Books	[4]
Alexander Pope: The Rape of the Lock	[9]
William Wordsworth: The Prelude, Book I	[8]
S.T. Coleridge : The Rime of Ancient Mariner	[4]
Percy Byssey Shelley: Adonais	[4]
Robert Browning: My Last Duchess	[5]
Gerard Manley Hopkins: The Windhover, Felix Randal.	[5]
Thomas Stearns Eliot: The Four Quarters	[4]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5.A,R, Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.1994.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.1964.

EL 523 American Literature 4-0-0-4

Ralph Waldo Emerson: The American Scholar	[4]
Walt Whitman: Crossing Brooklyn Ferry, Passage to India, I Hear It Charged Against Me	[8]
Sojourner Truth : Ar‟n‟t I a Woman?- Speech to the Women‟s Rights Convention in Akron, Ohio, 1851	[4]
Robert Frost: Birches, Mending Wall	[6]
Wallace Stevens : Thirteen Ways of looking at a Blackbird	[4]
Eugene O'Neill: Emperor Jones	[8]
N. Hawthorne: The Scarlet Letter	[8]
Tony Morrison: The Bluest Eye	[10]

Suggested Readings:

1.Bloom, Harold. ed. EuqueneO‟neill. New York, Chelsea, 1987.
2.Bentley, Eric. in Search of Theatre. New York, Knop, 1953.
3.Baqohee, Shymal. ed. Perspectives on O‟Neil:New Essays. New york:University of Victoria,1988
4.Lewis, Allan. American Plays and Playwrights of the Contemporary Theatre. New York:Crown, 1965.
5.Mukharjee, Sujit, and D.V.K. Raghara-Charyulu eds. Indian Essays in American Literature. 1969.
6.Ford, Boris. ed. The New Pelican Guide to English Literature, Vol. 9.1994.
7. Morrison, Toni. Playing in the Dark, I Chapter.2004.
8. Robert Spiller: Literary History of the United States, (Amerind Publishing Co.2006)
9.Marcus Cunliffe : American Literature to 1900, (Sphere Reference)
10.F.O.Matthiessen. American Renaissance, 1992.
11. George McMichel : Concise Anthology of American Literature.2000.
12. SD Palwekar, Literature and Environment:A Select Study of British, American and Indian Writings, Lambert Academic Publishing, Germany, 2012.

EL 591 Indian Writing in English 4-0-0-4

Raja Rao : Kanthapura	[8]
Anita Desai : Clear Light of Day	[8]
Salman Rushdie: Midnight‟s Children	[10]
A. K. Ramanujan : Is There an Indian Way of Thinking: An Informal Essay	[4]
Toru Dutt : Savitri- Part I	[4]
Nissim Ezekiel : "Goodbye Party for Ms Pushpa T.S., Background, Casually, Night of the Scorpion	[5]
JayantaMahapatra : Evening Landscape by the River, From Temple	[5]
Mahesh Dattani: Tara	[8]

Suggested Readings:

1. Ahmad, Aijaz. In Theory: Classes, Nations, Literatures.1994
2. Devy, G. N. After Amnesia: Tradition and Change in Indian Literary Criticism, 1992.
3. Gopal, Priyamvada. Indian English Novel: Nation,History and Narration, 2005.
4. Guha, Ranajit, ed. The Subaltern Studies Reader (Selected Essays), Delhi: OUP.2006
5. Iyenger, K. R. Srinivasa. Indian Writing in English.1998.
6. King, Bruce. Modern Indian Poetry in English.2002.
7. Khair, Tabish. Babu Fictions: Alienation in Contemporary Indian English Novels.2008.
8. Mukherjee, Meenakshi. The Twice Born Fiction, 2nd edn, 2001.
9. Naik, M. K. A History of Indian English Literature.2000.
10. Naik, M.K. and Shyamala A. Narayan. Indian English Literature 1980-2000: A Critical Survey. 2001.
11. Suleri, Sara. The Rhetoric of English India. 1992.
12. Vishwanathan, Gauri, Masks of Conquest: Literary Study and British Rule in India.1984.

EL 562 Introduction to Linguistics and Phonetics 4-0-0-4

Introduction: Linguistics and its Scope, Branches of Linguistics, Some Basic Concepts in Linguistics	[7]
Language and Communication, Language Variation and Language Change.	[6]
Phonetics and Phonology: Phoneme, Allophone, Human Speech Mechanism, Vowels and Consonants in English	[11]
Syllable structure, Supra-segmental features; GIE, Phonemic Transcription.	[14]
Morphology and Syntax; Morpheme, Word Formation Processes in English	[8]
IC Analysis, Phrase Structure Grammar, Transformation-Generative Grammar	[6]

Suggested Readings:

1.Abercrombie, D. Elements of General Phonetics (Edinburgh University Press, 1967).
2.Balasubramaniam, T. A Textbook of English Phonetics for Indian Students (Macmillan1981).
3.Chomsky, Noam. Aspects of the Theory of Syntax (Cambridge, Mass: MIT Press, 1965).
4.Crystal, David. Linguistics (Penguin, 1971).
5.Hockett, C.F. A Course on Modern Linguistics (New York: Macmillan, 1958).
6.Katamba, F. Morphology (Basingstoke: Macmillan, 1993).
7.Lyons J. 1968. Introduction to Theoretical Linguistics (CUP, 1981).
8.O'Connor, J.D. Phonetics (Penguin, 1973).
9.Robins, R.H. General Linguistics (Longman, 3rd Edition 1980).
10. Saussure, Ferdinand de. A Course in General Linguistics, Trans. Wade Baskin (New York: McGraw Hill), 1998.
11. Verma, S.K. and N. Krishnaswamy. Introduction to Modern Linguistics (OUP, 1993).

EL 572 Middle Ages to the Seventeenth Century English Literature-II 4-0-0-4

Geoffrey Chaucer: The Squire‟s Tale	[10]
Ben Jonson: Every Man in His Humour	[10]
Shakespeare: Othello	[7]
Edmund Spenser: Epithalamion	[8]
John Donne: Forbidding Mourning, Forbidding Weeping.	[6]
John Milton: Paradise Lost, Book II	[11]

Suggested Readings:

1. Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.1995.
2. Daiches, David:A Critical History of English Literature (vol. I), Delhi, Allied Publishers.1998.
3. Grose, M. W.: Chaucer: Literature in Perspective.2002.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Comedy.1988.
5. Rudram, Alan: A Critical Commentary on Milton‟s Paradise Lost.1978.

EL 582 Eighteenth Century to the Twentieth Century English Literature-II 4-0-0-4

William Collins: Ode to Simplicity, Ode to Music, Ode to Evening	[9]
Thomas Gray: Distant Prospects of Eton College, Death of a Favourite Cat, Elegy Written in a Country Churchyard	[11]
W. B. Yeats: When You Are Old, A Bronze Head, Lapis Lazuli, Sailing to Byzantium	[9]
W. H. Auden: Sir, No Man‟s Enemy, September 1, 1939, In Memory of W. B. Yeats	[11]
James Joyce: A Portrait of the Artist as a Young Man	[12]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5. A.R. Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.2004.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953.
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harvard University Press.1964.

EL 592 Creative and Technical Writing 4-0-0-4

Study of Literary Works in progress: Analysis of the Creative Writing Components (Poem, Novel, Short Story, Drama, Diary)	[8]
Craft of poetry: Subject matter, theme, rhythm, metre, stanza forms, sub-genres of Poetry	[8]
Fundamental Norms of Writing	[5]
Tools of Technical Writing: Feature Writing and Technical Writing	[5]
Editing & Proof Reading	[5]
Business Correspondence	[5]
Writing for various media: Learning to write scripts for Publishers and Copy Writing, Writing for Radio, Theatre, Television and Films	[8]
Assignment in Creative Writing: Poetry/Fiction/Drama	[8]

Suggested Readings:

1.Corbeff, Edward P. J. The little Rhetorica, Handbook. New York; John Wiley Sons, (1977).
2.Watkins, F. C. and Knight, K. E. Write to Write: Readings on the Craft of Writing. Bouston, HoughtounMifelin, (1966).
3.Mullins, Carolyne J. A Guide to writing and Publishing, New York; John Wiley & Sons, (1987).
4.The Writer‟s Manual, Califirnia; ETC Publications, (1977)
5. Baker, Sheridial. The Practical Stylistics, New York; Harper and Raw, (1977).
6. Vrooman Alan. Good writing An informal Mannual of Style. Athemeum: New York, 1972
7. Belcher, Diane D. (ED.) English for Specific Purposes in Theory and Practice. (University of Michigan Press, 2009).

EL 592 Comparative Literature 4-0-0-4

History of Development of Schools of Comparative Literature (French, American, British & Indian)	[8]
Influence and Reception Study	[8]
Genology, Literary History (Period and Movement Study)	[5]
Thematology	[5]
Comparative Literature and Intercultural Studies	[5]
Comparative Literature and Other Disciplines	[5]
The Future of Comparative Literature	[8]
Assignment in Comparative Literature	[8]

Suggested Readings:

1.Jost, Francois, Introduction to Comparative Literature. (Penguin, 2002).
2.Prawer, S.S. Comparative Literary Studies: An Introduction. (Allied, 1999).
3.Brandt, Corstius J. Introduction to the Comparative Study of Literature. (OUP, 2002).
4.Wellek,Rane & Warren, Austin. Theory of Literature. (OUP, 1998).
5.Weisstein, Ulrich (Ed.) Comparative Literature and Literary Theory: Survey and Introduction, Cambridge, 2002.
6.Susan Bassanett. Comparative Literature: Introduction, (Routledge, 2002).
7.Nagendra, Comparative Literature. Delhi, University of Delhi, OUP, 2004.

EL 661 Principles of Criticism-I 4-0-0-4

Aristotle: Poetics	[9]
Horace: Ars Poetica	[6]
John Dryden: Essay on Dramatic Poesy	[6]
Alexander Pope: Essay on Criticism	[4]
Dr. Samuel Johnson: Preface to Shakespeare	[5]
Samuel Taylor Coleridge: Biographia Literaria	[8]
Thomas Love Peacock: Four Ages of Poetry	[8]
T. S. Eliot: Metaphysical Poets	[6]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. "The Genetic-Structuralist Method in the History of Literature".
4. Gramsci, Antonio. "Hegemony".1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. "Crisis in Orientalism". 1987.
8. Sedgwick, Eve Kosofsky. "Introduction: Axiomatic" from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984.
10. Thiong'o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 671 Literature and Society-I 4-0-0-4

The Middle English Period: Norman Conquest of England	[5]
Manorial System of the Normans	[4]
Crusades in the Middle Ages	[4]
Hundred Years War	[4]
Social Life of England	[4]
England in the Sixteenth to the Eighteenth Century: Reformation and Renaissance in England	[6]
University Wits, Social Life in the Age of Milton	[5]
Puritan Revolution, Glorious Revolution of 1688	[4]
Industrial Revolution	[4]
Main Literary Trends in Poetry and Drama	[4]
Emergence of Novel	[4]
Humanism	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, Gale publication, 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2004.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism, Blackwell, 2013
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2000.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 681 Commonwealth Literature-I 4-0-0-4

Dom Moraes: A Letter	[5]
Gopal Honnalgere: The Donkeys	[5]
Kenneth Slessor: Country Towns	[5]
A.D. Hope: Australia	[5]
Les Murray: The Wilderness	[6]
Gabriel Okara: Were I to Choose	[5]
David Rubadiri: A Negro Labourer in Liverpool	[5]
Wole Soyinka: Death and the King's Horseman	[5]
Ngugi' wa Thiong'O:A Grain of Wheat	[6]
Chinua Achebe: Things Fall Apart	[5]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).
4. Césaire, Aimé. Discourse on Colonialism (1950).
5. Fanon, Frantz. The Wretched of the Earth (1961).
6. Gilbert, Helen and Joanne Tompkins. Post-Colonial Drama: Theory, Practice, Politics (London: Routledge, 1996).
7. Memmi, Albert. The Colonizer and the Colonized (1965).
8. Rushdie, Salman. Imaginary Homelands: Essays and Criticism,1981-1991 (London: Granta, 1991).
9. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
10. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984
11. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 691 Translation Studies 4-0-0-4

Concept of Translation in the West and in the Indian Tradition	[7]
Types of translation – intra-lingual and inter-semiotic; „word for word‟ or „sense for sense‟; decoding and recoding	[7]
Equivalence – linguistic and cultural; formal and dynamic; Equivalent Effect	[5]
Language and Culture	[5]
Translators' Invisibility – Domestication and Foreignization	[5]
Self-translation (Auto Translation), Transcreation	[5]
Translation of an actual text: a short story / excerpts from a novel or play / poems	[5]
Philosophical Theories of Translation – Steiner‟s Hermeneutic Motion; Ezra Pound and the Energy of Language; The Task of the translator; Walter Benjamin; Deconstruction	[5]
Literary Translation in Nineteenth Century India	[4]
Postcolonial Translation Theory	[4]

Suggested Readings:

1.Bassnett, Susan. Translation Studies (Revised ed 2000).
2.Catford, J.C. A Linguistic Theory of Translation.2002
3.Mukherjee, Sujit. Translation as Discovery and Other Essays, and Translation as Recovery.2004
4.Susan Bassnett and Harish Trivedi, eds. Post-Colonial Translation: Theory and Practice (London & New York: Routledge, 1999).
5.Venuti, Lawrence. Translation‟s Invisibility: A History of Translation.2009.

EL 613 Indian Writing in Translation 4-0-0-4

Munshi Premchand: Godan	[10]
Mohan Rakesh: Aadhe Adhure	[8]
U. R. Ananthamurthy: Samskara	[8]
Saadat Hasan Manto: Toba Tek Singh	[5]
Mahasweta Devi: Draupadi	[5]
Vijay Tendulkar: Kanyadan	[8]
Baby Kamble: The Prisons We Broke	[8]

Suggested Readings:

1. A.K. Mehrotra, The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008.
2. The Norton Anthology of World Literature. Volume F, 2009.
3. P.France, The Oxford Guide to Literature in English Translation (Oxford, 2000).
4. E Grossman, Why Translation Matters, Orient black swan Pvt. Ltd, 2007.
5. The Oxford India Premchand. OUP:Delhi, 1999.
6. Ananthmurthy. Samskara. OUP: Delhi.2000.
7. Collected Stories of Saadat Hasan Manto.2003.
8. Draupadi. Translated by Gayatri Spivak, 2001.
9. Baby Kamble. The Prisons We Broke. Orient Blackswan, Hyderabad.2004.
10. Tendulkar, Vijay. Kanyadaan. Trans. Gouri Ramnarayan. Delhi: Oxford U P, 1996

EL 623 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Autumn Semester of Second year shall be between 5,000 words and 8,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

EL 662 Principles of Criticism-II 4-0-0-4

Northrop Frye : The Archetypes of Literature	[8]
Ferdinand de Saussure : The Object of Study	[8]
Jacques Derrida : Structure, Sign and Play in the Discourse of the Human Sciences	[8]
Elaine Showalter: Towards a Feminist Poetics	[4]
Jean-François Lyotard : Answering the Question: What is Postmodernism?	[5]
Michel Foucault : What is an Author?	[5]
Roland Barthes : From Work to Text	[4]
Homi K. Bhabha : Cultural Diversity and Cultural Difference	[5]
Jacques Lacan : The Agency of the Letter in the Unconscious or Reason since Freud	[5]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. “The Genetic-Structuralist Method in the History of Literature”.
4. Gramsci, Antonio. “Hegemony”.1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. “Crisis in Orientalism”. 1987.
8. Sedgwick, Eve Kosofsky. “Introduction: Axiomatic” from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
10. Thiong‘o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 672 Literature and Society-II 4-0-0-4

England in the Nineteenth Century: Social and Religious tendencies of the Victorian Age	[6]
Oxford Movement	[5]
Feminist Movement	[5]
The Naughty Nineties	[5]
England in the Twentieth Century: Social and Literary Tendencies of the Early Twentieth Century	[5]
Emergence of the Labour Party	[5]
The Rise of the Problem Plays	[4]
The Stream of Consciousness Technique in Fiction	[5]
Main Trends in Poetry, Drama and Fiction	[8]
Cultural Studies	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, gale publication , 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2002.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism , Blackwell, 2004.
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2003.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 682 Commonwealth Literature-II 4-0-0-4

George Frederick Cameron: The Future	[5]
J. M. Smith: Ode on the Death of William Butler Yeats	[5]
Margaret Atwood: Journey to the Interior	[5]
Edward Brathwaite: Tizzic	[5]
Edwin Thumboo: Gods Can Die	[5]
Yasmine Goooneratne: There was a Country	[5]
Katherine Mansfield: The Man with the Wooden Leg	[4]
Pankaj Mishra: The Romantics	[9]
Kiran Desai: The Inheritance of Loss	[9]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).

1991).
4. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
5. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
6. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 692 Women Studies 4-0-0-4

Rokeya Sakhawat Hussain: Sultana‟s Dream	[8]
Katherine Mansfield: A Cup of Tea	[6]
Charlotte Perkins Gilman: If I were a Man	[6]
Ernest Hemingway: The Short Happy Life of Francis Macomber	[6]
Coventry Patmore: Angel in the House	[6]
Imtiaz Dharker: Purdah, Battle Line, She Must Be From Another Country	[6]
Virginia Woolf: A Room of One‟s Own	[6]
Suniti Namjoshi: The Mothers of Maya Diip	[8]

Suggested Readings:

1. Butler, Judith. Gender Trouble (1990).
2. de Beauvoir, Simone. The Second Sex (1949).
3. Freidan, Betty. The Feminine Mystique (1963).
4. Gardener, Judith Kegan, ed. Masculinity Studies and Feminist Theory: New Directions (Columbia University Press, 2002).
5. Greer, Germaine. The Female Eunuch (1970).
6. Lal, Malashri. The Law of the Threshold (Shimla: Indian Institute of Advanced Study, 1995)
7. Mill, John Stuart. The Subjection of Woman (1869).
8. Sedgwick, Eve Kosofsky. Gender Criticism: What Isn‟t Gender.2002.
9.Tharu, Susie and K.S. Lalita, eds. Introduction Women Writing in India (New Delhi: O.U.P., 1993)
10. Wolf, Naomi. The Beauty Myth (1991).
11. Wollstonecraft, Mary. A Vindication of the Rights of Woman (1792).
12. Woolf, Virginia. Shakespeare‟s Sister from A Room of One‟s Own (1929).

EL 614 World Literature(s) 4-0-0-4

Ibsen: A Doll‟s House	[8]
Brecht: Mother Courage	[8]
Dario Fo: Accidental Death of an Anarchist	[7]
Rabindranath Tagore: Gitanjali	[7]
Albert Camus: The Outsider	[8]
Pablo Neruda: Everyday You Play, I‟m Explaining a Few Things, Ode to a Tomato	[7]

Rainer Maria Rilke: Fear of the Inexplicable, Falling Stars, You Who Never Arrived [7]

Suggested Readings:

1. Kahns, Richards. Tragedy: Contradictions and Repression. Chicago: Chicago University Press, 1993.
2. Ellmann, Richard (ed.). The Modern Tradition: Backgrounds of Modern Literature. New York: Oxford University Press, 1992.
3. Parkar, Emmett. Albert Camus: the Artist in the Arena. New York: Routledge and Kegan Paul, 1965.
4. Northam, John. Ibsen: A Critical Study. London: Everyman, 1970.
5. Hirst, David. Dario Fo and Franca Rame. Hampshire: Macmillan, 1989.
6. Bloom, Harold. Modern Critical Views: Gabriel Garcia Marquez. New York: Chelsea House Publishers, 1989.
7. Metzger, Erika A. & Metzger, Michael M. (eds.). A Companion to the Works of Rainer Maria Rilke (Studies in German Literature Linguistics and Culture). New York: Camden House, 2004.
8. Raymond Williams. Drama from Ibsen to Brecht. London: Chatto and Windus,1968.

EL624 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Spring Semester of Second year shall be between 8,000 words and 10,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The Dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

Session 2019-2020

BJMC 2019-2020

JM 111 **Introduction To Communication & Media (A)** **3-0-0-3**

Communication & Media: Definition, meaning & concept, Different types of communication: Verbal and written, Scope and Process of Communication, Mass Communication: Concept & Characteristics.	[10]
History of Mass Media: Mass Media: Meaning & Concept, Introduction to Indian Press, Brief account of the origin and development of newspaper and magazine in India, History of the development of electronic media in India: Radio & TV.	[10]
Mass media & Mass Culture: Role, objectives functions & achievements of Mass Media, Relation between Mass Media and Mass Culture and their development, Media as fourth pillar of democracy, Mass Media in Rural-Urban divide.	[10]
Media, Market and Technology: Changing trends of Mass Communication under the process of globalization, Private and Public Media,Technology in the development of Media, Media and Market: Nature, Relation & Expansion.	[9]

Text Book:

1. Kumar, Kewal J, Mass Communication in India, Jaico Books, New Delhi

Reference Books:

1. J.S. Yadava & Pradeep Mathur, Issues in Mass Communication: The Basic Concepts, Kanishka Publishers, Delhi
2. Shymali Bhattacharjee., Media and Mass Communication: An Introduction, Kanishka Publishers, Delhi

JM 121 **3-0-0-3**

Introduction to Journalism (A)

Introduction to News: News: Meaning & definition, Sources and elements of news, Characteristics of news, Different styles of news writing, Headline: Importance & types.	[9]
Different Types of writing: Writing for newspaper and magazines-Nature & Difference, Feature writing: Meaning, definition & nature, Editorial: Importance & art of writing, Writing column, Reportage, analysis etc.	[10]
Reporting for Print Media: Definition, scope, concept & principles of news reporting, Types & techniques of news reporting, Functions of reporting: Interview, collection of data, research, Qualities & Responsibilities of a reporter, Introduction to different types of reporting: Investigative, Cultural, Political, Seminar & civic issues.	[10]
Editing for Print Media: Theories and Principles of Editing, Preparing good copies for Newspaper, Magazine & others, Introduction to editing symbol, proof reading symbols & Copy desk, Role, functions and responsibilities of Copy editor	[10]

Text Books:

1. Natrajan J, History of Indian Journalism, Publications Division, Ministry of Information & Broadcasting, Govt. of India, 1997
2. Ambrish Saxena., Fundamentals of Reporting & Editing, Kanishka Publishers, Delhi,

Reference Books:

1. Parthasarthy, Rangaswami., Journalism in India, Sterling Publishers Pvt. Ltd., New Delhi,
2. Aruna Zachariah., Print Media, Communication and Management : Elements, Dimensions and Images, Kanishka Publishers, Delhi
3. George A. Hough., News Writing, Kanishka Publishers, Delhi
4. Suhas Chakravarty.,News Reporting & Editing : An Overview, Kanishka Publishers, Delhi,
5. Wynford Hicks.,Writing for Journalist, Routledge, London

JM 131 **Writing For Media** **3-0-0-3**

Writing News for Newspaper: Hard News vs. Soft News, 5W's & 1H Formula, Basic components of a news story- Brevity, Dateline, Credit Line, Byline. [10]

Newspaper Writing: News writing vs. Opinion writing, Reading and reviewing Newspapers and Magazine. [09]

Feature Writing: Human interest, Backgrounder, Sports, Entertainment feature writing. Editorial, Article writing. [10]

Writing for Electronoc Media: Format of TV news writing. Writing for Radio & TV- Interviews, news, discussion. [10]

Text Books:

1. Bruce D. Itule and Douglas A. Anderson. *News writing and reporting for today's media;* McGraw Hill Publication, 2000.
2. George Rodmann. *Mass Media in a Changing World*; Mcgraw Hill Publication,2007.

Refrence Books:

1. Richard Keeble. *The Newspaper's Handbook*; Routledge Publication,2006.

JM 141 **Project & Presentation for Print** **3-0-0-3**

Themes for the Project: Newspaper & Magazine. Critical and analytical review of issues and trend in Media, Collection of information and data relating to the topic and analysis of the same. [10]

Steps of Project Report: Selection of the topic, Suitability of the topic, Relevance of the topic, comparative study of the topic. [06]

Presentation: Make a presentation based on project followed by question answer session. [10]

JM 151 **News & Contemporary Issues** **3-0-0-3**

National News: Daily national news, Background to the news items, Important bills, acts and Constitutional amendments passed by Indian Parliament, Important Supreme Court rulings. [10]

International News: Daily international news, Background to the daily news Thumbnail sketches of chief personalities figuring in current news reports Relevance of these reports to India and the world community or why they are considered to be important, Important actions taken under the UN umbrella, Regions of conflict in the world [09]

Economic News: Regional economic groupings of the world and their functioning, The European Union and its expansion, The World Bank The Asian Development Bank, World Economic Forum, Profile of the Indian economy (industry, agriculture, infrastructure, growth rates, world ranking, role of planning, budgets and government policies), The world's top 10 economies [10]

Issues for Discussion: Globalisation, The environment, US dominated world order – [10]

politically, culturally and economically, Parliamentary versus Presidential government, Indian Constitution – does it need a change?
Naxalism and Marxism, Clash of civilizations, Should the nuclear club remain exclusive? Criminalisation of politics, Reservation, Restructuring the UN

Refrences:

1. Daily News Paper & Magazine.
2. Prime time TV News Bulletin

JM 161 **Practical- Computer Application for Mass Media** **2-0-0-2**

Exercises and Assignment: PageMaker/Quark express
Describe DTP softwares used for design and layout.
Design and create layout using DTP softwares.
Design a visiting card, postcard, poster, brochure.
Design a magazine.
Prepare front page of newspaper.

JM 112 **Theory of communication (A)** **3-0-0-3**

Communication: Definition, meaning, concept, elements, process, functions and scope, Types and forms of communication, Barriers to communication, 7 C's of communication. [10]

Communication theory: Need & importance, Two Step and Multi Step Theory, Hypodermic needle theory. [10]

Communication model: Need & importance, SMCR Model, Shannon and Weaver Model, Harold D. Lasswell Model. [09]

Normative Theory and Seibert Theory of Communication: Authoritarian Theory, Libertarian Theory Social Responsibility Theory, Developmental Theory, Democratic Participant Theory. [10]

Text Book:

1. De Fleur, M ,Theories of Mass Communication, 2nd Edition, New York; David Mc Kay

Reference Books:

1. Dan Laughey Key ,Themes in Media Theories, Rawat Publication.
2. Taylor, Rosegrant, Meyrs Communicating, Prentice Hall
3. Allan and Barbara Pease, The Definitive Book of Body Language, Munjal Publishing House
4. D.M. Silviera, Personal Growth Companion, Classic Publishing

JM 122 **3-0-0-3**

Writing for media (A)

Essentials of Good Writing: Art of Writing, Kinds of Media Writing: Inform, Describe & Persuade, The ABCD of Media Writing: Accuracy, Brevity, Clarity & Discernment. [10]

Writing for Print Media: Basic principles of writing for print, Elements and Importance of News writing, Steps & elements of writing : editorial, features & review. [09]

Writing for Electronic Media: Basic principles of writing for electronic media: Radio & TV, Elements and Importance of News writing for Radio & TV, Steps & elements of writing for Radio & TV: editorial, features & review. [10]

Translation in Media: Concept & Definition of Translation, Nature & Norms of Translation, Types of Translation: Word to Word Translation, Literal Translation, Summarised Translation, The need and importance of Translation in Journalism, Guidelines for Translation. [10]

Text Books:

1. K.K. Rattu, Translation through media in New Millennium, Surubhi Publication, Jaipur.
2. Thomas S. Kane, Oxford Essentials Guide To Writing.

Reference Books:

1. Pal Rajenda and J.S Koriahalli. Essentials of English and Business Communication, S. Chand.
2. Robey, L Cora New Handbook of Basic Writing Skills, Hardcourt College Pb. Orlando.
3. Wren & Martin High School English Grammar & Composition, S.Chand.
4. George.A.,Hough News Writing , Kanishka press.
5. Robert Mc. Lesh, Radio Production , Focal Press.
6. Jitendra Gupt and Priyadarshan Patrakarita Mein Anuvaad, Radha Krishna Prakashan, N.Delhi.
7. Laxmikant Pandey, Translation, Objects and Methods.

JM 231 **Practical- Reporting & Editing (A)** **2-0-0-2**

Exercises and Assignment:

Basics of Reporting: principles of reporting, functions and responsibilities, reporting techniques.

Refrences:

JM 142 **News & Contemporary Issues - II** **3-0-0-3**

National News: Daily national news, Background to the news items, Important bills, acts and Constitutional amendments passed by Indian Parliament, Important Supreme Court rulings. [10]

International News: Daily international news, Background to the daily news Thumbnail sketches of chief personalities figuring in current news reports Relevance of these reports to India and the world community or why they are considered to be important, Important actions taken under the UN umbrella, Regions of conflict in the world [09]

Economic News: Regional economic groupings of the world and their functioning, The European Union and its expansion, The World Bank The Asian Development Bank, World Economic Forum, Profile of the Indian economy (industry, agriculture, infrastructure, growth rates, world ranking, role of planning, budgets and government policies), The world's top 10 economies [10]

Issues for Discussion: Globalisation, The environment, US dominated world order – politically, culturally and economically, Parliamentary versus Presidential government, Indian Constitution – does it need a change? Naxalism and Marxism, Clash of civilizations, Should the nuclear club remain exclusive? Criminalisation of politics, Reservation, Restructuring the UN [10]

1. Daily News Paper & Magazine.
2. Prime time TV News Bulletin

JM 152 **Basics Of Design & Graphics** **3-0-0-3**

Principles of Design & Graphics: Basics of Design and Graphics, Element of principles of design. Typography: physical form, aesthetics and classifications. Colour: physical forms, psychology, colour scheme and production. [10]

Layout: Components of layout and layout planning, advertisement layout, broadcast and tabloid layout, magazine and book layout. [10]

Visual and Design: Visuals: Physical forms, functions and editing, poster design, logo design, brochure design. [10]

DTP & Printing: Basics of desktop publishing, printing process, Printing methods: letter press, screen, offset. Paper and finishing. [9]

Text Books:

1. N.N. Sarkar, Art and Production, Sagar Publishers, new Delhi 2001
2. N.N. Sarkar, Designing Print Communication, Sagar Publishers, new Delhi 1998

Refrences Books:

1. A.K. Dhar, Printing and Publishing

JM 162 **Practical- Design and Graphics Lab** **2-0-0-2**

Exercises and Assignment:

To work with different textures, colour schemes and other elements on different topics/themes.
To work on various types of signographic, calligraphic and typographic letterforms.
Design a logo.
Design flash cards.
Design and develop a booklet (story/rhymes/play/comic or any other)
Visit a printing press

JM 211 **Reporting & Editing (A)** **3-0-0-3**

Basics of Reporting: Basics of Reporting: principles of reporting, functions and responsibilities. Writing news: Lead- types of lead, body. Reporting: Newspapers, News Agencies and Magazines. Techniques of re writing news agency copy, reporting technique [10]

Reporters: Qualities and Responsibilities. Reporting for different beats. Reporting for Newspapers – Reporting the expected & unexpected. Reporting Skills- Nose for News, Observation (listening & seeing) Taking notes finding, checking, verifying, analyzing & interpreting information. [10]

Types of Reporting: Reporting- crime, courts, society, culture, education, politics, sports, commerce and business and life style. Extracting Stories from outside sources: Citizens, Press releases, Institutional sources, Ministers & Govt. Departments etc. Pitfalls and problems in reporting. [10]

Editing: Nature and need for editing, Principles of editing. Functions of editorial desk. Copy editing. Preparation of copy for press, style sheet. Editing symbols, proof reading symbols and their significance. [09]

Text Books:

1. Kamat, M. V. **(1980).** *The Professional Journalism.* New Delhi: Vikas Publishing.
2. Kamat, M. V. **(1995).** *The Journalist 's Handbook* . New Delhi: Vikas Publishing.

Reference Books:

1. Hough, G. (1995). *News Writing*. New Delhi: Kanishka Publishers
2. Robey, L Cora. (1992). *New Handbook of Basic Writing Skills.* Orlando: Harcourt College Publication.

JM 221 **Media Laws & Ethics (A)** **3-0-0-3**

Introduction of Indian Constitution: Indian Constitution and freedom of press, reasonable restrictions, privileges, laws defamation, contempt of legislature, and court, censorship, need for a free press in a democracy. [10]

Media Ethics: What is Media Ethics? Why Media Ethics? Media's ethical problems including privacy, right to reply, sting operations, media ownership, paid news, Accountability and Independence of Media – Self Regulation. [10]

Acts and Laws: The Press Council Acts, Functions of Press commission and Press Commissions, Copyright Act 1957, Official Secrets Act 1923, Right to Information Act 2005, 66A of IT Act, Press Registration of Books Act. 1867. Cable Television Act and Rules, Cinematography Act, Cyber Laws etc. [10]

Official Secrets: Official secrets – sedition – Drugs and Magic Remedies (Objectionable) Advertisements Act, 1954, obscenity, copyright, monopolies and restrictive trade practices, Press Council, ombudsman, right to information, right to reply, codes of ethics, confidentiality of sources of information [09]

Text Books:

1. Rayudu, C. S. and Nageshwar Rao, S. B. (2014). *Mass Media Laws & Regulations Himalaya Publishing House*. Bombay: Himalaya Publishing House.
2. Ravindran, R. K. (1997). *Press in the Indian Constitution.* New Delhi*:* Indian Publishers Distributors.
3. Thakurta, P.G. *Media Ethics-Making and Breaking News.* New Delhi: Oxford University Press.

Reference Book:

1. Hakemuldar, J.R., Jouge, F. A.C. D. and Singh, P. P. (1998) *Principles & Ethics of Journalism*. New Delhi: Anmol Publications.

JM 231 **Practical - Reporting & Editing for Print** **3-0-0-3**

Beat Reporting: Covering of Beats- crime, courts, city reporting, local reporting, hospitals, health, education, sports. Covering speeches, meetings and press conferences, Political. [10]

Interviewing: Interviewing- Research, Setting up the interview, conducting the interview, writing news leads, writing news story, inverted pyramid, body of the story, attribution, verification. [09]

Feature Writing: Understanding features, writing types of feature, leads for features, writing article on current issues, writing headlines for various pieces of stories, clicking pictures for news. [10]

Case Studies: Case studies of understanding media and news, trial by media [10]

Text Books:

1. Bruce D. Itule and Douglas A. Anderson. *News writing and reporting for today's media;* McGraw Hill Publication, 2000.
2. George Rodmann. *Mass Media in a Changing World*; Mcgraw Hill Publication,2007.

Refrences Books:

1. Richard Keeble. *The Newspaper's Handbook*; Routledge Publication,2006.

JM 241 **Introduction to Broadcast Media** **3-0-0-3**

Audio: Characteristics of Radio as a medium, Basics of Sound, Types of Sound- Sync, Non Sync, Natural Sound, Ambience Sound, Sound Desigen-Its meaning with example from different forms, Sound recording techniques, Introduction and types of microphones. [10]

Visual: Characteristics of Television as a Medium, Still Image, Television image, Digital image, Edited image, Changing ecology of images today, Visual perspective, Visual grammar, Camera movement, Types of shots, Concept of continuity, Imaginary line. [09]

Camera: Structure of camera, Single & 3 CCD, Camera Basics; Viewfinder, Camera Lens systems and control, White balance, Handling the Camera; Contrast ratio, aspect ratio, Exposure and Zebra, Shutter Speed, Focus; Selective Focus, Follow Focus, Rack Focus, Depth-of-field. [10]

Production Format: Single camera shoot, Multi camera shoot, Elements of a TV news story; Gathering, Writing, Reporting, Elements of a TV news bulletins, Basics of editing; Basic software and its techniques, Basics of Recording and editing sounds. [10]

Text Books:

1. P.C. Chatterjee, Broadcasting in India, New Delhi, Sage Publication

Reference Books:

2. Zettl Herbert, Television Production Handbook. Pgenos.
3. Carrol Fleming, The Radio handbook

JM 251 **Film Appreciation** **3-0-0-3**

Language of Cinema I: Focus on Visual Language, Shot scene, Deep focus, Continuity editing, Montage, Watching films and understanding the concept practically. [10]

Language of Cinema II: Focus on sound and colour, Diegetic and Non Diegetic sound, Off scree sound, sync sound, use of color as a stylistic element, Difference between story plot, screenplay, watching relevant film. [09]

Alternative Vision: Third cinema and non fiction cinema, Introduction to Feminist film theory, special focus on Satyajit Ray and Guru Dutt, watching relevant film, hindi cinema in 1950s, New wave of cinema. [10]

Globalisation: Globalization and Indian Cinema, The multiplex era, Film culture, watching relevant film [10]

Screening:

1. Rear Window by Alfred Hichock (Language of Cinema)
2. Battelship, Potempkinby Sergei Eisenstin (Language of Cinema)
3. Man with a Movie Camera by Dziga Vertov
4. Germany Year Zero directed by oberto Rosselini
5. Pather Panchali by Satyajit Ray
6. The hour of the Furnaces by Fernando Solanas
7. Nishant by Shyam Benegal
8. Askrosh by Govind Nihlani
9. Pyaasa by Gurudatt

PS 211 **Indian Government and Politics - I** **3-0-0-3**

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement. [08]

Framing of the Indian Constitution: Major Acts, Morley – Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947. [08]

Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Pollicy, Fundamental Duties, Secularism, Unitary and Federal Features. [13]

Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism. [10]

JM 212 **Introduction to Television Journalism & Production** **3-0-0-3**

Reporting for TV: Nature and Language of TV, TV News script format, Fundamentals of TV reporting: Reporting skills, Ethics for TV reporting and sting oprations. Writing and Reporting for TV: Finding the story and developing the sources, gathering the facts (getting right visuals, facts and figures) [10]

Packaging for TV: Types of TV Programs, Conceot of Breaking News, Scripting for Fiction/Non Fiction Formats. Talk Show, Panel discussion, Recorded Programs. Interview – types of news interview, art of conducting a good interview, Packaging, Anchoring. [10]

TV Programme Production: Stages of production- pre-production, production and post-production. The production personnel, Single camera and Multi camera production, use of graphics and special effects, basics of editing. [10]

TV Programme Editing: Types of editing- linear and nonlinear editing, online and offline editing. Editing on different software. Process of visualization and its importance. Visual grammar and language. [09]

Text Book:

1. Zettl, H. (2011). *Handbook of Television Production*. Cengage Learning.
2. Shook, F., Larson, J. and DeTarsio, J. (2016). *Television Field Production and Reporting*. New York: Routledge.
3. Gormly, E.. K. (2005). *Writing and Producing Television News.* Wiley.
4. Bhat, S.C. (1993). *Broadcast Journalism: Basic Principles*. Delhi: Haranand Publications

Reference Books:

1. De Fleur, M. (1982). *Theories of Mass Communication*. New York: David Mc Kay.
2. Jan, R. H., Ray A.C de Jonge and Singh, P.P. *Broadcast Journalism.* New Delhi: Anmol Publication.
3. Donald, R. and Spann, T. (2000). *Fundamentals of Television Production*. New Delhi: Surjeet Publication.
4. Burrows, T. D. and Gross, L. S. *Video Production*. New York: Mc Graw Hill.

JM 222 **Photo Journalism (A)** **3-0-0-3**

Introduction to Photography: Introduction to Photography, Brief History of photography, what is photography. The role & importance of photography. Principles of Photographic composition. Various types of photography: Portrait, Wildlife, Nature, Photo Journalism, Advertising and Night Photography. [13]

Camera: Basic Parts of film & digital camera:- Lens, Aperture, Shutter, View finder, Memory. Camera formats. Photographic lenses – prime & zoom lens, angle of view. Aperture, Depth of focus, Depth of Field and how they work. Lens perspective, film speed, flash gun, light meter, Exposure Control – relationship between shutter speed and aperture. [13]

Light for Camera : Principles of Light, Various equipment's of lighting, Sources of light : Natural & artificial, different types of lighting used in videography. Nature and physical properties of light direction and angle of light: front, side and back. Lighting contrast and its control by fill in lights: One, two & three point [13]

lighting. Key, fill and back light, use of filter and reflectors.

Text Book:

1. Sharma, O.P. *Practical Photography*. (2003). New Delhi: Hind Pocket Books.
2. Langford, M. (2000). *Basic Photography*. New Delhi: Focal Press.

Refrence Book:

3. Folts, J. A. and Lovell, R. P. *Handbook of Photography*.

JM 232 **Practical- Camera & Light (A)** **2-0-0-2**

Exercises and Assignment: Different types of Camera and lighting aspects and their impact on photography.

JM 242 **Practical- Photography** **2-0-0-2**

Exercises and Assignment:

Understanding the mechanisms of camera, Types of still cameras and their structure (Pin hole, SLR, DSLR, Mirrorless), types of lenses.
Aperture (f-stop), shutter, light meter, focus and depth of field.
Understanding light and shadow.
Shadow and silhouettes, lighting equipment.
Digital Photography; Sensor (CCD, CMOS), Formats and storage.
Basics of Photoshop
Photo editing.

JM 252 **Development Communication** **3-0-0-3**

Concept of Growth & Development: Measurement of development- PQLI and HDI, Nehruvian Model, Gandhian Model of development, UN millennium development goal. [10]

Development Communication: Concept and approaches, sustainable development, participatory development and inclusive development. Development support communication; definition, genesis, Wood's Triangle. [09]

Role of Media: Role of Print, TV, Radio and traditional media in development, Role of developmental agencies and NGO's. Cyber media and e-governance, e-choupal, national knowledge network and Niti Aayog [10]

Development Journalism & Rural Reporting: Information needs in rural areas, use of traditional media for development in rural areas, community newspaper and radio. Critical appraisal of mainstream media's reportage on rural problem and issues, Panchayati Raj in India. [10]

Text Books:

1. Rogers Everett M : Communication and Development- Critical Perspective,Sage, New Delhi, 2000
2. SrinivasR.Melkote& H. Leslie Steeves: Communication For Development In The Third World, Sage Publications.
3. Dr. Anil Kumar : Mass Media and Development Issues, BhartiPrakashan Upadhyay Varanasi, 2007.
4. D V R Murthy : Development Journalism, What Next? Kanishka Publication, New Delhi, 2007.
5. Ghosh&Pramanik : Panchayat System in India, Kanishka Publication, NewDelhi, 2007.

6. Modern Media in Social Development: Harish Khanna.Everybody Loves a Good Drought : P. Sainath, 2000 by Penguin India
7. ShivaniDharmarajan : NGOs as Prime Movers, Kanishka Publication, NewDelhi, 2007.

Reference Books:

8. What Do We Mean By Development: An Article by Nora C Quebral in International Development Review, Feb, 1973, P-25.
9. UNDP : Human Development Report (published every year), Oxford University Press, New Delhi.
10. World Bank : World Development Report (published every year) Oxford University Press, New Delhi.
11. Yojna & Kurukshetra Magazine (Monthly published by Niti Aayog, New Delhi)
12. Wilbur Schramm : Mass Media and National Development- the role of information in developing countries, UNESCO/ Stanford University Press, 1964.
13. AmartyaSen : Development as freedom, Alfred A Knopf, New York.

JM 262 **Practical- Documentary Production** **3-0-0-3**

Understanding the Documentary: Six modes of Documentary Representation- Participatory, Expository, Observational, Performative, Reflexive and Poetic. Introduction to shooting styles. Introduction to Editing styles, structure and scripting the documentary. [09]

Pre Production: Documentary production, pre-production, researching the documentary- library, archives, locations, life stories, ethnography. Writing a concept- telling a story, treatment, writing a proposal and budgeting. [10]

Production Phase: Planning and managing crew, lighting- natural and artificial, understanding use of microphones, sound recording, voice over. Shooting schedule- shot breakdown and call list, production team, meetings, checklist, crowd management. [10]

Post Production: Grammar of editing, rough cut, transitions, scenic realism and sound effect and visual effect, finalizing the film, graphic and title, distribution and exhibition spaces (Traditional and online) [10]

References:

1. Charles Musser " Documentary" in Geoffrey Nowell Smith, the oxford of world cinema, oxford university prees, 1996
2. Trisha Das, How to write a Documentary.
3. Double take by PSBT

Screenings:

4. Films by PSBT
5. City of Photos by Nishth Jain
6. Bombay our city by Anand Patardhan
7. Web series

JM 272 **Advanced Broadcast Media** **3-0-0-3**

Video and Broadcast Technology: Analogue and Digital technology, Frame and field, Scanning process, Interlaced and progressive scanning, composite video signal, component video signal, Resolution, Aspect ratio, CCU, colour bars, Vectroscope, Waveform monitor, broadcast monitor, broadcast standards – NTSC, PAL, SECM, HDTV, Telecine. [09]

Transmission Technologies: Terrestrial transmission, Satellite and cabkle broadcasting, up linking and downlinking, conditional access system, DTH, IPTV. [06]

Introduction to Lighting: Why do we need light, mandatory light, creative light, characteristics of light, quality, quantity, colour temperature, three point lighting, natural lighting, sunlight and the realities, cyclodrama, soft and hard light sources. [06]

Production: Production personnel and their role and responsibilities in Radio and TV. Motion picture production. Three phases preparation of budget for various types of radio and TV programme, preparation of script breakdown, artiste, location/ setting, preparation of shooting schedule. Linear and non-linear editing, matching tone, cut in, cut away, jump out, compression and expression of time, cross cutting, circular and non- linear cutting, axial cut. [18]

Text Books:

1. Television Production Handbook, Herbert Zettl, Akash Press 2007, Delhi
2. Facilitating Community Radio in India:- Profiles of NGO's and their Community Radio Initiatives Other Voices. F. Vinod Pavarala, Kanchan K Malik, Sage 2007, New Delhi.
3. Radio in New Avatar- AM to FM, Ambrish Saxena, Kanishka Publication, New Delhi

Reference Books:

4. Glen Creeber, Toby Miller and John Tulloch, The Television Genre Book (London: British Film Institute, 2009)
5. Robert B Musburger and Gorham Kindmen, Introduction to Media Production, (Elsevier, Focal Press)
6. Mc Leash, Robert, Radio Production (US: Taylor & Francis)

PS 212 **Indian Government and Politics -II** **3-0-0-3**

Legislature: US Congress, British Parliament, French Parliament, Swiss Fedral Assembly, Chinese People's Congress. [11]

Executive: President of US, Monarchy and Prime Minister in Britain, President and Prime Minister in Britain, President and Prime Minister of France, Fedral Council of Switzerland, President and Premier of China. [14]

Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China. [13]

JM 311 **Radio Journalism (A)** **3-0-0-3**

Radio: As a medium of mass communication in today's context, Characteristics of radio, Limitations of radio, Three Modes of transmission: AM, SW and FM. Commercial, community and educational radio. [10]

Radio Writing: Writing for the Ear; Introduction, Characteristics of spoken word, Knowing your audience, Developing your style, Writing for different formats and messages. [10]

Radio Formats: Why formats, Simple announcements, Radio [10]

talks/commentaries/comments, interviews, panel discussions. Radio ads/commercials. Music on radio, fiction Phone in programmes, Radio News-Radio News defined, Main characteristics of Radio News as against news in other media, Non-fiction Phone-in Programs.

Radio Production: Introduction, Elements of radio productions- Acoustics, Perspective, Sound effects, Music. Distort/Filter. Different types of microphones, Recording and Editing. [09]

Text Books:

1. Liesh, R. M. (2005). *Radio Production*. New Delhi: Focal Press.
2. Radio in New Avatar- AM to FM, Ambrish Saxena, Kanishka Publication, New Delhi
3. Alburger, J. R. *The Art of Voice Acting*. New Delhi: Focal Press

Reference Books:

4. Luthra, H.R. (1986). *Indian Broadcasting*. New Delhi: Publication Division.

JM 321 **Public Relation & Advertising (A)** **3-0-0-3**

Basics of PR: Concepts and Definitions, Persuasion and Public Opinion, Employee communication, PR as distinguished from Marketing, Sales Promotion and Advertising and PR Techniques. [10]

Role of PR: Relationship and duties of the PR Practitioner. Functions of PR Department. Exhibition PR and its Planning, Uses and kinds of Exhibition PR. PR in Developing Countries, PR for NGOs, PR for Govt. organizations and communications. [10]

Writing For PR: Press Relation and its principles, The News Release-Seven point formula & its importance, Writing techniques, Press Events and organizing them. [09]

Advertising definition, historical development, social and economic benefits of advertising, mass media and advertising. Copy writing and advertising production techniques, print, radio, television, films, outdoor, ideation, visualization. Creativity, media selection, newspapers, magazines, radio, television, outdoor, strategy, planning, media budget, campaign planning, adverting agencies and their functions. [10]

Text Books:

1. Scott M. C., Genter, A.H. and Broom, G.M. (). *Effective Public Relations*. New Jersey: Pearson Education.
2. Seital, F. P. (2016). *The Practice of Public Relations*. New Delhi: Pearson Education.
3. Roy, S.K. *Corporate image of India*.

Reference Books:

4. Broom, G. M. and Dozier, D. M. (1990). *Using research in Public Relations*. New Delhi: Prentice-Hall.

JM 331 **Summer Training Report** **3-0-0-3**

Assignment - Students have to prepare a project report on the basis of training followed by presentation and viva

JM 341 **Practical- Public Relation** **2-0-0-2**

Assignment on the usage of tools of Public Relations.
PR campaign-planning, execution, evaluation.
Presenting slides show on PR and Crisis Management.
Publications – Developing Press Releases and detailed report for variety of events.
Case Studies- Public and Private ventures.

JM 351 **Practical- Radio Programme Production** **2-0-0-2**

Exercises and Assignment:
Use different types of microphones for radio/audio productions.
Recording and editing exercise in the studio.
Writing exercises
Interviews – simulated and actuality.
Research and scripting of radio documentary/feature/drama.
Production of radio discussion.
Production of social messages.
Preparation of audience profile.
End product.

JM 361 **Media Gender & Human Rights** **3-0-0-3**

Media and the Social World: Media impact on individual and society. Democratic polity and mass media, media and cultural change, grass root media. [10]

Gender: Conceptual frameworks in Gender studies, Feminist Theory. History of Media and Gender debates in India (case studies), Media and Gender – Theoretical concerns. Media and Masculinity. [08]

Media – Power and Contestation: Public sphere and its critique. Media and Social difference: class, gender, race etc. Genres- Romance, Television, Soap opera, sports. (Case Studies – watch a Indian TV soap opera/reality show for a week and for representation of family) [13]

Media and Human Rights: Human Rights: Theoretical perspective, Critique. Universal Declaration of Human Rights. Human rights and media. (Case Studies: Human right issues and violations in national & international media) [10]

Text Books:

1. 1. Ninan, Sevanti. *Headlines from the heartland: Reinventing the Hindi public sphere*. SAGE Publications Pvt. Limited, 2007.
2. . Curran, James. "Rethinking mass communication." *Cultural studies and communications. London: Arnold* (1996).

Reference Books:

1. Street, John. *Mass media, politics and democracy*. Palgrave Macmillan, 2011.
2. Balnaves, Mark, Stephanie Donald, and Brian Shoesmith. *Media theories and approaches: A global perspective*. Palgrave-Macmillan. 2009 (Pg No. 3-10, 11-34, 35-53)
3. Mackay, Hugh, and Tim O'Sullivan, eds. *The media reader: continuity and transformation*. SAGE Publications Limited, 1999. 13-28, 43-73, 287-305.
4. McQuail, Denis. *Mass communication theory: An introduction*. Barcelona, 1991.

5. Berger, Arthur Asa. *Media and society: A critical perspective*. Rowman& Littlefield,

JM 371 **Practical- Advanced Broadcast Media** **3-0-0-3**

Pre - Production: TV News Bulletin, Developing Run Down Sheet. Preparing a Package – Script writing, Chroma set up, Lighting setup and editing setup. Script Design, Script formatting, Shooting script, script elements, writing dialogues, point of view, use of sound in script, screenplay and storyboard. [13]

Production Phase: Preparing Talk show, Talk show formats, techniques of talk show, content development for talk show, camera set up, multi camera set up, Framing, Movement, lighting set up and editing. [13]

Assigmaent:- Students will be given at least one script and one practical exercise to be performed.

JM 381 **Practical- Advanced Media Software** **2-0-0-2**

Exercises and Assignment:
Video Editing Software (FCP latest version)
Audio Editing Software
Montage Cutting
Visual effects
Promo Cutting
Students have to prepare 30 sec Montage/ Promo on any subject.

JM 312 **Cyber Journalism** **3-0-0-3**

Cyber Space: Meaning; Information Super Highway; Internet and Information Revolution, Fundamentals of Cyber Media, Cyber Media Vs Print, TV and Radio. [10]

Cyber Journalism: Advantages and Disadvantages of Cyber Journalism, Web advertising, Circulation of Web Newspapers, Future of Web Journalism, Analysis of important Indian News-Based Web-sites. [10]

Cyber Reporting: Trends in Cyber Reporting & Editing, Impact of globalization on Web Journalism, Cyber Laws and Concept of e-governance. [10]

Web Writing: Writing for Web Media: Basic rules Do's and Don'ts, Writing News stories, Features and Articles on the Web, Interviewing on the Web, Why Print and Electronic Media networks are going on the Net? Impact of Web Journalism and Recent Trends. [10]

Text Books

1. Bharihoke, D. (2009). *Fundamentals of Information Technology.* New Delhi: Excel Books.
2. D'souza, Y. K. *Electronic Media & the Internet*.

Reference Books

3. Gleick, J. (2011). *The Information: A History, a Theory, a Flood.* New York: HarperCollins Publishers.

JM 322 **Practical- Media Lab** **3-0-0-3**

Exercises: Conversation between two students recorded on camera- To be self-critiqued. Presentation on TV programmes watched on the previous day Rewriting Headlines of Newspapers (Hindi & English) on the display boards. Reading of day's newspapers followed by discussions. Writing exercises to inform report and persuade. Interview and Group Discussion sessions for Radio and TV. Effective Presentation/talks/features using various audio – visual aids Practice of Radio news presentations, Radio Ads and Jingle, Vox-Pops etc. [13]

JM 332 **Communication Research & Method** **3-0-0-3**

Introduction To Research: Definition, Role, Function, Types, Scientific Approach, Role of Theory in Research, Steps of Research. [09]

Methods of Media Research: Qualitative, Quantitative techniques, Content Analysis, Survey Methods: Observation Methods, Experimental Studies, Case Studies. [10]

Sampling: Sampling Methods, Representativeness of the sample, Sampling Error, Tools of data collection: Primary and Secondary data: Questionnaire, Focus Group, Surveys, Online Polls, Published work. [10]

Research Design: Methods of analysis and report writing, Data Analysis Techniques: Coding and Tabulation, Working with Internet as a source, Writing the Citations, writing the research report, Bibliography. Readership and Audience Surveys. [10]

Text Books:

1.Wimmer, Roger, D and Dominick, Joseph, R. Mass Media Research, Thomson Wadsworth 2006.

Reference Books:

2. Arthur Asa Berger, Media Research Techniques, Sage Publication, 1998

3. John Fiske, Introduction to Communication Studies, Routledge Publication, 1982

JM 342 **Global Media & Politics** **3-0-0-3**

Media & International Communication: Communication Debates: NWICO, McBride Commission, UNESCO, UN, NHRC & SAARC, ASEAN, BRICS [10]

Media & Super Power Rivalry: Unequal development and Third world concern: North-South, Rich-Poor, CNN, Al Jazeera and others. Advent of popular media- a brief overview. [09]

Global Conflict and Global Media: Rise of embedded Journalism. Study of Vietnam, Iraq & Afghanistan war and role of media. Media as a force multiplier. [10]

Media & Cultural Globalisation: Cultural homogenization, cultural Imperialism, Media Hegemony and global culture. Discourses of Globalization; Barrier free economy, multinationals technological developments, digital divide, media conglomerates and monopolies in India. [10]

Text Books:

1. DayaKishanThussu. *International Communication: Continuity and Change*, Oxford University Press, 2003.
2. Yahya R. Kamalipour and Nancy Snow. *War, Media and Propaganda-A Global Perspective,* Rowman and Littlefield Publishing Group, 2004.
3. Communication and Society, Today and Tomorrow *" Many Voices One*
4. DayaKishanThussu .*War and the media : Reporting conflict 24x7*, Sage Publications, 2003.
5. Stuart Allan and Barbie Zelizer. *Reporting war: Journalism in war time*, Routledge Publication, 2004.

Reference Books:

6. Lee Artz and Yahya R. Kamalipor. *The Globalization of Corporate Media Hegemony*, New York Press, 2003.
7. ZahidaHussain and Vanita Ray. *Media and communications in the third world countries*,Gyan Publications,2007.

JM 352 **Practical- New Media** **2-0-0-2**

Analysis of News, features, articles in various media and make a comparative study.
Making rough layout for blog, selecting the themes
Designing and developing blog (writing articles, features, opinion)
Making rough layout for website, selecting the theme, color combination.
Designing and developing website.

JM 362 **Professional Project** **3-0-0-3**

Projects: All Students have to prepare a final project or show reel professionally. [13]
Format:- Talk Show, Short Documentary, News Reel, Magazine format, Profile.

BA Honours English 2019-20
B. A. (Hons.) in English

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]

W S Maugham: The Verger [4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct) [4]

Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative) [4]

Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most) [6]

Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing [4]

Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation [4]

Reading Comprehension: Efficient reading and note taking [4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers [13]

V.S. Naipaul: A House for Mr. Biswas [13]

Khushwant Singh: A Train to Pakistan [13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry [9]

Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists [7]

Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening [9]

Sylvia Plath: Morning Song, Death and Company [5]

R.W. Emerson: Brahma [4]

Edgar Allan Poe: The Fall of the House of Usher [5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree [4]

Sarojini Naidu: Indian Weaver, The Song of Radha. [4]

Rabindranath Tagore: Where the Mind is Without Fear [4]

Sri Aurobindo: Transformation [3]

Kamala Das: An Introduction as a Writer [4]

Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S. [4]

A K Ramanujan: Love Poem for a Wife [4]

Arun Kolatkar: Chaitanya [4]

Chinua Achebe: Refugee Mother and Child [4]

Wole Soyinka: Agbor Dancer [4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.

5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 331 Modern English Language and Phonetics-I 3-0-0-3

Basic Sentence Types – Subject, Verb, Object, Complement, Adverbials [5]

Coordination and Subordination Clauses [5]

Different Notions and Concepts (Request, Order, Purpose, Wish, Suggestion, Obligation, Concession, Condition) [5]

Morphology and Phonology (Various morphs and phonemes) [4]

Word Substitutions and Idioms [3]

Synonyms and Antonyms [3]

Theme Writing [4]

Literary Appreciation [4]

Advanced Comprehension [5]

Suggested Books:

7. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
8. Leech Geoffery: English Grammar for today, Longman, Delhi.
9. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
10. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
11. Quirk & Greenbaum: University English Grammar, Longman Publications.
12. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 341 English Literature : Pre and Post Elizabethans 3-0-0-3

Geoffrey Chaucer : General Prologue to Canterbury Tales (Line1-100) [6]

John Milton : Paradise Lost BK – I (Line 1-49, 94- 124) [10]

John Dryden : Absalom and Achitophel (Line 1-70) [10]

Alexander Pope : Rape of the Lock (Canto I & V) [13]

Suggested Books:

1. Chaucer, Geoffrey, The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.
2. Daiches, David, A Critical History of English Literature (vol. I), Delhi, Allied Publishers.
3. Grose, M. W.: Chaucer: Literature in Perspective.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Tragedy.
5. Rudram, Alan: A Critical Commentary on Milton's Paradise Lost.
6. Pope, Alexander: Rape of the Lock.
7. Dryden, John: Absalom and Achitophel.

EL 351 English Literature: Pre- romantics & Romantics-I 3-0-0-3

Thomas Gray : Elegy Written in a Country Churchyard	[6]
William Collins : Ode to Evening	[6]
William Wordsworth : Ode on the Intimation of Immortality	[5]
John Keats : Ode to Grecian Urn, Ode to Autumn, La Belle Dam Sans Merci	[7]
William Hazlitt : On the Ignorance of the Learned	[7]
Jane Austen : Mansfield Park (Non-detailed)	[8]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Ausen, Jane: Mansfield Park.
6. Hazlitt, William: On the Ignorance of the Learned.

EL 361 Twentieth Century English Literature-I 3-0-0-3

W B Yeats : When you are Old, The Second Coming, Byzantium, Lapis Lazuli	[9]
W H Auden : In Memory of W B Yeats	[4]
T S Eliot : The Wasteland	[13]
Samuel Backett : Waiting for Godot (detailed)	[13]

Suggested Books:

1. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books.
2. De Vane, W. C.: A Browning Handbook.
3. Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature).
4. Beckett, Samuel: Waiting for Godot.
5. Eliot, T S : The Wasteland
6. Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers.
7. Smith, Grover: T. S. Eliot's Poetry and Plays.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

Suggested Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press.
2. Hutcheun, Linda, Theorizing the Postmodern in K. M. Newton edited Twentieth Century Literary Theory, London, Macmillan,
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press.
4. Chandra, Naresh, New Criticism: An Appraisal, New Delhi, Doaba Publishing House.
5. Aristotle, Poetics, translated by S. H. Butcher.
6. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press.
7. Wright, Elizabeth, Psychoanalytic Criticism: Theory in Practice, Metheun,
8. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Oxford University Press.
9. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan.

EL 332 Modern English Language and Phonetics-II 3-0-0-3

Question Tags [4]

Transformation : Active-Passive voice, Direct-Indirect Narration, Assertive into Negatives and Interrogatives [5]

Punctuations [4]

Translations (English to Hindi, Hindi to English) [6]

Phonemic Symbols for Sounds of English, practice of Phonetic transcription [5]

Word Structure and word Stress [5]

Fallacies (Hasty Generalisation, *Petipio Principi*, Non-Sequitur, Composition, Division, *Post Hoc Ergo Propter Hoc*) [5]

Common Errors in English [3]

Word Power and Vocabulary [2]

Suggested Books:

1. Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.
2. Leech Geoffery: English Grammar for today, Longman, Delhi.
3. Murphy and Reynold: Essentials of English Grammar, Cambridge University Press.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi.
5. Quirk & Greenbaum: University English Grammar, Longman Publications.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi.
7. CIEFL material on Morphology and Phonology from the Distance Education Department.

EL 342 English Literature: Pre- romantics & Romantics-II 3-0-0-3

S T Coleridge : Kubla Khan	[6]
P B Shelley : Ode to Skylark, To Night	[6]
A. Tennyson : The Lotus Eaters	[5]
Charles Lamb : Imperfect Sympathies, All Fools' Day	[9]
Charles Dickens : A Tale of Two Cities (non-detailed)	[13]

Suggested Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.
2. Hough, Graham, The Romantic Poets, London, Hutchinson's University Library.
3. Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.
4. Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.
5. Dickins, Charles: A Tale of Two Cities.

Lamb, Charles: Imperfect Sympathies and All Fools

EL 352 Victorian Literature 3-0-0-3

Robert Browning : My Last Duchess, Porphyria's Lover, Andrea Del Sarto	[10]
G M Hopkins : Spring and Fall, Windhover, Felix Randal	[10]
Emily Bronte : Wuthering Heights (non- detailed)	[10]
Thomas Hardy : Far From the Madding Crowd (non- detailed)	[9]

Suggested Books:

1. Pick, John: Gerard Manley Hopkins: Priest and Poet, Delhi, Oxford University Press
2. Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books
3. Rhys, E.: Robert Browning and His Poetry.
4. De Vane, W. C.: A Browning Handbook.
5. Bronte, Emily: Wuthering Heights.
6. Hardy, Thomas. Far From the Madding Crowd.

EL 362 Twentieth Century English Literature-II 3-0-0-3

Ted Hughes : Pike, View of a Pig, Thought Fox	[7]
Philip Larkin : Toad, Coming, At Grass	[6]
James Joyce : A Portrait of the Artist as a Youngman (non- detailed)	[13]
Virginia Woolf : To the Lighthouse (non- detailed)	[13]

BA Honours Political Science 2019-20

B. A. (Hons.) in Political Science

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya [12]

Bal Gangadhar Tilak, Gopal Krishna Gokhale [15]

Raja Ram Mohan Roy, Dayanand Saraswati [12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement [8]

Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence [8]

of India Act, 1947

Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features [13]

Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism [10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha [8]

Executive: President, Prime Minister and Cabinet [8]

Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation [12]

Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups [11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress [11]

Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China [14]

Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China [14]

PS 331 Western Political Thought: From Plato to Bodin 3-0-0-3

Plato: ideal state, philosopher King, theory of education, theory of justice, theory of communism and its comparison with modern communism. [9]

Aristotle: father of political science, views on state, classification of states, justice, citizenship, slavery, revolution [9]

St. Augustine: political philosophy [3]

St. Aquinas: Christianized Aristotle, nature and functions of government, theory of law and justice [6]

Machiavelli: Father of modern political science, the child of his times, views on state and Prince [8]

Jean Bodin: political ideas, theory of sovereignty [4]

PS 341 International Relations-I 3-0-0-3

International relations: meaning, nature and scope. [3]

Theories in international relations: Idealism, Realism, Neo-realism, System theory, Functionalist [8]

Approaches: Decision making, Game theory and Bargaining theory [7]

National Interest and national power: meaning and elements. [4]

Balance of power: meaning and features. [2]

World War I: Causes and impacts [3]

World War II: Causes and impacts [3]

Cold war and détente: features and major events, post-cold war era [9]

PS 351 Contemporary Political Thought 3-0-0-3

Lenin: changes introduced into Marxism, Views on party organization and Imperialism [4]

Laski: On state & sovereignty [4]

F.A.Hayek: Concept of freedom [4]

Jean Paul Sartre: Existentialism [4]

Milton Friedman: Concept of freedom [4]

Herbert Marcuse: Critical Theory [4]

John Rawls: theory of Justice [4]

Robert Nozick: entitlement theory [4]

Samuel P. Huntington: Clash of civilizations [4]

Amartya Sen: views on justice [3]

PS 361 Public Policy-I 3-0-0-3

Public Policy: Introduction,Nature and scope, Concepts of public and policy [4]

Policy Analysis: Introduction, Meaning and issues of policy analysis, Stages in policy analysis [4]

Models of Policy analysis: System Model, Institutional approach, Rational Policy making model, Public choice approach, Political Public policy approach, Mixed approach by Hogwood and Gunn [16]

Forces in Policy making approach: Electorate power, Policy agenda, Influence of media, Pressure groups, Political parties [6]

Official policy maker (with reference to India): Legislature, Executive, Bureaucracy, Judiciary [9]

PS 371 Principles of Public Administration-I 3-0-0-3

Public Administration: Meaning, Nature and Scope [6]

Types of administration: Public and Private Administration [5]

New Public Administration and New Public Management: meaning and implications [4]

Theories of Organization: Classical, Scientific Management, Human Relations.[12]

Line Staff relationship: Hierarchy, Delegation, Coordination and Supervision. [12]

PS 381 Indian Administration 3-0-0-3

Evolution of Administration in India: The British legacies, the constitutional and Political system in Indian and its implications. The nature of administrative problems in India. Organization and working of Union Ministers of Home, Finance and Foreign Affairs. [12]

State Administration: role of Chief Secretary, Police administration in the state. [6]

District Administration: Divisional Commissioner, Role of Collector and its changing patterns. [8]

Role of Bureaucracy: the problem of Generalist and specialist in Public Services. Ministers-Civil Services relationship. [6]

Financial Administration in India: Budget- its formulation and execution, role of Public Accounts and Estimate Committee, Comptroller and auditor General in India. [7]

PS 332 Western Political Thought from Hobbes to Marx 3-0-0-3

Thomas Hobbes: human nature, state of nature, social contract, sovereignty and individualism [5]

John Locke: human nature, state of nature, social contract, sovereignty and individualism[5]

J.J.Rousseau: social contract theory, General Will, comparison with theory of Hobbes and Locke [5]

Jeremy Bentham: Utilitarianism, political philosophy [5]

J.S.Mill: Revision of Bentham's utilitarianism, views on liberty and representative government [6]

Hegel: views on state, dialectical idealism [5]

Karl Marx: dialectical materialism, class struggle, historical materialism, surplus value, communism [8]

PS 342 International Relations-II 3-0-0-3

United Nations: organs and functions, Reforms and Relevance. [13]

Nuclear Issues and disarmament: NPT, CTBT and India's nuclear policy. [6]

Foreign policy of major countries: United States, United Kingdom, Russia and China [8]

Regional organizations: SAARC, ASEAN, NAM and BRICS [8]

New International Economic Order: North- South Dialogue, South-South Cooperation [4]

PS 352 Indian Foreign Policy 3-0-0-3

Determinants and Principles of India's Foreign Policy: [6]

a) Domestic and International sources of India's Foreign Policy
b) Objectives and Principles

India and the Global Economic and Political Regimes – Main Issues [8]

a) India and World Trade Organization (WTO)
b) India at the United Nations: Security Council Reforms

India and South Asian States [8]

a) Pakistan: Challenges and Prospects
b) Afghanistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives: Main Issues

Changing Relations with the US and Russia from Cold War to Post Cold War [8]

India China Relations: Challenges and Prospects [4]

Security Challenges of India: An Appraisal [5]
a) Terrorism
b) Energy Security

PS 362 Public Policy-II 3-0-0-3

Policy implementation: Meaning, Elements in implementation, Techniques of implementation, Conditions for successful implementation [5]

Approaches to policy implementation: Top-down model, Bottom-up model, Policy action model, Managerial approach [10]

Policy Evaluation: Forms of policy evaluation, Criteria for evaluation, Techniques of evaluation, Problems in evaluation [6]

Policy change and continuity: Policy cycle approach, Organizational approach, Policy learning models [9]

Globalization of National policy making: an international perspective: Impacts of global events on national policy making, Need for a global perspective, Policy agenda in global context [9]

PS 372 Principles of Public Administration-II 3-0-0-3

Administrative Behaviour: Leadership, Decision Making and Communication. [6]

Management of Public Enterprises: with Special reference to the problem of Public Corporation. [5]

Control over Public Administration: Legislative, Judicial and Popular Nature, Limits and role of these controls. [10]

Personnel Administration: Recruitment, Training and Discipline. [8]

Financial Administration: Budget Formulation and Execution, Parliamentary control. [10]

PS 382 Local Self Government in India 3-0-0-3

Local Self Government: nature and scope [2]

Committees on Democratic Decentralization: Balwant Rai Mehta & Ashok Mehta Committee [2]

Rural Local Government: 73rd Amendment Act, 1992

a) Main features [2]

b) **Structural Facets of the Rural Local Government**: Gram Sabha, Panchayat, Panchayat Samiti, Zila Parishad. [6]

Urban Local Government: 74th Amendment Act 1992

a) Main features [2]

b) **Structural Facets of the Municipal Government**: Municipal Councils , Municipal committee and Corporations [6]

Election and Finance: Composition and Functions of State Election Commission and State Finance Commission [4]

Evaluation:

Regional Variations: Experience from the Indian States since the 73rd and 74th Amendment Acts. [5]

Critical Evaluation: SWOT (Strengths, Weaknesses, Opportunities & Threats) Analysis of Rural and Urban Local Institutions. [6]

Important Issues and Themes in Local Government in India: An Overview. [4]

BA Honours Psychology 2019-20

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology.	[8]
Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services.	[7]
Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling.	[6]
Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures.	[9]
Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures.	[9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PL 311	**Social Psychology - I**	**3-0-0-3**
	Social Psychology: Nature and Subject Matter; Relationship with other social sciences.	[3]
	Methods: Experimental, Observation, and Sociometry.	[5]
	Socialization: Nature, Process and Agents of Socialization.	[4]
	Group: Nature, Types and Functions; Psychology of Crowd, Mob and Audience.	[8]
	Social Norms: Meaning, Characteristics and Formation	[5]
	Prosocial Behavior: Co-operation and Helping Behavior -Nature and Determinants	[6]
	Leadership: Nature, Types and Functions. Theories- Trait , Situational and Interactional	[8]

PL 321	**Biological Basis of Behaviour**	**3-0-0-3**
	Biological basis of Behaviour: Evolutionary and genetic foundations. Research Methods – Neuroanatomical, Neurophysiologic, Neurochemical and Neuroelectrical.	[6]
	Cell and Neurons: Structure and types and functions of neurons; Neural impulse: Origin, Conduction and Measurement. Neurotransmitters.	[7]
	Nervous System: Central nervous system and Peripheral nervous system –Structure and Functions. Endocrine system and its behavioral implications.	[9]
	Sleep, arousal, and dreaming: Nature, stages of sleep, sleep deprivation, brain mechanisms of sleep and dreaming. Neural basis of arousal and attention.	[6]
	Motivation: Neural mechanism of Hunger, Thirst and Sex	[5]
	Biological basis of learning and memory: Neurophysiology of learning. Biological basis of memory: the search for the engram, PET scan and Biochemical factors in memory.	[6]

PL 331 Systems of Psychology 3-0-0-3

Nature and scope of Psychology: Psychology as science; Historical Origins: Preexperimental period- Science Among Greeks, British Empiricism, German Nativism.	[4]
Schools of psychology: Structuralism, Functionalism, Behaviourism, Psycho analysis, Gestalt psychology. Psychology in the post school era: cognitive revolution. Contemporary status	[5]
Learning: Concept and Theories: Hull, Tolman Spence, Miller and Dollard and Skinner.	[7]
Intelligence: Nature, Determinants Theories: Spearman, Thurstone, Cattell, Guilford, Sternberg, Gardner.	[6]
Memory: Concepts and Models. Level of Processing (Craik and Lockhart), working memory (Buddelay and Hitch), Monohierarichal (Tulving), PDP (McClelland).	[6]
Personality: Nature, Determinants,Theories- Psychoanalytic, Neo-Freudian, Rogress, Allport, Cattell, Eysenck.	[5]
Language Behaviour: Nature, Development of Language, Theories of Language Development: Mowrer, Skinner and Chomsky Language and thought: Whorfian Hypothesis.	[6]

PL 341 Psychopathology-I 3-0-0-3

Psychopathology: Meaning, Concept and Criteria of Normality and Abnormality.	[3]
Models of Psychopathology: Biological, Psychodynamic, Behavioral, Cognitive and Humanistic- Existential.	[7]
Classification System: Classification of Disorders, Need for Classification, DSM system of Classification.	[3]
Diagnostic Assessment: Case History, Interview, Projective Techniques	[5]
Anxiety Based Disorders: Nature, Symptoms and Etiology- Generalized Anxiety Disorders, Phobia, O.C.D, Somatoform and Dissociative Disorders	[12]
Psycho physiological Disorders: Nature, Symptoms and Etiology –Asthma, Peptic Ulcer, CHD, Hypertension	[5]
Mental Retardation: Nature, Types, Causes and its Management	[4]

PL 351	**Industrial and Organizational Psychology-I**	**3-0-0-3**
	Industrial/Organizational Psychology: Nature, historical development and scope.	[5]
	Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.	[9]
	Training of Personnel: Nature, Principles and Methods.On the job and of the job training methods. Evaluation of training programme	[9]
	Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal	[10]
	Work environment: Noise, atmospheric conditions. Illumination and performance	[6]

PL 361 Psychological Testing-I 3-0-0-3

Psychological Tests: Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.	[9]
Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems.	[9]
Validity: meaning, validation procedures, and special problems.	[9]
Construction and Standardization of Psychological Tests General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.	[12]

PL 312	**Social Psychology-II**	**3-0-0-3**
	Attitudes: Meaning, Characteristics, Measurement; Development of Attitudes and Attitude Change.	[6]
	Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primacy and recency effects. .	[6]
	Attribution process Nature and theories: Kelly and Weiner.	[6]
	Prejudice and Discrimination : Components of Group Antagonism, Origins of Prejudice and Remedies	[5]
	Propaganda: Nature, Tools and Techniques	[5]
	Aggression and Violence: Nature, Determinants and Management.	[5]
	Social Change: Nature, Factors and Theories.	[6]

PL 322 Guidance and Counseling 3-0-0-3

Guidance: Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational.	[5]
Counseling: Defining features, Goals. Necessary personal characteristics/qualities of effective counselors.	[5]
Counseling approaches: Affectively oriented approaches: psychoanalytic, person-centered and existential; Cognitively oriented approaches: Eclectic and behavioral.	[9]
Counseling process: External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.	[9]
Areas of counseling: Educational, career, family and marital gerontological and weaker sections; Stress management oriented counseling.	[7]
Evaluation of counseling: Nature and purpose, steps in evaluation, and outcome research.	[4]

PL 332	**Experimental Psychology**	**3-0-0-3**
	Experimental Psychology: Nature and History, Experimental Method	[4]
	Sensory Processes: Visual, Auditory – Structure and Functions of Eye and Ear. **Perception:** Nature, Perception of form – Figure and Ground, Perceptual Organization, Depth Perception–Cues.	[9]
	Psychophysics: Problems and Methods of Classical Psychophysics.	[8]
	Selective and sustained attention: Concepts and theories. Filter theory, response selection theory.	[6]
	Learning: Nature, Classical Conditioning- Phenomena and Procedure: Instrumental Conditioning- Appetitive and Aversive; Operant Conditioning	[5]
	Verbal Learning: Methods, Materials, Organizational Processes.	[3]
	Discrimination Learning: Phenomena, Procedures and paradigms	[4]

PL 342 Psychopathology-II **3-0-0-3**

Substance Abuse Disorder: Alcoholism and Drug Dependence; Causes Consequences and Rehabilitation.	[6]
Mood Disorders: Unipolar and Bipolar Symptoms and Etiology	[10]
Schizophrenia: Nature , Symptoms , Types and Etiology	[11]
Psychotherapy: Nature and Goals – Psychoanalysis, Behavior Therapy, Cognitive-Behavior Therapy, Client Centered Therapy, Chemotherapy and ECT	[12]

PL 352	**Industrial and Organizational Psychology-II**	**3-0-0-3**
	Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory.	[7]
	Job Satisfaction: Concept, determinants and measurement.	[5]
	Supervision and leadership: Functions and approaches. Trait, behavioral and contingency models.	[6]
	Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.	[6]
	Human engineering: Man-machine system. Designs, displays, controls and action.	[6]
	Occupational stress: counter productive behavior, role conflicts, absenteeism and burnouts, their causes and interventions.	[9]

PL 362	**Psychological Testing-II**	**3-0-0-3**
	Personality Tests: Purpose and Types, **Inventories**-Cattell's 16 PF, MMPI and Neo-five factors.	[9]
	Projective- Rorschach and TAT.	[9]
	Intelligence Tests: WAIS, WISC, Raven's Standard and Color progressive Matrices, Bhatia battery.	[8]
	Measurement of aptitude and Interest	[6]
	Measurement of Creativity- Torrance Test	[7]
	Anxiety and Depression,	

Pass Course 2019-20

EL 111 English Poetry-I 3-0-0-3

William Shakespeare: Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree	[6]
John Donne: The Sunne Rising, Batter My Heart, Death Be Not Proud	[6]
Christopher Marlowe: The Passionate Shepherd to His Love	[2]
Walter Raleigh: The Nymph's Reply	[2]
Andrew Marvell: To His Coy Mistress	[3]
George Herbert: Virtue	[2]
Ben Jonson: To Celia	[2]
John Milton: On His Twenty Third Birthday, On His Blindness	[6]
Robert Herrick: To the Virgins to Make Much of Time	[2]
Literary Terms: Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	[8]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd.
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher.
3. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd.
4. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
5. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
6. Gardner, Helen: The Metaphysical Poets, London, Penguin.
7. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL 121 English Prose-I 3-0-0-3

Francis Bacon: Of Studies, Of Revenge	[4]
Richard Steele: The Spectator Club	[4]
Joseph Addison: Meditations in Westminster Abbey	[4]
Oliver Goldsmith: Beau Tibbs at Home	[4]
Charles Lamb: Dream Children: A Reverie	[4]
William Hazlitt: Indian Juggler	[4]
Robert Lynd: The Student	[5]
Huxley: Pleasures	[3]
Maxim Gorky: The Mother of a Traitor	[3]
W S Maugham: The Verger	[4]

Suggested Books:

1. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd.
2. Sasikumar, J. , Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman.
3. Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.
4. Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
5. Walker, Hugh: The English Essay and Essayists.
6. Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers.

EL 101 Foundation Course in English 2-0-0-2

Sentence Structure: Elements of a sentence (Subject, verb, object, complement and adjunct)	[4]
Transformation of Sentence Structure: Degrees of adjectives, Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	[4]
Correct Usage of Language: Tenses (Present, Past and Future), Modals (can, could, will, would, shall, should, may, might, must, ought to, need) Phrasal verbs, Determiners (a, an, the, little, a little, few, a few, much, more, most)	[6]
Writing Skills: Theme (Paragraph) writing, Letter (formal, informal, business letters) and application writing, report writing, résumé writing	[4]
Common Errors in Effective Communication: How to avoid common sentence – structural errors, vocabulary and pronunciation	[4]
Reading Comprehension: Efficient reading and note taking	[4]

Suggested Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
4. Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)
5. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
6. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

SO 111 Introduction to Sociology-I 3-0-0-3

Sociology: The Meaning of Sociology, Nature of Sociology, Scope of Sociology-Formalistic and Synthetic School, Sociology and other Social Sciences [10]

Basic Concepts: Society, Community, Social Group, Status and Role [10]

Socialisation: Meaning of Socialisation, Agencies of Socialisation, Theories of Socialisation [9]

Culture: Meaning and Characteristics of Culture, Theory of Cultural Lag, Civilisation, Interrelationship and distinction between Culture and Civilisation [10]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 121 Social Thinkers-I 3-0-0-3

Auguste Comte: Positivism, Law of Three Stages, Social Statics and Social Dynamics [14]

Herbert Spencer: The Evolutionary Doctrine, The Organic Theory [10]

Talcott Parsons: Social Action, AGIL, Pattern Variables [15]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 111 Textile Science and Care 3-0-0-3

Introduction to Textile: basic terminology and classification of textile fibres	[2]
General Properties of Textile Fibres: physical, chemical and other properties of textile fibres	[2]
Properties of different textile fibres and their importance: Cotton, Wool, Silk and other natural fibres Rayon, Acetate, Nylon, Polyester, Acrylic, Glass and other manmade fibres	[4]
Preparation and manufacturing of different textile fibres: Cotton, wool and silk, rayon, acetate, nylon, polyester and acrylic	[10]
Yarn and fabric construction: Spinning methods- mechanical and chemical, yarn classification, methods of fabric construction	[7]
Laundry agents: water, detergents, soaps and other agents	[6]
Stain removal: classification and methods of stain removal	[4]
Care and storage of textiles-care of textiles with reference to service, appearance and economy	[4]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Dantyagi, S.: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
4. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
5. Mullick, P.: Textbook of Home science, Kalyani Publication.
6. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
7. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.

GM 121 Textile Science and care Laboratory 0-0-4-2

Suggested Experiments: Identification of textile fibres- burning, microscopic and solubility tests; Removal of stains from fabrics; Washing, ironing and finishing of textile articles

Suggested Books:

1. Dantyagi, S: Fundamentals of Textiles and their Care, Hyderabad Orient Longman Limited.
2. Deulkar, D: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
3. Hollen, N. and Saddler, J: Textiles, New York, Mac millan company.
4. Tortora, P.G: Understanding Textiles, New York, Mac millan company.

GM 131 Apparel Industrial Management 2-0-0-2

Textile Industry: Overview of textile industry, globalization and its impact on textile industry [6]

Status of garment industry in India: Production, marketing, distribution, consumption and export trends over the last five years [4]

Organization and association related to garment industry:

Problems of apparel industry and remedial measures, government role in promoting the growth of garment industry [13]

Sales promotion techniques [3]

Suggested Books:

1. Soundarapandian, M: Textile Industry Under Globalization, New Delhi, Vedams Books (P) Ltd.
2. Gurumurthy, G: A book on Textile Industry's 6-decade Journey, Coimbatore, The Hindu Business Line.
3. The Textile Industry and Trade Journal, Baroda, Comput –Media Services.
4. The Indian Textile Journal. Chennai, IPFonline limited.
5. Textile Trends. Kolkata, Eastland Publications Pvt. Ltd.
6. Textile Research Journal. New Jersey, Textile Research Institute.
7. Textile magazine, Chennai, Gopali and CO.

Note: The Students are advised to refer recent Journals of textiles.

EL 112 English Poetry-II 3-0-0-3

William Blake: London	[3]
William Wordsworth: The Solitary Reaper	[3]
Percy Byssey Shelley: Ode to the West Wind, Lines to an Indian Air	[5]
John Keats: Ode to a Nightingale	[4]
Lord Alfred Tennyson: Ulysses	[5]
Matthew Arnold: Dover Beach	[4]
Robert Browning: The Last Ride Together	[3]
Gerard Manley Hopkins: Pied Beauty, God's Grandeur.	[5]
William Butler Yeats: To a Shade	[3]
Thomas Stearns Eliot: Marina	[4]

Suggested Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.
2. Fifteen Poets, Delhi, Oxford University Press.
3. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
4. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
5. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
6. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
7. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
8. Lucas, F.L: Eight Victorian Poets, Cambridge.

Note: The Students are advised to read the critical books on English poetry by G. Bullough and V. de Sola Pinto.

EL 122 English Prose-II 3-0-0-3

John Ruskin: A Gentleman	[3]
John Bright: Peace	[3]
Charles Lamb: Modern Gallantry	[3]
Lord Riddel: The Art of Speaking	[3]
A. G. Gardiner: All about a Dog	[3]
William Cowper: On Conversation	[4]
W. R. Inge: Happy People, Ambition.	[7]
Thomas Hardy: The Mayor of Casterbridge	[13]

Suggested Books:

1. Approach to Life, Kolkata, Orient Longman Ltd.
2. Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press.
3. Lascelles, Abercrombie, Thomas Hardy: A Critical Study, New York, Russel & Russel.
4. Cecil, David, Hardy, the Novelist, London, Constable & Co.
5. Kettle, Arnold (ed), Hardy, the Novelist: A reconsideration in the Nineteenth Century Novel, London, Heinemann.
6. Walker, Hugh: The English Essay and the Essayists.

SO 112 Introduction to Sociology-II 3-0-0-3

Family: Meaning and Characteristics of Family, Functions, Types of Family, Changing Family Patterns	[10]
Marriage: Meaning and Functions of Marriage, Types of Marriage	[6]
Social Change: Meaning and Characteristics of Social Change, Causes of Social Change	[7]
Social Stratification: Meaning and Characteristics of Social Stratification, Caste and Class	[8]
Social Control: Meaning and Nature of Social Control, Process and Means of Social Control	[8]

Suggested Books:

1. Bottomore, T.B.: 1972, Sociology: A Guide to Problems and Literature, Bombay, George Allen and Unwin.
2. Giddens, A.: 1994, Sociology, Cambridge, Polity Press.
3. Gisbert, P.: 2004, Fundamentals of Sociology, Kolkata, Orient Longman.
4. Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.
5. Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
6. Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
7. Rao,C.N.S. : 2005, Sociology, New Delhi, S.Chand.
8. Srinivas, M.N.: 1998, Social Change in Modern India, New Delhi, Orient Longman.
9. Vidyabhushan and Sachdeva: 2005, An Introduction to Sociology, Allahabad, Kitab Mahal.

SO 122 Social Thinkers - II 3-0-0-3

Karl Marx: Historical Materialism, Class and Theory of Class Struggle	[10]
Max Weber: Social Action, Ideal Type, Protestant Ethics and Spirit of Capitalism	[15]
Emile Durkheim: Social Fact, Suicide, Division of Labour	[14]

Suggested Books:

1. Aron, R.: 1967, Main Currents in Sociological Thought, London, Weidenfield and Nicholson.
2. Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3. Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.
4. Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.
5. Timasheff, N.S.: 1967, Sociological Theory: Its Nature and Growth, New York, Random House.
6. Zeitlin Irving: 1998, Rethinking Sociology: A Critique of Contemporary Theory, Jaipur, Rawat Publication.

GM 112 Fundamentals of Textile Designing 2-0-0-2

Types of designs: structural and decorative	[2]
Elements of design: line, form, shape, colour and texture	[3]
Principles of design: proportion, rhythm, balance, emphasis and harmony	[3]
Weaving: history of weaving, looms and its parts, different types of weaves	[5]
Knitting: terminology, principles of knitting	[2]
Dyeing: types of dyes, different techniques of dyeing	[6]
Printing: styles and techniques of printing	[5]

Suggested Books:

1. Vastala, R.: Textbook of Clothing and Textiles, Indian Council of Agriculture and Research Publication.
2. Yadla,Vijay Lakshmi and Jasrai, Sucheta: UGC Guide to Home Science.
3. Smith, J. L.: Textiles Processing Printing Dyeing Finishing, Chandigarh, Abhishek Publications.
4. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.
5. Tortora, P.G. : Understanding Textiles, New York, Mac millan company.

GM 122 Clothing Construction-I 1-0-0-1

Sewing equipment: Tools required for clothing construction	[3]
Sewing machine: parts of machine their use and care, common machine problems	[3]
Fabric terms and definition	[1]
Preparation of fabric before cutting, placing, marking and cutting patterns	[2]
Taking body measurements	[1]
Simple stitches, seam and seam finish, Disposal of fullness in a garment	[3]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction, Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.

GM 132 Fundamentals of Textile Designing Laboratory 0-0-4-2

Suggested Experiments: Preparation of different types of weave; Preparation of samples of knitting; Dyeing-tie and dye technique; Printing- direct, discharge and resist style

Suggested Books:

1. Tortora, P.G.: Understanding Textiles, New York, Mac millan company.
2. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill Publication.

GM 142 Clothing Construction-I Laboratory 0-0-4-2

Suggested Experiments: Sewing tools and handling of sewing machine; Taking body measurements; Construction of following samples: stitches, seams, disposal of fullness, plackets, fasteners and binding

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. The Complete Guide to Sewing: Readers Digest, DK publishing.

EL 211 English Drama-I 3-0-0-3

William Shakespeare: Hamlet [13]

William Congreve: The Way of the World [13]

George Bernard Shaw: Candida [13]

Suggested Books:

1. Shakespeare, William: Hamlet, Penguin Popular Classics.
2. Congreve, William: The Way of the World.
3. Shaw, George Bernard: Candida.
4. Bradley, A C, Shakespearian Tragedy.
5. Dowden, Edward: Shakespeare: His Mind and Art.
6. Alexander, N, Poison, Play and Duel: A Study in Hamlet.
7. Frye, R. M., The Renaissance Hamlet: Issues and Responses in 1600,
8. Whitaker, V. K, The Mirror up to Nature: the Technique of Shakespeare's Tragedies.
9. Nicoll, Allardyce: British Drama

EL 221 English Fiction-I 3-0-0-3

Charles Dickens: Oliver Twist [13]

George Orwell: Animal Farm [13]

R. K. Narayan: The Bachelor of Arts [13]

Suggested Books:

1. Dickens, Charles: Oliver Twist, Oxford University Press.
2. Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir.
3. Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications.
4. Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher.
5. Chesterton, G. K.: Charles Dickens: A Critical Study.
6. Ford, Boris: From Dickens to Hardy, Penguin.
7. Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd.
8. Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave.
9. Crick, Bernard, George Orwell: A Life.

SO 211 Methodology of Social Research-I 3-0-0-3

Social Research: Meaning, Scope and Significance of Social Research, Scientific Method, Difference between Social Research and Social Survey [12]

Research Design: Meaning and Purpose of Research Design, Types – Exploratory, Descriptive and Experimental Research Design [10]

Sampling: Meaning and Characteristics of Sampling, Steps in Sampling Design, Types of Sampling - Random, Stratified, Cluster and Multi-stage Sampling [12]

Hypothesis: Meaning and Procedure of Hypothesis, Types of Hypothesis. [5]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 221 Sociological Theories-I 3-0-0-3

Structure-functionalism: Radcliffe-Brown – The idea of Social Structure, Malinowski - Functional Analysis [12]

Empirical Functionalism: Merton – Theory of Middle Range, Merton's critique and reformulation of Functional analysis [11]

Conflict Theory: Marx – Conflict Theory, Coser – Functional Analysis of Conflict [11]

Sociology of Knowledge: Karl Mannheim [5]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

GM 211 Textile Finishes 2-0-0-2

Finishes: meaning and its classification	[3]
Basic finishes: singeing, stiffening, mercerization and others	[6]
Surface finishes: delustering, flocking, napping, calendaring and others	[7]
Functional finishes: fireproof, water proof, wrinkle resistance, mothproof and other finishes	[7]
Consumer problems and care labels	[3]

Suggested Books:

1. Potter, B and Corbman, P.: Textiles: Fiber to Fabric, Delhi, McGraw Hill International Publication.
2. Gohl, EPG and Vilensky, L.D.: Textile Science, New Delhi, CBS Publishers & Distributors.
3. Deulkar, D.: Household Textiles and Laundry Work, Delhi, Atma Ram & Son's Publication.
4. Hollen, N. and Saddler, J.: Textiles, New York, Mac millan company.
5. Tortora, P.G.: Understanding Textiles, New York, Mac millan publishing company.

GM 221 Clothing Construction-II 1-0-0-1

Importance of clothing	[2]
Application of elements and principles of design for clothing construction	[3]
Factors affecting clothing: Social, psychological and economic	[3]
Wardrobe planning: Principles of wardrobe planning and wardrobe planning for different age groups	[3]
Consumer rights and responsibilities	[2]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Carson, B.: How You Look and Dress, Webster Division, Mc Graw-Hill Book company.
3. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
4. Erwin, M.D and Kinchen, A.L.: Clothing for Moderns, Mac millan Publishing, New York.
5. The Complete Guide to Sewing-Readers Digest, DK publishing.
6. Brocknam, H.L. The Theory of Fashion Design, John Wiley and Sons Inc., New York.

GM 231 Textile Finishes Laboratory 0-0-2-1

Suggested Experiments: Study and identification of finishes; Market survey for collection of fabric samples of different types of weaves; Laboratory tests for different fabric finish; Collection of care labels

GM 241 Clothing Construction-II Laboratory 0-0-4-2

Suggested Experiments: Construction of garments for different age groups

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.

EL 212 English Drama-II 3-0-0-3

Girish Karnad: Tughlaq [13]

Rabindranath Tagore: Chandalika [13]

Harold Pinter: The Birthday Party [13]

Suggested Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press.
2. Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press.
3. Pinter, Harold: The Birthday Party.
4. Esslin, Martin: Pinter: The Playwright.
5. Trussler, Simon: The Plays of Harold Pinter: An Assessment

EL 222 English Fiction-II 3-0-0-3

D.H. Lawrence: Sons and Lovers	[13]
V.S. Naipaul: A House for Mr. Biswas	[13]
Khushwant Singh: A Train to Pakistan	[13]

Suggested Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Surjeet Publication.
2. Naipaul, V. S.: A House for Mr. Biswas.
3. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd.
4. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher.
5. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., pp. 479-518.
7. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher.

SO 212 Methodology of Social Research-II 3-0-0-3

Observation Method: Meaning and Characteristics of Observation Method, Types- Participant, Non- participant and Quasi- participant Observation [10]

Interview Method: Meaning, Objectives and Techniques of Interview Method, Types- Structured, Unstructured and Focused Interview [10]

Questionnaire and Schedule: Meaning, Construction and Application [08]

Analysis of Data and Report Writing: Tabulation, Interpretation of Data and Steps in writing Report [11]

Suggested Books:

1. Bajpai S.R.: 2005, Methods of Social Survey and Research, Kanpur, Kitab Ghar.
2. Bose, P. K.: 1995, Research Methodology. New Delhi, ICSSR.
3. Goode and Hatt: 1981, Methods in Social Research, New York, McGraw Hill Book Company.
4. Kothari, C.R.: 1997, Research Methodology: Methods and Techniques, New Delhi, Wishwa Prakashan.
5. Mukherjee, P.N. (ed.): 2000, Methodology in Social Research: Dilemmas and Perspectives, New Delhi, Sage Publications.
6. Sjoberg, Gideon and Roger Nett. : 1997, A Methodology for Social Research, Jaipur, Rawat Publications.
7. Thakur, D.: 1997, Research Methodology in Social Science, New Delhi, Deep Publication.
8. Young, P.V.: 1996, Scientific Social Surveys and Research, New Delhi, Prentice-Hall of India.

SO 222 Sociological Theories-II 3-0-0-3

Phenomenology and Ethnomethodology: A. Schutz- Phenomenological Sociology, H.Ganfinkel- Ethnomethodology [11]

Interactionalist Perspective: G.H. Mead and H. Blumer- Symbolic Interactionism [11]

***Verstehen* Approach:** Max Weber [6]

Exchange Theory: Homans - Psychological Exchange Perspective, Blau - Structural Exchange Theory [11]

Suggested Books:

1. Cohen, Percy: 1968, Modern Social Theory, London, Heineman Educational Books Ltd.
2. Collins, Randall: 1997, Sociological Theory, Jaipur, Rawat Publications.
3. Coser, L.A.: 2002, Masters of Sociological Thought, New Delhi, Rawat Publications.
4. Giddens, Anthony: 1983, Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis, London, Macmillan.
5. Kuper, Adam: 1975, Anthropologists and Anthropology – the British School 1922-1972, London, Penguin.
6. Rex, John: 1961, Key Problems in Sociological Theory, London, Routledge and Kegan Paul.
7. Ritzer, George. : 1992, Sociological Theory, New York, McGraw-Hill.
8. Rose. A.M. (ed): 1962, Human Behaviour and Social Process- An Interactionist Approach, London, Routledge & Kegan Paul.
9. Turner, J.H.: 1995, The Structure of Sociological Theory, Jaipur, Rawat Publications.

CA 111 Fundamentals of Computers and Information Technology 3-0-0-3

Computer Concepts: Definition, Block Diagram and Applications in Modern Society, History, Types and Generations [3]

Functional Units of Computer Processing System: Hardware, CPU, Storage Devices and Media, VDU, Input/Output Devices, Data Communication Equipments, Information Concept and Processing: Data, Information, Knowledge and Wisdom [8]

Data representation: Representation of Data, Bits and Bytes, Number System; Binary, Octal, Hexadecimal, Conversions, Arithmetic Operations in Binary Number, ASCII and EBCDIC, BCD Character Sets [6]

Software Concepts: Types of Software, Programming Language; Machine Language, Assembly Language, High Level Language, Generation of Language, Assembler, Interpreter, Compiler [6]

Operating System: Functions, System Call, Interrupts, Concept of Resource Manager, Batch Processing, Multiprogramming, Multiprocessing, Time Sharing and Real Time System, MS-DOS, MS-Windows [10]

Data Communication: The Basic Communication System, Data Transmission Modes-Simplex, Half Duplex, Full Duplex, LAN, MAN, WAN, Network Topologies [6]

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 212 Clothing Construction-III 1-0-0-1

Basic pattern: definition and methods of making pattern [2]

Pattern making: Principles of pattern making and process of designing by flat pattern method [4]

Figure irregularities: Types and methods of changing garment according to it [2]

Pattern making: different types of collars, sleeves and skirts [5]

Suggested Books:

1. Doongaji, Sherie and Deshpande, R.: Basic Process and Clothing Construction, New Raj Book Depot, New Delhi.
2. Mansfield, A and Lucas, E.: Clothing Construction. Houghton Mifflin Company. London.
3. The Complete Guide to Sewing: Readers Digest, DK publishing.
4. Hollen, Norma R. and Carolyn J. Kundel: Pattern Making by the Flat Pattern Method. Prentice Hall
5. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

CA 141 Application Software Laboratory 0-0-4-2

Assignments are based on the course CA 111 Fundamentals of Computers and Information Technology

Suggested Books:

1. Sinha, P.K: Fundamentals of Computers, New Delhi, BPB Publication.
2. Norton's Peter: Introduction to Computers, New Delhi, TMH.
3. Taxali, R. K: PC Software for Windows, New Delhi, TMH.
4. Coutrer: Mastering Office 2000, New Delhi, BPB Publication.
5. Introduction to Computer Science, New Delhi, Pearson Education
6. Rajaraman V.: Introduction to Computer, New Delhi, PHI

GM 222 Clothing Construction-III Laboratory 0-0-4-2

Suggested Experiments: Construction of different types of collars, sleeves and skirts by flat pattern method

Suggested Books:

1. The Complete Guide to Sewing.: Readers Digest, DK publishing.
2. Bane, Allyn: Flat Pattern Design, Delhi, McGraw Hill Publication.

EL 311 American Literature 3-0-0-3

Walt Whitman: When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry [9]

Emily Dickinson: A Bird came down the Walk, I heard a Fly Buzz, A Light Exists [7]

Robert Frost: Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening [9]

Sylvia Plath: Morning Song, Death and Company [5]

R.W. Emerson: Brahma [4]

Edgar Allan Poe: The Fall of the House of Usher [5]

Suggested Books:

1. Kaplan, Justin, Walt Whitman: A Life, S & S.
2. Allan, Gay W., The Solitary Singer: Walt Whitman, New York University.
3. Allan, Gay W., Waldo Emerson, Viking.
4. Anderson, C. R., Emily Dickinson's Poetry, Holt, Rinehart and Winston.
5. Hoffman, Daniel, Poe Poe Poe Poe Poe Poe Poe, Avon.
6. Frost, Robert, The Poetry of Robert Frost, H. Holt.
7. Rao, K. B. (ed), Selected Stories of Edgar Allan Poe, Macmillan India Ltd.

Note: Students are required to consult "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers.

EL 321 New Literature in English 3-0-0-3

Toru Dutt: Our Casuarina Tree	[4]
Sarojini Naidu: Indian Weaver, The Song of Radha.	[4]
Rabindranath Tagore: Where the Mind is Without Fear	[4]
Sri Aurobindo: Transformation	[3]
Kamala Das: An Introduction as a Writer	[4]
Nissim Ezekiel: A Goodbye Party for Miss Pushpa T.S.	[4]
A K Ramanujan: Love Poem for a Wife	[4]
Arun Kolatkar: Chaitanya	[4]
Chinua Achebe: Refugee Mother and Child	[4]
Wole Soyinka: Agbor Dancer	[4]

Suggested Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd.
2. Narasimhaiah, C. D., The Awakened Conscience, New Delhi, Sterling Publishers.
3. Walsh, William, Commonwealth Literature, Oxford Paperbacks University Series, London, Oxford University Press.
4. Beier, Ulli (ed.), Introduction to African Literature, London, Longman.
5. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books.
6. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd.

EL 312 Literary Trends and Movements 3-0-0-3

The Renaissance	[4]
The Metaphysical School of Poets	[4]
The Classical Movements	[4]
The Romantic Revival	[4]
The Fin De Siecle Movement	[3]
The Georgian Poets	[4]
Poets of the First World War	[4]
The High Modernist Mode	[4]
Poetry of the Thirties	[4]
Poets of the Second World War	[4]

Suggested Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
3. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
4. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
5. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
6. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.
7. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL 322 Literary Criticism 3-0-0-3

Aristotle's Concept of Tragedy	[5]
Arnold's Touchstone Method	[5]
Eliot's Concept of Tradition	[4]
Post Modernism	[4]
The New Critics and Chicago Critics	[5]
Psychoanalytic Criticism	[6]
Marxist Criticism	[5]
Post-Colonial Criticism	[5]

Suggested Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press.
2. Hutcheun, Linda, Theorizing the Postmodern in K. M. Newton edited Twentieth Century Literary Theory, London, Macmillan,
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press.
4. Chandra, Naresh, New Criticism: An Appraisal, New Delhi, Doaba Publishing House.
5. Aristotle, Poetics, translated by S. H. Butcher.
6. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press.
7. Wright, Elizabeth, Psychoanalytic Criticism: Theory in Practice, Metheun,
8. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Oxford University Press.
9. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan.

SO 311 Gender and Society-I 3-0-0-3

Social Construction of Gender: Gender vs. Biology, Equality vs. Difference, Women in the Family, Gender roles, Development and Women's Empowerment. [9]

Emergence of Feminist Thought: Socio-historical perspective, Mapping various Women's movements. [11]

Gender and Sociological Analysis: Feminist critiques of Sociological Theories, Emergence of Women's Studies. [11]

Gender based Division of Labour: Production vs. Reproduction, Household work, Invisible work, Women's work and technology. [8]

SO 321 Society in India-I 3-0-0-3

Social Change in India: Sanskritisation, Westernisation and Modernisation.	[10]
Marriage in India: *Hindu Marriage- a sacrament, Types and changing patterns; Muslim Marriage- a contact, Types and changing patterns, Divorce among Muslims, Differences between Hindu and Muslim Marriages.*	[9]
Kinship in India: Meaning and Types of Kinship, Kinship Behaviour and Usages, Classificatory Terminology of Kinship.	[7]
Varna and Jati: Origin and changing dimensions.	[7]
Jajmani System: Functions, Roles and Changes in Jajmani System.	[6]

SO 312 Gender and Society-II 3-0-0-3

Women in India: Changing profile, The changing status of women in India—pre-colonial, colonial and post-colonial. [8]

Demographic profile: Sex ratio, Child Sex ratio. [8]

Gender and Society in India: Economy: Marginalisation of Women and Sexual Division of Labour, Polity — Reservation for Women, Religion and Culture, Marriage, Dowry and Property. [15]

Issues affecting the Quality of Life of Women: Health, Education, and Domestic Violence. [8]

SO 322 Society in India-II 3-0-0-3

Indian Society: *Hindu View of Life- Ashramas and Purusharthas*	[9]
India as a Plural Society: *Religion, Language and Region.*	[6]
Challenges of Unity in Diversity: Problems of Communalism, Religionalism, Casteism, Regionalism.	[10]
Tribal Life in India: Religious beliefs and practices, Tribal problems in India.	[5]
Population Problems and Society in India: Population explosion, causes and its remedies, Population Policy, Population and Sustainable Development.	[9]

FR 111 Grammar and Composition-I 3-0-0-3

Articles (definite, indefinite and partitive, contracted)-le,la,les,un,une des and du,de la,des,de l',au,a la,a l',aux.	[6]
Gender: The formation of feminine, The Formation of the Plural, Collective noun. Numbers (coordinal and ordinal).	
Conjugation of different regular and irregular verbs.	[5]
Verb: Regular conjugation, standard spelling irregularities, reflexive verbs, impersonal verbs.	[8]
The sentence, word order, negative expression, direct questions, answers.	[6]
Introduction of Adjectives and their uses in different sentences, Agreement of adjectives, position of adjectives. Affirmative, Interrogative and Negative Sentences.	[5]
Adjectives: demonstrative and possessive	[5]
Plural of adjectives, comparatives and superlatives of adjectives.	[4]
Audio Visual Programme	

FR 121 Written Expression-I 3-0-0-3

Greeting someone in formal and informal situation, Knowledge of etiquettes through telephonic conversation.	[4]
Introducing oneself / speaking of oneself, Giving the time/ giving one's telephone number.	[4]
Introducing someone/ describing a person (indicating one's nationality, saying where one lives, revealing one's profession, saying what one likes or does not like).	[4]
Fixing an appointment over the phone, Expressing one's agreement and disagreement.	[4]
Describing about one's daily activities, Seeking clarification on something.	[3]
Asking and giving information, Describing an action.	[4]
Making hypotheses**,** Solution to problem.	[2]
Study of monuments and different public places	[6]
Study of different geographical/historical/political regions of France.	[8]
Audio Visual Programme	

FR 211 Comprehension, Grammar and Translation-I 3-0-0-3

Adverbs: Adverbs of manner, Adverbs of time. Adverbs of place, Adverbs of intensity and quantity.	[7]
Pronoun relative, interrogative, demonstrative, possessive.	[4]
Pronoun: (emphatic, disjunctive, indefinite pronouns, personal pronoun).	[4]
Present indicative and recent past.	[5]
Questions based on seen or unseen passages	[9]
Passive form, subjunctive, impersonal form, translation from English to French	[6]
Possessive adjectives and pronouns.	[4]
Audio Visual Programme	

FR 221 Letter Writing, Composition, Culture and Civilization-I 3-0-0-3

Current important French personalities and events after World War Second in France	[8]
Function of national and regional institution of France.	[7]
History of France (Medieval era & 16th to 18th century)	[8]
Writing of paragraphs and Dialogues, Letter writing (Formal Letters)	[8]

[8]

FR 222 Letter Writing, Composition, Culture and Civilization-II 3-0-0-3

Simple translation, applied translation, skills and techniques in translation.	[8]
Writing resume, application.	[8]
Report writing (formal and informal).	[7]
Translation of passage from French to English and English to French.	[10]
History of France (19th & 20th century).	[6]
Audio Visual Programme	

FR 311 **History of French literature-I** **3-0-0-3**

History of French Literature: Middle age to 17th century.	[5]
Renaissance in France, its origin and significance.	[5]
French revolution: its impact on social and religious philosophy, politics & literature.	[6]
Writer and poets: life & work.	[7]
Classical Literature in 17th century	[8]
General idea of 16th, & 17th century	[8]

FR 312	**History of French literature-II**	**3-0-0-3**

L’histoire de la littérature française : moyen âge au 17ème siècle.	[5]
La renaissance en France, son origine et signification.	[5]
La révolution française : son impact sur philosophie sociale et religieuse, politique et littérature.	[6]
Les écrivains et les poètes : leurs vies et leurs travails.	[7]
La littérature Classique au 17e siècle	[8]
L’idée générale de 16e et le 17e siècle	[8]

FR 312	**History of French literature-III**	**3-0-0-3**

History of French Literature: 18th century.	[5]
History of French Literature: 19th century.	[5]
History of French Literature: 20th century.	[6]
Romantic movement.	[7]
Realism, realistic, symbolisms periods in France.	[8]
Music cinema, theater in 20th century.	[8]

FR 322	**History of French literature-IV**	**3-0-0-3**

L’histoire de la littérature française : le 18ème siècle.	[5]
L’histoire de la littérature française : le 19ème siècle.	[5]
L’histoire de la littérature française : le 20ème siècle.	[6]
Le mouvement romantique	[7]
Les périodes de réalisme, réaliste et symbolismes en France.	[8]
La musique, le cinéma, et le théâtre au 20ème siècle.	[8]

SN 131 Origin and Development of Sanskrit 3-0-0-3

Evolution of Sanskrit: Nomenclature of Sanskrit, Vedic Sanskrit and Classical Sanskrit, Prakrita, Pali, Apabhransha, Modern Indian Languages [9]

Vedic Sanskrit: Origin of the word veda, Vedic hymns, division of Vedic hymns, branches, content of the Samhitas, women vedic seers [11]

Post Vedic Literature: Brahmana, Aranyaka, Upanishad [8]

Classical Sanskrit: Epics, Mahabharata, Ramayana, Gita, Purana, Poetry, Prose, Champoo, Modern Sanskrit Literature [11]

Suggested Books:

1. Keith, A.B.; History of Sanskrit Literature, MLBD, Delhi
2. Krishnamachariar; History of Classical Sanskrit Literature, MLBD, Delhi
3. Macdonell, A.A.; History of Sanskrit Literature, MLBD, Delhi
4. Shastri, Gaurinath; A Concise History of Sanskrit Literature, MLBD, Delhi
5. Winternitz, Maurice; History of Indian Literature (Vol. I & II), MLBD, Delhi
6. Warder, A.K.; Indian Kavya Literature, MLBD, Delhi
7. Gairola, Vachaspati; Sanskrit Sahitya Ka Itihas, Chaukhamba Vidyabhawan, Varanasi
8. Tripathi, Radhavallabha; Sanskrit Sahitya Ka Abhinav Itihas, Vishvavidyalaya Prakashan, Varanasi
9. Dasgupta, S.N.; A History of Sanskrit Literature: Classical Period, University of Calcutta
10. Burrow, T.; Sanskrit Language (also Trans. into Hindi by Bholashankar Vyas), Chaukhamba Vidya Bhawan, Varanasi
11. Altekar,A.S.; Education in Ancient India, Delhi
12. Altekar,A.S.; Position of Women in Hindu Civilization, MLBD, Delhi
13. Basham, A.L.,; The Wonder that was India, London
14. Dandekar, R.N.; Vedic Religion & Mythology: A Survey of the Works of Some Western Scholars, University of Poona, Poona
15. Vaidya,C.V.; Epic India, Delhi

SN 141 Self Management in the Bhagavad Gita 3-0-0-3

Mind and its Functions- Nature of Mind-7.4-6,15.7,15.9,3.42,10.20,10.22, Mental Conflict-1.1, 2.60, 67,3.36-38,40,16.21, Factors responsible for Mental Conflict-16.21, 2.62-63, Factors responsible for *Karma* & *Swabhava*- 18.13-16	[9]
Infirmity of Mind and Quandary of Intelligence- Sense control and Importance of Intellect- 2.3,2.49,52,55,62,65,67, 4.38,39,42, 18.63,18.3.-32, Versatility of Mind and restraint- 6.11-14, 25-26,34,36, Factors for Perfection in Yoga- 3.8, 6.3, 16-17, 17.8-10, 3.12-13, 17.14-19, 6.36	[7]
Importance of Karma-Nature of soul and its difference from the material world- 2.19-26 , *Karma-yoga* :as a means to attain the knowledge – 2.40-44, 47-50, *Bhakti-yoga*: as a means to facilitate *Nishkaam karmayoga*- 12.19-20, Concept of *Lokasangraha*- 3.18-25	[16]
Relationship between consciousness and divine-13.31-32, 10.41, 7.12, 10.4,18.51-66,78	[7]

SN 132 Grammar and Composition-I 3-0-0-3

Inititialising Sanskrit Language through conversation -Diclension (Shabdaroopa), Conjugation (Dhaturoopa), Avayay with their applications in simple sentences	[10]
Laghusiddhanta Kaumudi- Maheshvara Sutra and concept of Pratyahara, Sanjna and Sandhi (Only essential rules based on application in the texts to be taught)	[12]
Elementary Knowledge of Case (Karaka) – Meaning, Numbers, Vibhakti	[5]
Translation -From English into Sanskrit, From Sanskrit into English	[12]

SN 142 Classical Sanskrit Literature-I 3-0-0-3

Panchatantram of Vishnu Sharman- Fifth Episode- Aparikshitakarakam	[15]
NitiShatakam of Bhartrihari (selected verses only) - Mangalacharan, Moorkhapaddhati, Vidwatpaddhati, Manshauryapaddhati	[9]
Raghuvansham of Kalidasa- 1st Canto (Verse 1-35)	[15]

SN 231 भारतीय-वैज्ञानिक-निधिः (Indian Scientific Heritage) 3-0-0-3

13. D. D. Kosambi; Bhartrihari's Shatakatrayam (with the Oldest Commentary of Jain Scholar Dhanasaragani) , Bharatiya Vidya Bhavan, Mumbai

Text Books:

संस्कृत साहित्ये प्रतिबिम्बित-वैज्ञानिक-भिज्ञता (Scientific Awareness reflected in Sanskrit Literature),वैदिकसाहित्ये ऋतुविज्ञानम्(Rituvigyana in Vedic Literature),संवत्सरचक्रम्(Samvatsarchakra),वृष्टिविज्ञानम्(Vristhivigyana),वराहमिहिरमते प्राचीनभारते जलवायुविज्ञानस्यावधारणा (Concept of Climatology in Ancient India-according to Varahmihira), बृहत्-संहिता 21.1-2,28.1-5(Brihatsamhita-21.1-2,28.1-5), भद्रबाहुसंहिता-9.1-15(Bhadrabahusamhita-9.1-15) ,प्राचीनभारते जलसंसाधनप्रबन्धस्य इतिहासः (History of Water Resource Management in Ancient India)-ऋग्वेद-10.9 (Rigveda-10.9),अर्थशास्त्रम्(Arthashastra(2.1.20-24,3.9.29-38,7.12.4-5), बृहत्संहिता(Brihatsamhita-54.1-10),महाभारत-आदिपर्वः(Mahabharata -Adi Parva-96) [10]

पातञ्जलयोगसूत्रसंदर्भे तनाव-प्रबन्धनम् (Stress Management: In context of PatanjaliYogasutra)समाधिपादः(Samadhipad 1.1,1.2,1.5,1.12,1.13,1.15,1.23, 1.30,1.30-37),साधनपादः(Sadhanapada (2.1, 2.3 ,2.11, 2.16, 2.27, 2.29) [20]

वैदिकजीवनचर्या आसनं प्राणायामः च –सिद्धान्तमात्रं (Vedic Life Style- Aasana and Pranayama (theory only), यौगिक-षट्कर्मः(Yogic Satkarma), ऋतुचर्या (Ritucharya),आहार: विहार:(Ahaara-Vihaara),आयुर्वेदतः प्राकृतिकचिकित्सा (Naturopathy from Ayurveda) [09]

SN 241 व्याकरणं रचना च- द्वितीयः भागः (Grammar and Composition-II) 3-0-0-3

सिद्धान्तकौमुद्यानुसारं कारकम् **(Case)-** Based on Siddhantakaumudi) [15]

लघुसिद्धान्तकौमुद्यानुसारं समासः**(Compound)-**Based on Laghusiddhantakaumudi) [14]

वाच्यम् (Voice) [10]

Text Books:

1. Kale, M.R. (2011). *Higher Sanskrit Grammar*. Delhi: MLBD.
2. Apte, V.S. (1996). *The Students' Guide to Sanskrit Composition*. Varanasi Chowkhambha Sanskrit Series.

Reference Books:

3. Kanshiram (2009). *Laghusiddhantakaumudi (Vol. 1-2)*. Delhi: MLBD.
4. Shastri, B. (2008). *Laghusiddhantakaumudi- Bhaimivyakhya* (Vol. 3-6). Delhi: Bhaimi Prakashan.
5. Shastri, C. (1960).*Vyakaranchandrodaya* (Vol. 1-3). Delhi: MLBD.

SN 232 लौकिकसंस्कृतसाहित्यम्- द्वितीयः भागः (Classical Sanskrit Literature-II) 3-0-0-3

कालिदासविरचितम् अभिज्ञानशाकुन्तलम् –चतुर्थाङ्कः पञ्चमाङ्कः च (Abhigyana-Shakuntalam of Kalidasa- 4th & 5th Act) [24]

बाणभटविरचितम् कादंबरी(शुकनासोपदेशः)- (Shukanasopadesha –Kadambari- of Banabhatta) [15]

Text Books:

1. Kale, M.R. (2010). *Abhigyana-Shakuntalam of Kalidasa*. Delhi:MLBD.
2. Kumar, P. (1974). *Shukanasopadesha (Kadambari).* Delhi: Meharchand Lachchmandas.

Reference Books:

3. Pant, S.C. (1992). *Abhigyana-Shakuntalam*. Delhi: MLBD.
4. Dwivedi, K. (1989). *Abhigyana-Shakuntalam*. Allahabad: Ramnarayan Lal Benimadhav Press.
5. Tiwari, R. (2005). *Natakakar Kalidasa aur Kavyakar Kalidas*. Delhi: Parimal Publication.
6. Macdonell, A.A. (1970). *History of Sanskrit Literature*. Delhi: MLBD.
7. Saxena, R. (1990). *Shukanasopadesha (Banabhatta).* Indore: Bharati Publication.
8. Karmarkar, R.D. (1980). *Bana*. Dharwar: Karnataka University.
9. Dwivedi, H. (1976). *Kalidas ki Lalitya Yojana*. Delhi: Rajkamal Prakashan.

SN 242 राष्ट्रवादः भारतीय-राजशास्त्रं च (Nationalism and Indian Polity) 3-0-0-3

संस्कृतसाहित्यम् राष्ट्रवादः च (**Sanskrit Literature and Nationalism**)- शुक्लयजुर्वेदः 22.22(Shuklayajurveda (22.22),अथर्ववेदः-12.1.1-2(Atharvaveda (12.1.1-2), रामायण कृ.कि. काण्डम् .46-48 (Ramayana (KK 46-48), विष्णुपुराणम्2.3 (Vishnupurana (2.3), अम्बिकादत्तव्यासः, Ambikadutt Vyas, प.क्षमारावः Pt. Kshama Rao,मथुराप्रसाददीक्षितः (Mathura Prasad Dixit), चारुदेवशास्त्री (Charudev Shashtri)	[24]
भारतीयराजशास्त्रम्- स्वरूपम्,महत्त्वम्,सैद्धान्तिकविकासः च Indian Polity: Nature, Importance and Development- कौटिल्यः(Kautilya),भीष्मः(Bhishma),मनुः (Manu), शुक्राचार्यः (Shukracharya),सोमदेवसूरी(Somdev Suri),कमंदकः(Kamandaka)	[7]
भारतीयराजशास्त्रस्य प्रमुखग्रन्थानि (Important Texts on Indian Polity)-ऋग्वेदः-10.173,10.174 (Rigveda -10.173,10.174), अथर्ववेदः-6.87,7.13 (Atharvaveda 6.87,7.13),शतपथब्राह्मण 5.1.1.8-13,9.4.1.1-5(Shatapath Brahmana -5.1.1.8-13, 9.4.1.1-5),अर्थशास्त्रम् -1.4.1-19 (Arthashastra 1.4.1-19), महाभारत-शान्तिपर्वः-120.1-35(Mahabharata- Shantiparva 120.1-35),मनुस्मृतिः-7.1-35(Manusmriti 7.1-35),गान्धीगीता-सत्याग्रहनिरुपणम् 5.1-25 (Gandhigita- Satyagraha Nirupana - 5.1-25)	[8]

SN 311 वैदिकसाहित्यम् (Vedic Literature) 3-0-0-3

ऋग्वेद: - अग्नि: 1.1 (**Rigveda-** Agni-1.1), इन्द्र:-1.18(Indra-1.18), उषस् 3.61 (Ushas- 3.61), विष्णु: -1.154 (Vishnu- 1.154), हिरण्यगर्भ: 10.121(Hiranyagarbha-10.121),संज्ञानम्(Sangyana-10.191),**यजुर्वेद**:-शिवसङ्कल्प: -34.१-6 (**Yajurveda-** Shivasankalpa- 34.1-6), **अथर्ववेद**: -सामनस्य 3.30 (**Atharvaveda-** Sammanasya-3.30),भूमि: -12.1-12 (Bhoomi- 12.1-12) [20]

उपनिषद् -कठोपनिषद्, **1-2** (**Upanishad-** Kathopanishad (1st and 2nd Chapter) [19]

Text Books:

1. Velankar, H.D. (1965). *Riksuktashati*. Pune: Vaidika Samshodhana Mandal.
2. Bandhu, V. (1960). *Atharvaveda (Shaunakiya)* Hoshiyarpur: VVRI.

Reference Books:

3. Upadhyay, G.P. (2001). *Shatapatha Brahmana.* Delhi: S.L.B.S.Rastriya SanskritVidyapeetha.
4. Shashtri, J. L. (1978).*Shuklayajurveda-Samhita(Vajasneyi-Madhyandina).* Delhi: MLBD.
5. Trivedi, R. (1996). *Rigveda Samhita*. Delhi: Chaukhambha Sanskrit Pratishthan.
6. Shashtri, S. D. (1986). *Kathopanishad(Shankarbhashya*). Delhi: Chaukhambha Sanskrit Pratishthana.
7. Krishnalal (1998).*Vaidiksangraha.* Delhi:Eastern Book Linkers.
8. Tripathi,V.N. (1986).*Vedachayanam.*Varanasi:Vishwavidyalaya Prakashan.
9. Velankar, H.D. (1970). *Riksuktavaijayani.* Mumbai:Bharatiya Vidya Bhawana.

SN 321 सौन्दर्यशास्त्रम् भारतीयनाट्यशाला च (Aesthetics and Indian Theatre) 3-0-0-3

सौन्दर्यशास्त्रम्(**Aesthetics**)-काव्यप्रकाशः-4.27-28 (Kavyaprakasha-4.27-28), सहित्यदर्पणः-दशमपरिच्छेदः (Sahityadarpana -Dashamparichcheda)	[12]
छन्दशास्त्रम्-(**Chhandashastr**a)- अनुष्टुपः(Anushtupa), आर्या(Arya), इन्द्रवज्रा(Indravajra), उपेन्द्रवज्रा(Upendravajra), उपजातिः(Upajati), वन्शस्थ:(Vanshastha), द्रुतविलंबित:(Drutavilambita), पुष्पिताग्रा(Pushpitagra), वसन्ततिलका(Vasantatilaka), मालिनी(Malini), मन्दाक्रान्ता(Mandakranta), शिखरिणी(Shikharini), शार्दूलविक्रिडीतं (Shardulavikridita),स्रग्धरा(Sragdhara)	[15]
नाट्यशास्त्रम्- द्वितीय अध्यायः (**Natyashastra (2nd Chapter)**परम्परागतभारतीय आधुनिकनाट्यशाला च (Traditional Indian and Modern Theatre), नाट्यमण्डपम् (Natyamandapa),रङ्गशीर्ष(Rangashirsha),रङ्गपीठम् (Rangapeetha), रङ्गमञ्चः (Rangamancha) स्वरूपम् विकासश्च (Features and Developments)	[12]

Text Books:

1. Nagendra (1996). *Kavyaprakash of Mammata with Vishveshwar Vyakhya*. Varanasi: Gyanmandal Ltd.
2. Nagar, R. (1994). Natyashashtra of Bharata. Delhi: Parimal Publication.

Reference Books:

1. Shastri, S. (1978). *Sahityadarpana*. Delhi: MLBD.
2. Bakshi, M.C. (1971). *The Concept of Ancient Theatre*. Delhi: Munsiram Manoharlal.

3. Ghosh, M.M. (2007). *Natyashastra of Bharat,* Delhi: Chaukhambha Publication.
4. Gupta, C.B. (1987). *Indian Theatre*. Delhi: Munshiram Manoharlal.
5. Mankad, D.R. (1996). *Ancient Indian Theatre*. Delhi: MLBD
6. Warder, A.K. (2004). *Indian Kavya Literature*. Delhi: MLBD

SN 312 संस्कृतव्याकरणम् भारतीयतर्कपद्धतिः च **3-0-0-3**
Sanskrit Grammar and Indian System of Reasoning

वरदराजाचार्यविरचितलघुसिद्धान्तकौमुदी- अच्-सन्धिःसूत्रबोधसहितः- - 6.1.47,1.1.65,1.149,6.1.75,1.3.10,1.1.2,1.1.69,6.1.84,1.3.2,1.1.50,1.1.1,6.1.85,6.1.91,6.1.97 (**Laghusiddhantakaumudi of Varadaraja** (Achsandhi with sutrabodha)- 6.1.47, 1.1.65, 1.149, 6.1.75, 1.3.10, 1.1.2, 1.1.69, 6.1.84, 1.3.2, 1.1.50, 1.1.1, 6.1.85, 6.1.91, 6.1.97 [20]

अन्नम्भट्टप्रणीतः तर्कसंग्रहः (**Tarkasangraha of Annambhatta**) [19]

SN 322 **वैदिकगणितम् खगोलविद्या च** **3-0-0-3**

(Vedic Mathematics and Astronomy)

Text Books:

भारतीयगणितस्य खगोलविद्यायाः च संक्षिप्त-इतिहासः (A Brief History of Vedic Mathematics & Astronomy- वेदाङ्ग-ज्योतिषम्(Vedanga Jyotisha), शुल्बसूत्रं (Shulbasutra),पञ्चसिद्धान्तिका(Panchasiddhantika),सूर्यसिद्धान्तः Suryasiddhanta, आर्यभट्टः-I(Aryabhatta-I),गणेशदैवज्ञः(Ganesh Daivagya),कमलाकरः Kamalakara, जयसिंहः Jay Singh, सुधाकरद्विवेदी (Sudhakar Dwivedi)	[8]
वैदिकगणितम्-लगध्-ज्योतिषम्(4&42) **Vedic Mathematics-** Selected section of LagadhJyotish(4&42),लीलावती(21श्लोकाः)),Lilawati(21Verses),श्रीभारतीकृष्णतीर्थः(5 सूत्राणि), Shri Bharati Krishna Teertha(5 Aphorism)	[12]
खगोलविद्या (लगधज्योतिषं -1-3&43)**Astronomy-** Selected section of Lagadh Jyotisha(1-3&43),सूर्यसिद्धान्तः(चतुर्दश-अध्यायः)Suryasiddhanta(14thChapter), आर्यभटीयम(गोलपद-1-22)Aryabhatiyam (Golapada- 1-22)	[12]
वेधशाला अथ च खगोलीयगणनार्थं प्रमुखप्राचीनयन्त्राणि (Observatories and Important Ancient Instruments for Astronomical Calculations)	[7]

GY 111 **Physical Geography-I** **3-0-0-3**

Solar System and origin of planets: Introduction to Solar system, Theories regarding origin of planets- hypothesis by Kant, Nebular hypothesis by Laplace, Planetesimal hypothesis of Chamberlin, Tidal hypothesis of James Jeans, Binary Star hypothesis of Russell and Big-bang.	**[15]**
Earth & Its components: Rotation, revolution of the earth and its consequences, Axis of the earth, Longitude and Latitude of the earth, Shape of the earth, Local time and standard time, Time zone and International Date line, Internal structure of the earth, Distribution of land and water on the earth.	**[7]**
Rocks, Earth movements, Volcanoes & Earth quake: Mode of occurrences of rocks: Igneous, Metamorphic and Sedimentary, Earth movements-folding and faulting of rocks, Earth quake: causes and consequences, Volcanoes: causes and consequences.	**[8]**
Work of different agents and resulted landforms: Weathering: Physical, Chemical and Biological, Work of River, Wind, Glacier, Sea wave and Karst: erosion, transportation, deposition and resulted landforms, Groundwater, springs and artesian wells.	**[9]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 121 **Bio-Geography-1** **3-0-0-3**

Biogeography: Introduction: Biogeography: Meaning, Definitions, Concept, importance and relevance, Ecology and Ecosystem: Definitions and principles, Dimensions in Ecology: Definition of Ecotope, Ecotone and Habitat, Biosphere, food chain, food web and ecological pyramid.	**[14]**
Biogeochemical Cycles and Soil: Biogeochemical cycles- Carbon cycle, Nitrogen cycle, Oxygen cycle and Phosphorus cycle, Soil: forming processes, factors responsible. Soil profile.	**[7]**
Distribution of Flora and fauna: Distribution of flora and fauna over geographical space, Factors affecting plant ecology: light, temperature, moisture etc.	**[5]**
Introduction to Biome, Biodiversity and Issues: Biome: meaning, concept and importance, Introduction to Bio-diversity-meaning and concept, Major bio-diversity hotspots in India, Issues related to the bio-diversity with special reference to India, Human induced changes in the ecosystem: causes and consequences.	**[13]**

Text Books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998) Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones, G.R. (eds) (1966) Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.

GY 112 **Physical Geography-II** **3-0-0-3**

Isostasy, Processes and Mountain building: Theories of Isostasy: Models of Pratt & Airy, Brief understanding of Geological time, Endogenetic and Exogenetic processes, Concept of geosynclines and orogenic processes, Mountains: types and their formations, Mountain building theories: theories by Kober, Joly, Holmes, Daly **[18]**

Concept of Scale, Cycles and landform evolution: Concept of scale in physical geography: spatial and temporal, Cyclic and non-cyclic concept of erosion, Normal cycle of erosion by W.M. Davis, Landscape evolution theory by W. Penk **[14]**

Evolution of drainage network on different topography: Development of drainage network on uniclinal structure, Development of drainage network on folded structure, Development of drainage network on faulted structure **[7]**

Text Books:

1. Singh S. (2015) Physical Geography, Pravalika Publications, Allahabad.
2. Lal D.S. (2009) Physical Geography, Sharda Pustak Bhawan, Allahabad.

Reference Books:

1. Strahler A.N. (1975) Physical Geography, John Wiley & Sons, Canada.
2. Lake P. (1985) Physical Geography (Indian Edition), Macmillan & Co., Calcutta, Bombay, Madras, London.
3. Trewartha G.T., Robinson A. H., Hammond E.H. (1967) Physical Elements of Geography, McGraw Hill, New York.
4. Kellaway G.P. (1960) Introduction of Physical Geography, Mcmillan, London.
5. Tikka R.N. (1989) Physical Geography, Kedarnath Ramnath & Co., Meerut.

GY 122 **Bio-Geography-2** **3-0-0-3**

Introduction to Community: Concept of community, Factors affecting community: Succession, vegetation climax, Effects of human interventions in the community (with special reference to India), Effects of industrial effluents on the community with special reference to India, management practices **[10]**

Spatial distribution of Biomes: Description of major biomes of the world in reference to the location, extension, climate, soil, flora, fauna, succession and human activates **[12]**

Soil formation, erosion and management: Mechanism of formation of podzol, laterite, chernozem and saline alkaline soils, Soil erosion and land degradation: Types and factors, their impacts on soil fertility and their management, Major ecological regions of India: Tropical rain forest, Desert, Mountain, aquatic ecosystem, mangrove and deciduous forest **[17]**

Text books:

1. Singh S. (2011) Bio Geography, Prayag Pustak Mahal, Allahabad.
2. Mathur H. S. (1998): Essentials of Biogeography, Anuj Printers, Jaipur.

Reference Books:

1. Dansereau P. M. (1957) Biogeography: An ecological Perspective, Ronald Press.
2. Eyre S. R., Jones G.R. (eds) (1966): Geography as Human Ecology, Edward Arnold, London.
3. Cox C.B., Moore P.D. (2010) Biogeography: An Ecological and Evolutionary Approach, John Wiley & Sons.
4. Barry C. (1993) Biogeography, Blackwell Scientific Publication, Oxford, London.
5. Huggett R.J. (2004) Fundamentals of Biogeography, Psychology Press.

GY 132 **Practical Geography-1** **0-0-4-2**

Scale and Maps: Introduction and Types: Introduction of Practical Geography, Concept of Maps and their importance in Geography, Concept of Scales and their importance in Geography, Type of Scales: Construction of Linear, Diagonal and Vernier scales **[16]**

Projections and Contours, Types and representation: Concept of projection in their importance, types and uses in Geography, Construction of projection in graphical method: polar, conical and cylindrical cases, Contours: Concept and representation **[14]**

Text Books:

1. Singh R. L., Singh R. P. B. (1999) Elements of Practical Geography, Kalyani Publishers.
2. Sarkar A. (1997) Practical Geography, A systematic Approach, Orient Longman Ltd.

Reference Books:

1. Anson R., Ormelling F. J. (1994) International Cartographic Association: Basic Cartographic Vol. Pregmen Press.
2. Gupta K.K., Tyagi, V. C. (1992) Working with Map, Survey of India, DST, New Delhi.
3. Loxton J. (1980) Practical Map Production, John Wiley.
4. Mishra R.P., Ramesh A. (1989) Fundamentals of Cartography, Concept, New
5. Delhi.
6. Monkhouse F. J., Wilkinson H. R., (1973) Maps and Diagrams, Methuen, London.
7. Rhind D. W., Taylor D. R. F. (eds.) (1989) Cartography: Past, Present and Future, Elsevier, International Cartographic Association.
8. Robinson A. H. (2009) Elements of Cartography, John Wiley and Sons, New York.
9. Sharma J. P. (2010) Prayogic Bhugol, Rastogi Publishers, Meerut.
10. Steers J. A. (1965) An Introduction to the Study of Map Projections, London.

GY 211 Geography of India 3-0-0-3

Physiography and brief Geology of India: India: location, shape, size, boundaries and extent; Major physiographic divisions of India: Northern Hills, Northern plains, Peninsular Plateau, Coastal plains, Indian deserts and the islands, Brief understanding of major Geological structures of India. **[8]**

Drainage and Climate of India: Drainage of India: Himalayan drainage and Peninsular drainage, National Water grid., Characteristics of Indian climate and seasons (Temperature, Humidity and Precipitation), Indian Monsoon: mechanism and consequences and its relation to Indian agriculture. **[8]**

Soils and Vegetation of India: Distribution of Soils of India, Distribution of Vegetation of India, Problem of flood and drought in India. **[4]**

Demographic Aspects of India:
Population distribution, density, sex ratio and literacy pattern of India. **[8]**

Cultural and Social Aspects of India:
Schedule tribes and scheduled tribes, Religious diversity in India, Linguistic diversity in India, Distribution of different races in India, Contemporary Issues: Poverty, Population explosion, globalization and its impact on the environment, regional disparity. **[11]**

GY 221 Human Geography 3-0-0-3

Basic concepts and Theory of Population: Introduction to the Human Geography: meaning, definitions and concept, Relation of Human geography with other fields of sciences, Population resource relationship: concept of over population, optimum population and under population, Population transition theory. **[15]**

Adaptation and Distribution of Population: Human adaptation in different parts of the world: Equatorial, Tropical, Temperate, and Polar area; Settlements: meaning and concept; Rural and Urban settlements: types and pattern, Elements of the environment and their impact on the Habitat, economy and Society of Eskimos, Pygmies, Bushman, Distribution of Population - World patterns, Factors influencing spatial patterns of population distribution – physical, economic and social aspects. **[15]**

Migration, Urbanization and Globalization: Migration of population: causes and consequences, brain drain, World population problems and policies, Urbanization, problems of urbanization, Globalization: causes and its impact, Concept of a region: types of regions. [9]

GY 212 **Economic Geography** **3-0-0-3**

Introduction to Different Economic Sectors: Introduction to economic geography: definition, meaning and concept, Economic geography and its relation to human geography, Classification of economic activities of the world: Primary, Secondary and tertiary activities (Hunting and food gathering, agriculture, industries and market economy). **[11]**

Agricultural Resources: an Introduction to Primary activities: Agriculture systems: Intensive subsistence agriculture (Rice) and plantation agriculture (Tea), Commercial grain farming (Wheat), Horticulture and mixed farming. **[8]**

Industrial locations and Manufacturing Industries: Industrial activities: an introduction, Factors Affecting location of Economic Activity with special reference to Industry; Secondary Activities: Manufacturing (Cotton Textile, Iron and Steel) (World pattern). **[10]**

Manufacturing Regions: Concept of Manufacturing Regions, Special Economic Zones and Technology Parks., Tertiary activities: Transport, Trade and Services. **[10]**

Text books:

1. Bagchi-Sen, S. & Smith, H.L. (2006). *Economic Geography: Past, Present and Future*. U.K., Taylor and Francis.
2. Sharma, T.C. & Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Publication.

Reference Books:

1. Alexander, J. W. (1963). *Economic Geography*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
2. Clark Gordon, L., Feldman, M.P. & Gertler, M.S., (eds.) (2000). *The Oxford Handbook of Economic Geography*. N.Y., Oxford University Press.
3. Coe, N. M., Kelly, P. F. & Yeung, H. W. (2007). *Economic Geography: A Contemporary Introduction*. U.K., Wiley-Blackwell.
4. Combes, P., Mayer, T. and Thisse, J. F. (2008). *Economic Geography: The Integration of Regions and Nations*. U.S., Princeton University Press.
5. Hodder, B.W. & Lee, R. (1974). *Economic Geography*. U.K., Taylor and Francis.
6. Leong, G.C. & Morgan, G.C. (1979). *Human & Economic Geography*. N.Y., Oxford University Press, Oxford.
7. Wheeler, J. O. (1998). *Economic Geography*. U.S., Wiley.
8. Willington, D. E. (2008). *Economic Geography*. U.K., Husband Press.

GY 222 **Geography of Resources** **3-0-0-3**

Distribution of Mineral Resources: Resources: meaning, concept and Definitions; Mineral resources: Uses and distribution: Iron ore, Coal, Bauxite, Zinc, Gold, Silver, Mica. **[8]**

Energy Resources: Renewable energy resource: Wind energy and Solar energy, Non-renewable energy resource: Petroleum, Natural Gas. **[5]**

Distribution of Agricultural Resources and Agricultural Infrastructure: Rice, wheat, Millet, Cotton, Sugarcane, Tea and Coffee; HYV seeds, Irrigation, Fertilizers and Pesticides. **[13]**

Concept of Industry, industrial resources and Industrial Regions: Iron and steel industry, Cotton textile industry, Aluminum industry, Cement Industry; Free trade zones and Special Economic Zones, Concept of Human Resource. **[13]**

Text books:

1. Roy, P. (2007). *Economic Geography, A Study of Resources.* New Delhi, New Central Book Agency Pvt. Ltd.

Reference Books:

1. Gautam, A. (2009). *Advanced Geography of India*. Allahabad, Sharda Pustak Bha.
2. Khullar, D.R. (2000). *India: A Comprehensive Geography*. New Delhi, Kalyani Publishers.
3. Krishnaswamy, K. (1972). *India's Mineral Resources*. New Delhi, Oxford IBM.
4. Rao, K.L. (1975). *India's Water Wealth*. New Delhi, Orient Longman.
5. Sharma, T.C. and Coutinho, O. (1981). *Economic & Commercial Geography*. New Delhi, Vikad Pub.
6. Singh, G. (1988). *Geography of India*. New Delhi, Atmaram & Sons.

GY 232 **Practical Geography-II** **0-0-4-2**

Cartographic techniques and Introduction to the topographical Maps: Construction of one dimensional, two dimensional and three dimensional graphs and diagrams, Topographical maps and their interpretation.

Basics of Field Survey and Chain and Tape Survey: Introduction to the field survey, Chain and tape surveying and plotting.

Introduction of Remote Sensing: Mechanism of remote sensing, Different platforms of Remote sensing, Spectral signature and its application in remote sensing, Introduction to GPS and GIS, Applications of GIS.

Text books:

1. Joseph, G. (2005). *Fundamentals of Remote Sensing*. India, United Press India.
2. King, L.S. (1969). *Statistical Analysis in Geography*. U.S., Prentice-Hall.
3. Lillesand, T.M., Kiefer, R.W. and Chipman, J.W. (2004). *Remote Sensing and Image Interpretation*. U.S., Wiley. (Wiley Student Edition).
4. Mishra, R.P. and Ramesh, A. (1989). *Fundamentals of Cartography.* New Delhi, Concept.
5. Monkhouse, F.J. and Wilkinson H.R. (1973). *Maps and Diagrams*. London, Methuen.

Reference Books:

1. Gupta, K.K. and Tyagi, V.C. (1992). *Working with Map*. Survey of India, New Delhi, DST.
2. Hammond, P. and Mc. Cullagh, P.S. (1978). *Quantitative Techniques in Geography: An Introduction*. U.K., Oxford University Press.
3. Loxton, J. (1980). *Practical Map Production*. U.K., John Wiley.
4. Rhino, D.W. and Taylor, D.R.F. (eds.) (1989). *Cartography: Past, Present and Future*. Elsevier, Amsterdam, International Cartographic Association.
5. Robinson, A. H. (2009). *Elements of Cartography*. New York, John Wiley and Sons.
6. Sharma, J. P. (2010). *Prayogic Bhugol.* Meerut, Rastogi Publishers.

GY 311 Climatology and Oceanography 3-0-0-3

Basic Components of atmosphere: Atmosphere, Climate and Seasons: concept and meaning; Structure and composition of atmosphere, Humidity; Distribution of Temperature. **[6]**

Circulation of atmosphere: Pressure and wind and their broad pattern, General circulation of atmosphere, jet streams. **[5]**

Atmospheric Disturbances and Winds: Different types of atmospheric disturbances: Tropical cyclone, Extra-tropical cyclone and Hurricane, Winds: planetary, seasonal and local, Climatic classification, climate change: causes and consequences. **[8]**

Geography of Ocean Basins: Ocean basin relief (Indian ocean, Atlantic ocean and pacific ocean). **[4]**

Salinity and Temperature of ocean water: Salinity: causes, determinants and distribution, Distribution of temperature and salinity. **[5]**

Dynamics of Ocean water:
Waves, Currents and Tide: formation and types. **[6]**

Coral Reefs and Ocean Deposits:
Coral reefs: types and theories; Ocean deposits. **[5]**

Text books:

1. Lal, D.S. (2011). *Climatology*. India, Sharda Pustak Bhawan.
2. Sharma, R.C. and Vatal, M.(1980). *Oceanography for Geographers*. Allahabad, Chaitanya Publishing House.

Reference Books:

1. Anthes, R.A., Panofsky, H.A., Cahir, J.J. & Rango, A. (1978). *The Atmosphere*. SRA, Columbus.
2. Barry, R.G. & Carleton, A.M. (2001). *Synoptic and Dynamic Climatology*. U.K., Routledge.
3. Barry, R.G. & Corley, R.J. (1998). *Atmosphere, Weather and Climate*. N.Y., Routledge.
4. Batten, L.J. (1979). *Fundamentals of Meteorology*. New Jersey, Prentice-Hall Inc., Englewood Cliffs.
5. Pinet, P.R. (2008). *Invitation to Oceanography (Fifth Edition)*. USA, UK and Canada, Jones and Barlett Publishers.
6. Stowe, K. (1987). *Essentials of Ocean Science*. New York, John Wiley &Sons.
7. Sverdrup, K.A. & Armbrust. E.V. (2008). *An Introduction to the World Ocean*. Boston, McGraw Hill,
8. Thurman, H.V. (1996). *Essentials of Oceanography*. New Jersey, Prentice-Hall.
9. Tikka, R.N. (1989). *Physical Geography*. Meerut, Kedarnath Ramnath & Co.

GY 321 **Man and Environment** **3-0-0-3**

Basics of Environment: Environment: meaning, concept, definitions and types; Components of physical and cultural environment.

Relationship between Man and Environment:
Man and environmental relationship of time and space; Approaches in understanding the man and environment relation-Deterministic approach, Possibilistic approach and neo determinism, Geography and geographers: association with man and environment.

Changing relationship of Man and Environment and Issues:
Population explosion, technology and environment: changing relationship.

Environmental Issues: Environmental issues in Tropical, Temperate and Polar areas; Environmental hazards: natural and manmade.

Environmental Management: Environmental policies, Management, Concept of Sustainability.

Text Book:

1. Singh, S. (2015): *Environmental Geography*. Allahabad, Pravalika Publications.

Reference Books:

1. Chandna, R.C. (2002). *Environmental Geography*. Ludhiana, Kalyani.
2. Cunninghum, W.P. and Cunninghum M.A. (2004). *Principals of Environmental Science: Inquiry and Applications*. New Delhi, Tata Macgraw Hill.
3. Goudie, A. (2001). *The Nature of the Environment*. U.K., Blackwell, Oxford.
4. Miller, G.T. (2004). *Environmental Science: Working with the Earth*. Singapore, Thomson Brooks Cole,

GY 312 **Geography of Settlement** **3-0-0-3**

Basics of Settlement: Introduction: Nature and Scope; Basic Concepts: Rural and Urban Settlements, Hamlet, Village, Town, City, Metropolis, Megalopolis, Conurbation, Rural-Urban Fringe. **[9]**

Rural Settlements: Types and Patterns, Determinants. **[4]**

Theories of Settlement: Regional Settlement Hierarchy: Central Place Theory, Rank-Size Rule, Primate City. **[10]**

Urban Land use: Models; Types – Residential, Commercial, Industrial, Institutional, Recreational, Heritage, Public and Green Spaces, and Transport. **[9]**

Site and situation: Concept of Site and Situation, and Landuse, Services and Infrastructure; Problems and their prospects. **[7]**

Text Books:

1. Ghosh, S. (1999). A Geography of Settlements. Kolkata, Orient Longman.
2. Singh, R.Y. (1994). The Geography of Settlement. New Delhi, Rawat Publication.

Reference Books:

1. Chishlom, M. (2007). Rural Settlement and Land Use. U.S., Transaction Publishers.
2. Daniel, P. (2002). Geography of Settlement. Jaipur & New Delhi, Rawat publication.
3. Kaplan, D.H., Wheeler J.O. & Holloway S.R. (2008). Urban Geography. John U.S., Wiley.
4.Misra, R.P. and Misra, K. eds. (1998). Million Cities of India. New Delhi, Sustainable Development Foundation.
5. Pacione, M. (2009). Urban Geography: A Global Perspective. U.K., Taylor and Francis.
6. Ramachandran, R. (1989). Urbanisation and Urban Systems in India. India, Oxford University Press, India.
7. Ramachandran, R. (1992). The Study of Urbanisation. New Delhi, Oxford University Press.

GY 322 Spatial Dimensions of Development 3-0-0-3

Introduction to Development: Concept of Development; Measures of Development (Economic, Social and Environmental); Efficiency- Equity Debate. [8]

Regional Development: Concept of Region and Regional Development; Intral and Inter-regional Development pattern. [6]

Theories of development: Myrdal, Hirschman and Friedmann. [10]

Impact of Development: Interrelationship between environment and development; Impact on physical environment in terms soil erosion, land degradation, deforestation. [8]

Different Issues in Developed and Developing Countries: Pollution and issues in developed and developing countries of the world; Human development: International, interstate comparison of India. [7]

Text Books:

1. Claval, P.L. (1998). An Introduction to Regional Geography. Oxford and Massachusetts, Blackwell Publishers.
2. Gore, C.G. (1984). Regions in Question: Space, Development Theory and Regional Policy. London, Methuen.

Reference Books:

1. Abler, R., Adams, J. S., & Gould, P. R. (1971). Spatial Organization: A geographer's View of the World. Prentice-Hall, Englewood Cliffs.
2. Blij, H. J. (1971). Geography: Regions and Concepts. N.Y., John Wiley and Sons.
3. Friedmann, J. & Alonso, W. (1975). Regional Policy - Readings in Theory and Applications. Massachusetts, MIT Press.
4. Gore, C. G., Köhler, G., Reich, U-P. & Ziesemer, T. (1996). Questioning Development: Essays on the Theory, Policies and Practice of Development Intervention. Marburg, Metropolis-Verlag.
5. Haynes, J. (2008). Development Studies. U.K., Polity Short Introduction Series.
6. Peet, R. (1999). Theories of Development. N. Y., The Guilford Press.

GY 332 **Practical Geography-III** **0-0-4-2**

Basics of Survey: An introduction to survey and different instruments.

Prismatic Compass and Plane Table Survey: Prismatic compass survey and Plane Table Surveying

Weather instruments, Weather Maps and graphs: Introduction to weather instruments, Interpretation of weather maps, Hythergraph and climograph: uses and applications. 26

Introduction to Statistical Techniques: Frequency distribution, central tendency: mean, median and mode, measures of dispersions.

Text Books:

1. Hussain, S.K. & Nagaraj, M.S. (1992). Textbook of Surveying. New Delhi, S. Chand and Co. Ltd.
2. Pal, S. K. (1998). Statistics for Geoscientists. New Delhi, Tata McGraw Hill.
3. Sarkar, A. (1997). Practical Geography: A Systematic Approach. Hydrabad, Orient Longman Ltd.

Reference Books:

1. Elfic, M.H., Fryer, J.G. Brinkner, R.C. & Wolf, P.R. (1994). Elementary Surveying. London, Harper Collins Publishers.
2. Kanitkar, T.P. & Kulkarni, S.B. (1988). Surveying and Leveling, Part 1. Pune, Pune Vidyarathi Griha Prakashan,
3. Mahmood, A. (1977). Statistical Methods in Geographical Studies. New Delhi, Concept.
4. Monkhouse, F.J. & Wilkinson, R. (1971). Map and Diagrams: there compilation and construction. New Delhi, B.I. Publications Private Ltd.
5. Silk, J. (1979). Statistical Concepts in Geography. London, Allen and Unwin.
6. Singh, R.L. & Singh, R.P.B. (1991). Elements of Practical Geography. New Delhi, Kalyani Pub.
7. Venkatramaiah, C. (1996). A textbook of Surveying. Hydrabad, University Press/Orient Longman Ltd.

HY 111 Ancient Indian History– I

Objectives: The course intends to provide an extensive survey of early Indian history to the students of the history honors course. It also familiarizes them with the tools of studying ancient Indian history. It further aims empowers the students not only with the significance of sources in history writing but make them aware with the importance of environmental factors in the study of history

Unit1. Sources: Literary/written sources - Vedic/Hindu canonical literature: Buddhist Canonical Literature, Jain Canonical Literature, Secular Literary Sources - Sangam Literature. Foreign Accounts - The Greeks and Romans, Chinese. Material/Archaeological sources –Inscriptions, Epigraphs, Coins, and Monuments.

Unit 2. The Pre-Historic Period: Paleolithic Cultures – Sequence and geographical distribution, evolution and uses of stone industries. Mesolithic Cultures – regional and chronological distribution. Neolithic Age and Chalcolithic Age.

Unit 3. The Harappan Civilization: Origin, distribution, morphology of major sites (Mohanjodaro, Harappa, Kalibangan, Lothal, Dholavira). Society, economy, polity and religion as reflected in Vedic literature. Religious beliefs and practices and art and architecture.

Unit 4. Vedic age to 6th Century B.C: The origin of Aryans, geographical background, Political, Social, Economic and religious conditions of the Aryans in the Rig Vedic and Later Vedic Period. Rise of Territorial States in Northern India: Urbanisation of the Ganga Valley, Sixteen Mahajanapadas, Ascendency of Magadha. Iranian and Macedonian Invasion: Significance; Religious Movements in 6th Century B.C Buddhism and Jainism: Rise, Growth and Contribution to Indian History.

HY 121 Ancient River Civilization- I

Objectives: To offer a historical survey of human evolution. It details the features of material culture of early humankind by tracing the transitions from the hunting-gathering subsistence pattern to more advanced human subsistence patterns involving domestication of animals and food production. The paper highlights how such changes were gradual and did not unfold uniformly in all parts of the world; thereby allowing for coexistence of different subsistence forms.

Unit 1. Cradle of civilization Mesopotamia: Origin of Fertile Crescent, Geography, Early civilization of Sumerian, Akkadian, Babylonian and Assyrians, Religious Beliefs, Rituals and practices, Social Levels, Classification, Priest, King, Upper class, Nobles, Lower Class, Slavery, Medicines, Astronomy, Astrology, Time, Inventions, Mummification, Tools and Methods, Script on Tablets, Seals , Mode of warfare, Strategies, Government, Polity, Administrative units Law Code, Justice, Causes of Decline of Civilization.

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units, Social stratification in society, food, Dress, Social Classes, Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization, Contribution of Civilization

HY 112 Ancient Indian History–I

Objectives: This course is about early historical developments taking place in Indian history especially post-Harappan period, that is Vedic and later Vedic periods. Highlighting the features of early historic times , the course tries to trace the emergence of state system from proto-state stage and at the same time seeks to underline the important development in the arena of economy, society and culture.

Unit 1. The Age of Maurya: Sources of Mauryan History: Kautilyas Arthasastras and Meghsthenes Indica and Ashokan Inscriptions. Chandragupta Maurya, Bindusara and Asoka- Foundation and Consolidation of Empire, Administrative system. Ashoka's policy and reforms, Dhamma, Art and architecture: Decline of Mouryan Empire.

Unit 2. Post Mauryan Polity: Post Mouryan Polity in India: Ruling dynasties in Northern and Southern India: Sungas, Satavahanas and Kushanas. Rise of Kharavela in Kalinga. Sangam age- Literature, Economy and Society.

Unit 3. Age of the Guptas and Post-Gupta period (to c. 750): Political history of northern and southern India. Samanta system and Changes in political structure. Economy and Social structure. Culture and Religion.

Unit 4. Themes in early Indian cultural history: Languages and texts, Major stages in the evolution of art and architecture, Major philosophical thinkers and schools.

HY 122 Ancient River Civilization- II

Objectives: This paper traces the changing political formations, economic and social structures in the ancient Greek and Roman empires because ancient history of these two regions explain in great detail about Europe owes to the development of civilization to these particular regions in large measure**.**

Unit 1. Classical Greece civilization: Mythologies in ancient Greek, Social structure and stratification, Classes, Athens Olympics in ancient Greece, Art and Architecture in ancient Greece

Unit 2. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units Social stratification in society, food, Dress, Social Classes Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline.

Unit 3. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization Contribution of Civilization

HY 211 History of Medieval India (750-1526 A.D.)-I

Objectives: The purpose of this paper is to introduce to students the idea of major transition in early medieval India in the wake of disintegrating power at the Centre. It aims to guide students as to how the corresponding rise and rapid spread of Islam marks the advent of Islam in India through various channels**.**

Unit 1. Early Medieval India, 750-1200: Polity: Major political developments in Northern India and the Peninsula, Origin and the rise of Rajputs, The Cholas: administration, village economy and society -"Indian Feudalism" Agrarian economy and urban settlements, Trade and commerce, Society, Science and technology.

Unit 2. Cultural Traditions in India, 750- 1200: Philosophy: Skankaracharya and Vedanta, Ramanuja and Vishishtadvaita, Madhva and Brahma Mimansa, Religion, Tamil devotional cult, Growth of Bhakti, Islam and its arrival in India Sufism, Literature, Growth of Tamil literature, Kalhan's Rajtarangini, Alberuni's, Art and Architecture: Temple architecture, Sculpture, Painting.

Unit 3. Establishment of the Delhi Sultanate: The Ghurian invasions, Factors behind Ghurian success, Economic, Social and Cultural consequences, Foundation of Delhi Sultanate and early Turkish Sultans - Consolidation: The rule of Iltutmish and Balban.

Unit 4. "The Khalji Revolution": Alauddin Khalji, Muhammad Tughluq, Firuz Tughluq, Decline of the Sultanate, Foreign contacts and Ibn Battuta's account, Sayyid Dynasty: Khizr Khan, Mubarak Shah, Lodhi Dynasty : Bahlol Lodhi,. Sikander Lodhi, Ibrahim Lodhi, Sultanate administration.

HY 221 Main Outline of World History-I

Objectives: Through discussion of a period in Europe marked by Renaissance, Protestantism, Thirty-Years-War Counter-Reformation, rise of absolutism, this paper seeks to familiarize students with phenomenal movements in Europe in the fields of culture, religion and politics which laid the future roadmap for largerdevelopment in Europe and the world. It covers discussion on famous monarchs and friction between the state and the Church over the issue of power share.

Unit 1. Renaissance: Meaning and Definition, Nature & Impact, The Reformation, Causes, Nature of Reformation, Results, counter reformation.

Unit 2. Rise of National States: Causes Main monarchies and their growth - Ferdinand, Isabella of Spain, Louis XI of France, England - Henry VII, and Holy Roman Empire. Rise and Decline of Spain - Foreign Policy of Charles V, Philip II, Revolt of Netherland, Thirty Years War, Causes of downfall of Spain.

Unit 3. France under Henry IV: Growth of Royal absolutism, Cardinal Richelieu, Cardinal Mazarin, Louis-XIII, The Thirty Years War, Treaty of Westphalia, Louis XIV, Foreign Policy, Religious Policy , Policy of Colbert's.

HY 212 History of Medieval India (1526- 1740 A.D.)-II

Objectives: Teaching of this paper plans to demonstrate political transition with the establishment and consolidation of the Mughal Empire. It introduces students to a new rounds of social-political-cultural-religious and economic developments under the Mughal regime. By covering about a period of over two centuries, this paper covers the arrival of Europeans and takes into account a larger sort of development as a result of industrial development in Europe and its cascading impact all over places including India where it coincides with the downfall of a mighty Mughal empire. Other issues also get covered under this paper like

Unit 1. Mughal state's relation with regional powers (Rajput, Sikhs, Afghans, Marathas, Deccani kingdoms and the like.

Unit 2. Foundation and Expansion of the Mughal Empire: struggle for empire in North India; Babur's invasion; Mughal-Afghan conflict. Shershah Suri and his administrative reforms.

Unit 3. Consolidation of the Empire: Akbar's imperialist agenda—administration, Mansabdari system, Zabt system; Religion and state—Akbar to Aurangzeb; evolution of the nobility under the Mughals.

Unit 4. Mughal Economy, Society and Culture: rural society and agrarian relations; crafts and industries; monetary system; inland and oceanic trade; literature; technology; architecture and painting.

Unit 5. Disintegration of the Mughal Empire: problems of succession and court politics in the reign of Aurangzeb; popular revolts within the Mughal empire—the Jats, Satnamis, Afghans, and the Sikhs; crisis in the Jagirdari system; peasant uprising and agrarian crisis; Bhakti Movement & Prominent saints, Sufism meaning and Sects.

HY 222 Main Outline of World History-II

Objectives: The paper aims to acquaint the students with a brief history of Russia, Prussia and Austria from thematic standpoint of political and economic changes. Moreover, effort is to familiarize students with the development in the field of art and architecture along with the French revolution and further rise and fall of Napoleonic phase.

Unit 1. Rise of Modern Russia: Peter the great, Catherine II their foreign policies, Austrian Empire - War of Austrian succession - Treaty of Aix-La-Chapple, Causes of seven years' war, Foreign policy of Joseph II, The Rise of Prussia, Domestic, foreign and religious policy of Frederick the great.

Unit 2. The Baroque Age: Science and Technology in 17th and 18th Centuries, The Anglo-French Rivalry for overseas Colony, French Revolution, Causes and results.

Unit 3. Napoleon Bonaparte: Continental System, Battle of Waterloo-Fall of Napoleon-Vienna Congress-Concert of Europe .

HY 311 History of Modern India (1740-1857 A.D.)

Objectives: This paper on modern India familiarizes with the strategies of Europeans especially British traders who soon took over entire India under the initial garb of trading. Herein, the discussion encompasses the establishment, consolidation and ultimately dissolution of East India company and transfer of power to the British Queen in 1857-58. All sorts of developments during the stated period are discussed and debated in great detail. The ideas of modernity and modern ideas are also discussed in brief.

Unit 1. Political Condition of India in the 18th Century: Decline of Mughal emperor and its impact, Advent of Europeans in India – Establishment of bases and trading centres of East India Company and other European companies, Rise of Maratha power, Third battle of Panipat, Cause of defeat of Maratha's and impact of Maratha defeat, Early Anglo – French conflict.

Unit 2. Establishment of British rule in India: Causes of Anglo-French rivalry, Conflict in Bengal, Clive as Governor of Bengal, Battle of Plassey and Buxer, Administrative and Judicial Reforms. Consolidation of English Rule in India, Lord Cornwallis and his reforms, Judicial And Commercial reforms, Lord Wellesley, Lord William Bentinck, Lord Dalhousie and the policy of annexation (1848-56).

Unit 3. Relations of Leading Indian States with English powers: Anglo- Mysore relations – Anglo Mysore wars, Haidar Ali and Tipu Sultan, Anglo- Sikh Relations – Anglo-Sikh wars, Raja Ranjit Singh, Anglo- Maratha Relations- Anglo- Maratha wars.

Unit 4. Revolt of 1857: Causes, Nature and Impact, British Policy towards Burma, The British Afghan Policy –Afghan Wars, Policy Towards Sindh and Nepal, The British Social and Economic Policies.

HY 321 History of China and Japan(1840-1949)-I

Objectives. In this paper, focus is on gradual downfall of Chinese political system and gradual transition of power into the hands of Western powers especially Britain with the first and second Opium wars. The rise of regional powers and anti-manchus sentiments, anti-foreign sentiments, rise of Christianity, and occurrence of several rebellions and movements, the Chinese effort to modernize and militarize are planned to be cover under this paper.

Unit 1. Chinese Feudalism: Gentry, Bureaucracy and peasantry; The Confucian value system; Sino centrism; The Canton commercial system, The transformation of China into an 'informal' colony; the Opium Wars; The Unequal Treaties; The 'scramble' for concessions; Finance Imperialism; The 'Open Door' policy.

Unit 2. Agrarian and Popular Movements: Taiping and Yi Ho Tuan, Attempts at 'Self-Strengthening' (Tzu-Chiang): Reforms of 1860-95; 1898; and 1901-08.

Unit 3. The Revolution of 1911: Causes, Nature and significance; The social composition of the Revolution; Sun-Yet-Sen and his contribution; The formation of the Republic; Yuan Shih Kai; Warlordism. May Fourth Movement of 1919: Nature and significance.

HY 312 History of Modern India (1858-1947 A.D.)

Objectives: This paper provides a thematically arranged overview of the history of India from the first major revolt of 1857 to the making of the republic in 1950. The paper tries to bring up discussion about changing nature of leadership and forms of resistance over period of time.

Unit 1. Impact of the rule of British Rule in India: Destruction of village economy and handicrafts, Impact on agriculture and Industries, Social Impact- Social and Religious reform movements.

Unit 2. Early Stages of Emergence of Nationalism: Peasant and tribal revolts, rise of middle class, Formation of Associations and Pressure groups, Birth of the Indian national Congress, Rise of the Extremism in the Indian National Congress, Programs and objectives of moderate and extremist functions, partition of Bengal and Surat split, Swadeshi Movement, Leaders of Extremist and Moderate factors.

Unit 3. Rise of Revolutionary Nationalism: Impact of Bengal partition, Growth of revolutionary ideas and organization in India and abroad, Home Rule movement, Lucknow Pact, Rise of Communal organizations, Gandhian movements, Rowlett Act, Kilafat Movement, Round table conference, Poona Pact, British Response to Indian Demand – Simon Commission, Rise of communal Politics – Policies and Act of Muslim League and other communal bodies, the Jinnah Factor, Partition of India and attainment of freedom, August offer, Cripps mission, cabinet mission, Wavell Plan, Mount Batten Plan, Leaders of Indian National Movement.

Unit 4. Constitutional Development: Queen's Proclamation and Act of 1858, Indian Council Act 1892, Indian Council Act 1909, Govt. of India Act 1919, Govt. of India Acts 1935, 1947

HY 322 History of China and Japan(1840-1949) -II

Objectives: The purpose of this paper is to discuss the end of dynastic rule in China, beginning of new era altogether with contestation between nationalists and communists for Centre stage of politics along with unsuccessful attempt to revive the dynastic and traditional pattern. There is also an effort to situate China in a new global order which was underway. There is particular reference to the rise communism under the leadership of Mao Zedong. In this paper, the rise of Japan as a new force to reckon with in East Asia under the restored Meiji government has been discussed along with the Japanese antagonism with USA and its consequences.

Unit 1. Nationalism and Communism in China (1921-1937): Formation of the CCP, The Kuomintang (Nationalist Party or KMT), The First United Front.

Unit 2. The Communist Movement (1928-1949): The Jiangxi Period and the rise of Mao Tse-Tung, The Second United Front.

Unit 3. Transition from feudalism to capitalism: Crisis of Tokugawa, Bakuhan system, Meiji Restoration, Political Reorganization, Military Reforms, Social, Cultural and Educational reforms (Bunmeikaika), Financial reforms and Economic development in the 'Meiji' era, Meiji Constitution. Japanese Imperialism: China, Korea and Manchuria. Democracy and Militarism/Fascism: Popular/People's Rights Movement, Nature of political parties, Rise of Militarism, Second World War.

PL 111 Basic Psychological Processes-I 3-0-0-3

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology. [9]

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment. [7]

Motivation: Meaningand Nature, Types of Motives: Primary and Secondary, Conflicts in Motives: Approach-Approach, Avoidance-Avoidance and Approach-Avoidance. [6]

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements. [9]

Personality: Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality: Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory. [8]

PL 121 Experimental Methodology & Elementary Statistics-I 3-0-0-3

Scientific Foundations of Research: Nature of Science and Scientific Method, Steps Involved in Experimentation. [5]

Problems and Hypothesis: Nature, Type and Sources. [5]

Variables: Nature and Types; Control of Variables. [7]

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement. [5]

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks. [6]

Measures of Central Tendency: Mean, Median and Mode. [8]

Reliability of Statistics: Significance of Difference Between Two Means [3]

PL 112 Basic Psychological Processes-II 3-0-0-3

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception. [8]

Memory and Forgetting: Sensory,Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory. [7]

Emotion: Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer. [6]

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation. [9]

Intelligence: Nature, Theories of Intelligence: Factor and Process Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests. [9]

PL 122 Experimental Methodology & Elementary Statistics-II **3-0-0-3**

The Measurement of Variables: Types of Scales: Nominal, Ordinal, Interval and Ratio Scales. [4]

Sampling Methods: Probability and Non-Probability Sampling Methods. [7]

Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs. [8]

Measures of Variability: Range, Quartile Deviation and Standard Deviation. [5]

Normal Probability Curve: Properties and Applications. Skewness and Kurtosis. [4]

Reliability of Statistics: Chi-Square. [6]

Correlations: Product-Moment and Rank Order. [5]

PL 221 Psychology of Human Development-I 3-0-0-3

Concept of Development: Principles of Growth. Maturation and Development, Developmental Stages.	[8]
Determinants of Development: Biological and Socio- Cultural.	[6]
Methodological Approaches: Longitudinal and Cross-Sectional; Sequential Strategies and Cohorts. Methods of Study: Observational, Experimental, Field Study, Interview and Testing.	[9]
Prenatal Development: Stages and Factors Affecting Prenatal Development.	[8]
The Neonate: Physical Characteristics, Reflexes, Sensory and Motor Capacities.	[8]

PL 231 Applied Psychology-I 3-0-0-3

Introduction: Nature and Fields of Applied Psychology. [8]

Guidance: Definition and Objectives, Type of Guidance: Personal Guidance, Educational Guidance and Vocational Guidance, Role of Family and School in Guidance Services. [7]

Counseling: Meaning and Definition, Objectives and Functions of Counselor, Phases of Counseling: Initial, Middle and Follow-Up, Modern Trends in Counseling, Ethical Issues in Counseling. [6]

Psychology in Education: School as an Agent of Socialization, Factors Influencing School Achievement, Learning and Motivational Problems, Exceptional Children: Problems and Remedial Measures. [9]

Psychology and Anti – Social Behaviour: Crime and Delinquency, Techniques of Crime Detection, Treatment of Offenders, Drug Addiction and Remedial Measures. [9]

PL 212 Psychology of Human Development-II 3-0-0-3

Development during Infancy: Physical Growth and Motor Development; Sensory and Perceptual Development; Language, Emotional and Social Development. [8]

Development during Childhood: Cognitive, Social, Emotional and Moral Developments. Development of Self-Identity. [6]

Puberty and Adolescence: Developmental Tasks; Physical and Psychological Changes; Development of Identity. [9]

Adulthood: Developmental Tasks; Choice of Vocation; Adjustment to Careers, Marriage and Family. [8]

Old Age: Physical, Physiological, Psychological and Social Changes. Adjustment Problems and Specific Issues. [8]

PL 222 Applied Psychology-II 3-0-0-3

Psychology in Organization: Personnel Selection, Job Analysis and Performance Appraisal, Fatigue and Accidents, Advertising and Consumer Behaviour. [7]

Psychology and Health: Mental Health and General Health, Dimensionsof Health and Health Behaviour, Mental Retardation. Major Therapies: Psychoanalytic, Behaviour and Person- Centered. [10]

Stress Management: Meaning and Definition of Stress, Causes and Effects of Stress, Techniques of Stress Management. [9]

Psychology and Social Behaviour: Social Cognition: Prejudice and Stereotype. Conflicts and Resolution. [8]

Psychology and Sports: Personality Traits of Efficient Sportsmen, Team Feeling, Motivational Problems. [5]

PS 141 Political Theory-I 3-0-0-3

Nature and Scope of Political Science: Definition, Traditional and Contemporary Approaches- Institutional, Behavioural, post-Behavioural and Systems Analysis [14]

Political Concepts: State, Sovereignty, Liberty, Equality, Revolution and Human Rights [11]

Power, Authority and Legitimacy: Definition, Type, Inter-relationship [7]

Theories of Justice: Utilitarian, Egalitarian, Entitlement and Socialist [7]

PS 121 Indian Political Thought-I 3-0-0-3

Manu, Kautilya	[12]
Bal Gangadhar Tilak, Gopal Krishna Gokhale	[15]
Raja Ram Mohan Roy, Dayanand Saraswati	[12]

PS 142 Political Theory-II 3-0-0-3

Patterns of Administration: Theories of Democracy- Elite, Pluralist, Participatory; and Features of Dictatorship [11]

Political Ideologies: Liberalism, Communism, Evolutionary Socialism- Fabian, Guild, Revisionism and Democratic; Idealism [17]

New Trends in Political Theory: Neo Marxism and Libertarianism, Environment and Politics, Feminism and Gender Politics, Multiculturalism [11]

PS 122 Indian Political Thought-II 3-0-0-3

Mohandas Karamchand Gandhi, Subash Chandra Bose [17]

M. N. Roy, Jay Prakash Narayan [10]

B. R. Ambedkar, Jawaharlal Nehru [12]

PS 211 Indian Government and Politics-I 3-0-0-3

Rise of Nationalism in India: Establishment of British Rule in India, Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement	[8]
Framing of the Indian Constitution: Major Acts, Morley-Minto Reforms, Montegu-Chelmsford Reforms, Nehru Report, Government of India Act, 1935, Independence of India Act, 1947	[8]
Major Features of the Constitution: Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Secularism, Unitary and Federal Features	[13]
Major Challenges to Democracy: Terrorism, Regionalism, Casteism, Communalism	[10]

PS 221 Comparative Government and Politics-I 3-0-0-3

Constitutionalism, Political Development and Political Socialisation [11]

Political Parties and Pressure Groups [8]

Salient Features of Major Constitutions: United States, England, France, Switzerland and China [20]

PS 212 Indian Government and Politics-II 3-0-0-3

Legislature: Lok Sabha, Rajya Sabha	[8]
Executive: President, Prime Minister and Cabinet	[8]
Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism, Public Interest Litigation	[12]
Political Parties and Pressure Groups: National Parties, State Parties, Coalition Politics, Pressure Groups	[11]

PS 222 Comparative Government and Politics-II 3-0-0-3

Legislature: US Congress, British Parliament, French Parliament, Swiss Federal Assembly, Chinese National People's Congress	[11]
Executive: President of US, Monarchy and Prime Minster in Britain, President and Prime Minister of France, Federal Council of Switzerland, President and Premier of China	[14]
Judiciary: Supreme Court and Judicial Review in US, British Judicial System, French Judicial Structure, Federal Tribunal of Switzerland, Supreme People's Court in China	[14]

M.A. Psychology 2019-2020

PL 511 Advanced General Psychology-I 4-0-0-4

Introduction to Psychology: Definition, Nature, Scope, Purpose of psychology, Methods of Psychology: Observation, Experimental, Case Study. [6]

Biological Basis of Behaviour : Neuron and its structure, Nervous System; Peripheral & Central Nervous system, Endocrine gland and Personaliy. [12]

Sensory-Perceptual Processes: Visual, Auditory- Structure and function of eye and ear. Attention: Nature of Attention and its determinants, Perceptual organization: Perceptual Constancy, Determinants of perception, Types of perception: Form, Space, Depth. Methods of Psychophysics, Signal Detection theory and Subliminal Perception. [12]

Learning: Classical Conditioning: Procedure, phenomena & related issues **,** Operant Conditioning; Procedure, phenomena & related issues, Cognitive theories of learning: Latent, Insight, Observational**,** Neurophysiology of Learning. [10]

Memory & Forgetting: Models of memory; Atkinson & Shiffrin, Craik & Lockhart, Tulving**,** Sensory, Short term & Long term Memory; Flashbulb memory, Reconstruction and distortion of memory, Biological Basis of Memory, Improving memory strategies**,** Forgetting; Theories of forgetting [12]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology*. Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan*. Motilal Banarasi Das, Varanasi.

PL 521 Applied Psychology-I 4-0-0-4

Introduction: Nature, scope, history, fields, methods and importance of applied psychology. [8]

School Psychology: Role of psychologist in school system, measurement and evaluation, education technology, behavior modifications in classroom. [10]

Guidance & Counselling: Types of guidance and counselling, counselling process, characteristics of a effective counsellor, ethics of counselling, uses of psychological tests in counselling, counselling effectiveness in solving personal, social, educational and career, developmental, preventive and curative aspect of counselling. [12]

Mental Health and Hygiene: Factors affecting mental health, indicators of mental health, role of psychologists in promoting mental health, alternative therapies for promoting mental health. [12]

Neuropsychology: what is neuropsychology, scope, functions of neuropsychologists, techniques of neuropsychology. [10]

Suggested Books:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Singh, A. P. Vyavaharik Manovigyan. Abhishek Publication, Varanasi.
3. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
4. Rao, S. N. *Counselling and Guidance*. Tata McGraw-Hill, New Delhi.
5. Charles, J. G., & Bruce, R. F. *Counseling Psychology: Practices, Issues and Intervention*. CENGAGE Learning, New Delhi.
6. Sue, R., Sue, D., & Sue, S. *Understanding Abnormal Behaviour*. Houghton Mifflin.
7. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
8. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.

PL 531 Systems in Psychology 4-0-0-4

Development of Psychology as a Discipline: History of Psychology, how psychology as evolved as an independent discipline, Structuralism; Wundt and Tichener, Functionalism: Dewy, William James, Galton. [10]

Behaviourism school of psychology: Pavlov, Skinner, Thondike, Watson, Lashley. [10]

Gestalt School of Thought: Max Wertheimer, Kohler and Kofka, Jean Piaget. [10]

Psychoanalytic and Neo- Psychoanalytic Prospective: Freud, Jung, Erikson, Adler, Horney, Eric Fromm. [11]

Humanistic and Existential Perspective: Maslow and Carl Rogers, Victor Frankl, Rollo May. [11]

Suggested Books:

1. Wolman, B.B., *Contemporary theories and systems of Psychology*, Harper and Bors, N.Y.
2. Chaplin, T. Kraweic, T.S. *Systems and Theories of psychology*. Holt Rinehart and Winston.
3. Schiffman, H.R. *Sensation and Perception.* New York : John Wiley and Sons.
4. Hilgard, E.H., and Bower, G.H. *Theories of Learning*. Englewood Cliffs : Prentice Hall.
5. Matlin, M.W. *Cognition*. Bangalore : Prism.
6. Mazur, J.E. *Learning and Behaviour*. Englewood Cliff's : Prentice Hall.
7. Kling, J.W. and Riggs, L.A. Woodworth and Schlosberg's *Experimental Psychology*. London : Methuen and Co.
8. Marks, M.H. and William, A. Cronan – Hillix, *Systems and Theories in psychology*. McGraw Hill International Editions, Psychology Series.
9. Vygotsky, L.S. *Thought and Language*, Cambridge, mass. MIT Press.
10. Hall C.S. : Lindzey, G. *Theories of Personlaity*. New York : Wiley Eastern Limited.
11. Leahey, Thomas.Hardy, *History of Psychology: main currents in psychological thought*, New Delhi: Peacock Books.

PL 541 Life Span Developmental Psychology 4-0-0-4

Introduction to life span psychology: Meaning, nature, purpose, scope, Methods; Longitudinal, cross-cultural**,** Stages of human development, Difference between growth and development, Types of development; Quantitative and qualitative. [12]

Pre-natal and Neonate development: Conception**,** Stages of pre natal development, types of birth and its impact. [10]

Infancy and Childhood: Developmental milestones, cognitive, motor, moral, social, emotional, language development. [10]

Adolescent: Physical and psychological changes**,** Developmental task of adolescent**,** Problems of adolescent. [10]

Adulthood and old age: Choice of vocation, Adjustment to career, marriage and family, Developmental tasks of adulthood**,** problem of aging**,** Special issues of old age. [10]

Suggested Books:

1. Hurlock, E. *Child Development*. Tata McGraw-Hill, New Delhi.
2. Berk, L. E. *Child Development.* Prentice-Hall of India, New Delhi.
3. Kaluger, G. S., & Kaluger, M. F. *Human Development: The Span of Life*. Times Mirror, St. Louis.
4. Santrock, J. W. *Life-Span Development*. McGraw-Hill, New York.
5. Shaffer, D. R. *Developmental Psychology*. Brooks & Cole, California.

PL 551 Practicum-I 0-0-8-4

Assignments are based on the courses PL 511 Advanced General Psychology-I, PL 521 Applied Psychology-I, PL 531 Systems in psychology, PL 541 Life span development Psychology.

PL 561 Seminar-I 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 512 Advanced General Psychology-II 4-0-0-4

Motivation: Motivational Cycle, Biological & Social Motives, Theories of motivation. [8]

Emotion: Physiological correlates of emotions**,** Theories of emotions, Conflict & Stress management. [8]

Thinking: Language &Thought, Imagination, Theories of thinking**,** Problem Solving, Reasoning, Decision Making & Creative thinking with classroom implication. [10]

Cognition & Meta-cognition: Factor & Process theories, Abilities & achievement- concept & Role of Emotional Intelligence, Classroom implication of Gardner's Multiple Intelligence Theory, Meta-cognition-Concept & Implication. [12]

Personality Approaches of personality- Psychoanalytic, Neo-Freudian, Social Learning, Trait & Type, Cognitive, Existential & Humanistic**,** Personality Assessment- Projective, psychometric & Behavioral measure. [14]

Suggested Books:

1. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.
2. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
3. Baron, R. A. *Psychology: The Essential Science*. Allyn & Bacon, New York.
4. Sdorow, M. Laster. *Psychology*. Mc Graw Hill, New York.
5. Ciccarelli, K. Saundra: *Psychology* Pearson, south asian edition.
6. Singh, A. K. *Uchchtar Samanya Manovigyan.* Motilal Banarasi Das, Varanasi.

PL 522 Applied Psychology-II 4-0-0-4

Industrial and Organizational Psychology: Principles and dynamics of organizational behavior; Motivation, Job satisfaction, models of leadership, work enviorment, personnel psychology, engineering psychology, role of industrial and organizational psychologists. [12]

Consumer Psychology: Nature and functions, consumer decision making, Black Box model of consumer behavior, factors affecting consumer decision making, e-shopping, virtual mall, Different modes of advertisement, Role of psychological factors in making advertisement**.** [10]

Clinical Psychology: concept of normality and abnormality, characteristic of abnormal behavior, causes of psychopathology, various psychopathological disorders; neurosis, psychosis, assessment and treatment; psychoanalytic, behavioural, cognitive. [12]

Forensic and Law Psychology: Introduction and Historical Perspective, Fields of Forensic Psychology, Criminal Identification techniques, Psychology and judicial process, Eyewitness testimony, role of psychologist in legal judicial system, juvenile delinquency, ethical issues in forensic psychology, Police interrogation and false confession, Legal rights of inmates: Rights to treatment, Right to refuse treatment. [10]

Sports Psychology: What sports psychologists do, role of psychology in motivation, mental health, skills to enhance performance, sport injury and rehabilitation of athletes. [8]

Suggested Book:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Goldstein, A. P., & Krasner, B. *Modern Applied Psychology*. Pergmon Press, New York.
3. McCormick, E. J., & Ilgen, D. *Industrial Psychology*. Prentice Hall, Englewood Cliffs.
4. Misra, G. *Psychological Perspective on Stress and Health*. Concept Publishing Co., New Delhi.
5. Baron, R. A., & Byrne, D. *Social Psychology*. Prentice-Hall of India, New Delhi.
6. Sandhu, G. S. *Psychology in Sports: A Contemporary Perspective*. Friends, New Delhi.

7. Singh, A. P. Vyavaharik Manovigyan. Abhishek Publication, Varanasi.
8. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
9. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publisher.

PL 532 Psychometrics and Statistics in Psychology 4-0-0-4

Psychometrics: Measurement in Psychology, History of psychological measurement & testing, Levels of Measurement; Scales, Functions of measurement, General problems of measurement. [10]

Test development: Meaning & Classification of psychological tests, Characteristics of a good test, Ethical issues in psychological testing, Uses and limitation of Psychological tests, General steps of test Construction; Item writing, Item analysis, reliability, validity & norms. [12]

Overview of descriptive statistics and probability: Overview of measures of Central tendency, variability, curves and graphs , Percentiles, percentile ranks and standard scores, Characteristics of normal distribution curve. [10]

Parametric statistics: t-test and ANOVA, Correlation and regression analysis. [10]

Non parametric statistics: Chi-square, Mann-Whitney U test, Rank-difference Method, Coefficient of Concordance, Kruskal –Wallis H test, Friedman test. [10]

Suggested Books:

1. Garrett, H. E. *Statistics in Psychology and Education*. Paragon International Publishers, New Delhi.
   McGuigan, F. J. *Experimental Psychology*. Prentice-Hall of India, New Delhi.
2. Broota, K. D. *Experimental Design in Behavioural Research*. Wiley Eastern, New Delhi.
3. Guilford, J. P., & Fruchter. *Fundamentals of statistics in Psychology and Education*. Kogakusha, Tokyo.
4. Kapil, H. K. *Sankhyiki Ke Mool Tatwa*. Vinod Pustak Mandir, Agra.
5. Anastasi, A. & Urbina, S. (1997). Psychological testing. N.D.: Pearson Education.
6. Singh, A.K. (2006). Tests, Measurements and Research Methods in Behavioural Sciences.Patna: Bharati Bhavan.

PL 542 Research Methodology 4-0-0-4

Research: Meaning and characteristics of research, Stages in Research, Types of Research and Meaning, types and methods of sampling. [8]

Problem and Hypothesis: Meaning and characteristic of a problem, Sources of stating up a problem, Types of problem, Meaning and characteristics of a good hypothesis, Formulating a hypothesis, Sources of hypothesis. [8]

Review of Literature: Purpose of the review, Sources of the review, Types of literature, Writing process of the literature review. [10]

Variables: Types of variables, Methods of measuring dependent variable, Approaches to manipulate variables**,** Techniques of controlling extraneous variables. [10]

Research Design: Meaning and purpose of research design, types of research design, between group and within group design. [10]

Research Report & Research Proposal: purpose, structure and style of writing a research report, preparing a research proposal. [6]

Suggested Books:

1. Guilord J.P. *Psychometric Method*. McGraw Hill. N.Y.
2. Guilford J.P. Fruchter's. *Fundamental Statistics in Psychology Education*. International McGraw Hill Publisher, New York.
3. Kerlinger, F.N. *Foundations of Behavioral Research*. ND : Surjeet.
4. Kothari, C.R. *Research Methodology, Methods and Techniques.* ND : Wiley Eastern Limited.
5. Broota; K.D. *Experimental Design in Behavioral Research*. Wiley Eastern. New Delhi.
6. Singh, A.K. Tests, *Measurements and Research Methods in Behavioural Sciences*.Patna: Bharati Bhavan.

PL 552 Practicum-II 0-0-8-4

Assignments are based on the courses PL 512 Advanced General Psychology-II, PL 522 Applied Psychology-I, PL 532 Psychometrics and Statistics in psychology, PL 542 Research Methodology and Field Study.

PL 562 Seminar-II 0-0-0-2

The student has to attend a seminar, present paper and submit seminar report.

PL 611 Peace Psychology 4-0-0-4

Introduction: Psychology of peace, Types of peace, Historical perspective of peace psychology, role of individual and society. [8]

Peace and Non-Violence: Indian perspective of peace**,** views of Buddha, Mahaveer, Gandhi, Values of non-corporation and Indian experience. [10]

Violence: what is violence, different types of violence as School, youth, domestic, cultural, structural, direct etc, causes of violence, impact of violence. Role of individual and society in reducing violence. [10]

Life Peace and Culture: role of peace education, colobration, humility and social values in promoting peace in individual and social living [12]

Psychology of specific conflicts and peace efforts: war ethics and Geneva convention, role of organizations promoting peace, accounts and challenges. [12]

Suggested Books:

1. Suryanarayan, N.V.S. Peace Psychology. Discovery Publishing House, Pvt. Ltd.
2. Christie, D. J., Wagner, R.V., and Winter, D.A., Peace, Conflict and Violence: Peace Psychology for the 21st century. Englewood Cliffs, N.J: Prentice Hall.
3. Aber, L.,Brown, J., and Henrich, C.Teaching Conflict Resolution: An Effective School based Approch to Violence Prevention. N.Y.:National Centre for Children for Poverty.

PL 621 Social Psychology 4-0-0-4

Social Psychology: Introduction to social psychology, definition, nature and scope of social Psychology, Methods of social Psychology: Experimental and Non-experimental. [10]

Social Per caption and Social Cognition: Meaning of social perception, Role of non verbal communication in social perception, Role of schemas, heuristics, automatic and controlled processing**,** Potential sources of error in social cognition. [12]

Attitudes: Meaning and Characteristics of attitudes**,** Attitude formation**,** Attitude change**,** Theories of attitude change; cognitive dissonance.

Interpersonal attraction: Meaning and nature of interpersonal [10] attraction, Internal and External determinants of attraction, Theories of attraction.

Stereotype, Prejudices and Discrimination: Meaning and nature [10] of prejudice**,** Formation of norms and prejudice**,** Techniques for countering its affects**,** Difference between prejudice, stereotype and discrimination.

[10]

Suggested Books:

1. Baron, R.A., Byrne, D. *Social Psychology* -Prentice-Hall.
2. Daniel, P, Cozby, P.C. *Social Psychology*, New York: CBS College Publishing Holt, Rinehart and Winston.
3. Lindzey, L., and Aronson, E..*The Handbook of Social Psychology* , Vol. II, III & IV, New Delhi: Amerind Publishing Co. Pvt. Ltd., New Delhi.
4. Mathur, S.S . *Social Psychology,* Agra: Vinod Pustak Mandir.
5. Million, T. & Lerner, M. *Handbook of Psychology* (Vol.-5).- John Wiley and sons Inc
6. Myers, D.G. *Social Psychology*-Tata McGraw Hill International Editions.
7. Penrod, S. *Social Psychology* ;New Jersey: Prentice Hall, Englewood Cliffs.
8. Singh, A.K. *Samaj Manovigyan Ki Rooprekha*, NewDelhi: Moti Lal Banarsi Dass.
9. Taylor, S.E. Peplau, L.A. Sears, D.O. *Social Psychology* - Pearson Education.

PL 631 Introduction to Guidance 4-0-0-4

Guidance: Historical Perspective**,** Objectives & Principles of guidance**,** Types of guidance-Educational, Career, Personal and Social. [6]

Guidance and School Education: Guidance and role of teacher, parents, Counsellor and school administration, facilitating learning through guidance. [10]

Pupil Personal Services: Orientation, Evaluation, Individual inventory service, Information service, counselling service, Placement and evaluation and research. [14]

Guidance and School curriculum: Meaning of curriculum, Why guidance and Curriculum is inseparable, role of counselor in curriculum planning, personalization of curriculum, guidance functions through the subject matter areas. [8]

Special Concern for Guidance: Guidance of special group of Children; Cognitive, Physical, Social and Emotional exceptionality**,** Guidance for Drug abuse, delinquent behavior, adult Sex abuse, spouse abuse ,child abuse, HIV, ADHD, Learning disability. [14]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd.
3. Jones. A.J., *Principal of Guidance*, McGraw Hill, N.Y.
4. Psricha, *Guidance and Counselling in Indian education*, New Delhi, NCERT.
5. Mayers, G.E., *Principles and Techinques of vocational Guidance*, McGraw Hill, N.Y.

PL 641 Introduction to Counselling Psychology 4-0-0-4

Definition and history of counselling: What is counselling, effectiveness of counsellor, ethical and legal aspects of counselling. Individual and Group counselling, Stages of group counselling. [10]

Counseling Process: External Conditions and preparation, Stages of counselling process. [12]

Rapport Building- Building counselling relationship, generic and specific skill for rapport building. [10]

Assessing the Problem: Purpose, component, types of problems, skills required by counsellor for assessing the problem. [10]

Goal Setting: Functions and types of goal, obstacles in setting specific goals, effect of goal setting , skills associated with goal setting. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.

3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). Therapeutic Psychology : Fundamentals of Counselling Psychotherapy. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) Career Counselling Techniques, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) Handbook Emotional and Behavioral Difficulties. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) Career Counselling a Developmental Approach, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 651 Practical of Guidance & Counselling Psychology 0-0-8-4

Assignments are based on the courses PL 631 Introduction to Guidance, PL 641Introduction to Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 661 Advanced Industrial Psychology 4-0-0-4

Introduction to industrial psychology: Definition, role, Nature and scope**,** Origin and History of industrial psychology**,** Contribution of Hugo Munsterberg, Taylor, Gilbreth and Alton Mayo. [10]

Job Analysis: Purpose, importance and uses of job analysis**,** Various methods of job analysis**,** Job design approaches and job enrichment [10]

Recruitment and selection: Purpose and importance of recruitment and selection**,** Recruitment process; external and internal**,** Stages in selection process**,** Selection methods. [10]

Personnel Training: Nature and principals of training**,** Assessing training needs**,** Training methods; on-the job training, of the job apprenticeship, business games, Evaluation of training programme. [10]

Performance appraisal system: Purpose, importance, Uses of Performance appraisal**,** Methods of evaluating Performance appraisal; traditional methods, 360 degree appraisal and management by objectives**,** Issues and biases related to Performance appraisal. [12]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975. *Industrial Psychology*, Prentice Hall, 6th Ed.
2. Glimer. *Industrial Psychology*.
3. Ghiseli and Brown. *Personnel and Industrial Psychology*.
4. Dunnette, M.D. Handbook of Industrial and Organizational Psychology.
5. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
6. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
7. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co

PL 671 Dynamics of Organization Behaviour-I 4-0-0-4

Introduction: Meaning and Importance of OB, Historical overview; Classical and Neo-classical**,** Approaches of OB; contingency and system approach. [10]

Motivation in Organization: Needs theories of motivation**,** Equity theories of motivation**,** Job Design and work motivation**,** Determinants of job satisfaction**,** Organizational commitment, citizenship behavior and organizational justice. [10]

Leadership: Trait Theories, Behavioural Theories, Contingency theories: Fiedler Modal and situational leadership Theory; Path Goal theory, Inspirational Approaches to leadership: Charismatic Leadership; Transformational Leaders**,** Authentic Leadership: Ethic and trust are the foundation of leadership**,** Contemporary Leadership Roles: Mentoring, self Leadership, E-Age. [12]

Organizational Communication: Meaning and functions**,** Directions of communication in organization**,** Directions and methods of improving communications**,** Barriers of effective communication. [10]

Decision Making: Nature of decision Making, Behavioural decision

making: decision rationality, models, decision making techniques: [10] traditional and Modern Participation technique.

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.

2. Luthans F, *Organizationa Behaviour*, Prentice Hall of India pvt. Ltd. New Delhi.

3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.

4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.

8. Nelson, D.B. and Quick J.C. (2005) *Understanding Organizational Behavior.* South Western Thomson Learning.

PL 681 Practical of Industrial & Organizational Psychology-I 0-0-8-4

Assignments are based on the courses PL 661 Advanced Industrial Psychology, PL 671 Dynamics of Organizational Behaviour-I. That also accompany by field visit, and practical's related to compulsory papers.

PL 691Synopsis 0-0-0-2

The student has to submit two copies of a research proposal by first week of November in the department. It will be followed by presentation for approval.

PL 612 Positive Psychology 4-0-0-4

Introduction to Positive Psychology: Positive Psychology; Goals & Definition, Western & Eastern view of Positive Psychology, Classification and measurement of Human Strengths & Positive outcomes**,** Developing Strength and living well. [10]

Positive Emotional states and processes: Pleasure, positive effect, Happiness & Wellbeing, Emotional intelligence**,** Living well across life stages. [10]

Positive cognitive states and processes: Self efficacy and self acceptance, wisdom, optimism & hope, Mindfulness and flow. [10]

Pro-social behavior and well-being: Empathy, altruism, gratitude, Forgiveness, attachment, Positive experiences in school life. [10]

Spirituality and Positive Psychology: Creativity, giftedness and industry, Religion & spirituality, Emotional and social intelligence. [12]

Suggested Books:

1. Snyder, C.R. & Lopez, S.J., *Positive Psychology*. New Delhi: Sage.
2. Snyder, C.R. & Lopez, S.J., Handbook of Positive Psychology. N.Y.Oxford.
3. Wong.P.T. & Fry. The Human Quest for meaning. Mahwah, New Jersey. Lawrence, Erlbum.
4. Baumgardner, S. & Crothers, M. Positive Psychology, New Delhi, Pearson Education.

PL 622 Health Psychology 4-0-0-4

Physical and Mental Health: what is health, what is physical and mental health, relationship between physical and mental health, different dimensions of mental health, concept of psychological health in , the development of changed outlook in nature of health and illness, scope of health psychology.

Eating Behaviour: what is healthy diet, how does diet affect health, models of eating behavior, weight concern and eating behavior, dieting, overeating, under eating, Body dissatisfaction, causes of body dissatisfaction, obesity; role of psychological factors in obesity, relation of obesity with coronary heart diseases, diabetes and other health problems.

Exercise: what is exercise, why exercise, different forms of exercise including yoga, meditation, pranayam, aerobics etc., physical and

psychological benefits of exercise, Relation of exercise with mood, depression, pleasure and good health.

Sex and women's health issues: sex as biological for reproduction, sex as a risk and pregnancy avoidance, use of contraception, sex as a risk to health in context of STDs/HIV and AIDS, Sex education. [10]

Health behaviour and Primary prevention: What is health bhaviour, Barriers to effective health promotion. Factors influencing the practice of health behavior, Modification of health behavior. Changing health behaviours by changing health beliefs, Changing health behaviours through social engineering. [10]

Suggested Books:

1. Ogden, Jane. *Health Psychology*.Mcgraw Hill Education, India.
2. Brannon, Linda. Introduction to Health Psychology, Australia: Thomson, Wadsworth.
3. Baum, A. Revenson, T.A. and Singer, J.E. Handbook of Health Psychology, New Jersey: Lawrence Erlbaum.
4. Dimatteo, M.R., and Martin, L.R. *Health Psychology*. Boston: Allyn and Bacon.
5. Marks, D., Murray, M., Evans, B. and Willing,C. *Health Psychology: Theory, research and practice*. New Delhi: Sage.

PL 632 Intervention in Guidance & Counselling 4-0-0-4

Psychoanalytical Approach: Classical psychoanalytic theory, view of human nature, role of counsellor, goals and techniques of psychoanalytic approach. [10]

Cognitive Approach: Back's cognitive therapy and ELLIs Rational Emotive theory, Transactional analysis. [10]

Gestalt Approach: Fritz Perls therapy, goal, view of human nature and techniques of gestalt therapy. [10]

Behavioural Approach: Techniques based on classical and operant conditioning for behavior modification: systematic desensitization, flooding, shaping, aversion, punishment, assertive training etc. [12]

Humanistic & Existential Approach: Carl Rogers Clint centered therapy, Rollo May and Victor Frankls therapy. [10]

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.
3. Nelson, J. (1982). The Theory and Practice of Counselling Psychology. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). Counselling and Psychotherapy : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). Therapeutic Psychology : Fundamentals of Counselling Psychotherapy. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) Career Counselling Techniques, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) Handbook Emotional and Behavioral Difficulties. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) Career Counselling a Developmental Approach, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 642 Areas of Counselling Psychology 4-0-0-4

School Counselling: Developmental, Preventive and curative aspects of counselling at elementary, middle and secondary school, role of counselling in promoting academic excellence and personality development of the students. [10]

Career Counselling: Career as a way of life, concept of career choice, measurement of career choices, role of personality, interest and values in career choice, major theories of career counselling: Holland theory. [10]

Crisis Intervention counselling: Introduction, types of crisis, typical response to crisis, process and principles for crisis intervention. [10]

Counselling across the life span: Counselling before planning the pregnancy, during and after the pregnancy, counselling for parents, child and adolescent counselling, counselling for adults and old-age people. [12]

[10]

Emerging fields and trends in Counselling: Multi-cultural, homosexual, marriage, rehabilitation, mental health, substance abuse,

HIV and Health counselling, computers, feminist prospective, group work etc.

Suggested Books:

1. Gladding, T. Samuel. *Counselling A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). *Introduction to Counselling*. W.G. : Brown Publishers.
3. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
4. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy* : Classics on Theories and Issues. Science and Behavior Books Co.
5. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
6. Brown, D; Brooks, L. (1991) *Career Counselling Techniques*, Allyn and Baron.
7. Clough, P; Pardeck, J.T.; Yuen, F. (eds0 (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.
8. Drummond, R.J. and Ryan, C.W. (1995) *Career Counselling a Developmental Approach*, Prentice Hall.
9. Rao, S.N., *Counselling Psychology*, Tata McGraw Hill, New Delhi.

PL 652 Practical of Guidance & Counselling-II 0-0-8-4

Assignments are based on the courses PL 632 Interventions in Guidance & Counselling, PL 642 Areas of Counselling Psychology. That also accompany by field visit, and practical's related to compulsory papers.

PL 662 Engineering Psychology 4-0-0-4

Human engineering: Scope and origin of engineering psychology**,** Importance of engineering psychology**,** Aim of engineering psychology. [10]

Man-machine system: Meaning of man-machine system**,** Design, display, control and action**,** Application of man-machine system. [10]

Working Conditions: Concept of efficiency and Work curve**,** Physical enviorment; noise, illumination, atmospheric conditions, music, rest pauses**,** Working conditions and performance. [10]

Accidents and Safety: Definition of accident, risk taking behavior and accident proneness**,** Human and economics cost of accidents**,** Causes of accidents**,** Individual, situational, organizational factors related to accident reduction; safety measures. [12]

Work and Fatigue: Concept of work and fatigue**,** Work schedule**,** Methods of design**,** Monotony and boredom, Way to reduce monotony and boredom. Industrial morale. [10]

Suggested Books:

1. Tiffin J. and McCormic E.J. 1975.*Industrial Psychology*, Prentice Hall, 6th Ed.
2. McCormick D.J. 1976. *Human Factors Engineering and Design*. McGraw Hill 4th Edition.
3. Glimer. *Industrial Psychology*.
4. Ghiseli and Brown. *Personnel and Industrial Psychology*.
5. Dunnette, M.D. *Handbook of Industrial and Organizational Psychology.*
6. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
7. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
8. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co.

PL 672 Dynamics of Organizational Behaviour-II 4-0-0-4

Organizational Structure: Meaning and issues in organizational structure**,** Work specialization, departmentalization, chain of command, span of control, centralization v/s Decentralization**,** Traditional organizational structure; The team structure, the virtual organization, the boundary less organization. [12]

Organizational culture: Organizational culture meaning and definition and related concepts**,** Perspective and topologies of organizational culture**,** Creating and sustaining culture. [10]

Organizational Change and development: Nature and perspective of change**,** Levels of change, structure, technology and leadership**,** Types of change; organizational change as growth, transformation and as turn [10]

around, Resistance to change, Strategies to overcome resistance to change, Nature and importance of organizational development, Role, values and ethics of organizational development practitioners.

Group Dynamics: Meaning, nature and types of group, concept of group dynamics and theories of group formation, group role, norms, decision making. Group cohesiveness and group conformity. [10]

Conflict and stress: Meaning and types of conflict, Interpersonal and Intergroup conflict, Work-family conflict, Strategies for conflict resolution, Work stress; sources, consequences, managing stress: individual and organizational coping strategies. [10]

Suggested Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizationa Behaviour*, Prentice Hall of India pvt. Ltd. New Delhi.
3. Pareek, U. *Understanding Organizationa Behaviour*, Oxford University Press, New Delhi.
4. Steven, I. McShane Marayann.Von Glinow, *Organizational Behaviour*, Tata McGraw Hill, New Delhi.
5. Nelson, D.B. and Quick J.C. (2005) Understanding Organizational Behavior (2nd Edition) South Western Thomson Learning.

PL 682 Practical of Industrial & Organizational Psychology -II 0-0-8-4

Assignments are based on the courses PL 662 Engineering Psychology, PL 672 Dynamics of Organizational Behaviour-II. That also accompany by field visit, and practical's related to compulsory papers

PL 692 Dissertation 0-0-0-4

The student has to submit two copies of dissertation by the first week of May in the department. It will be followed by presentation and viva-voce.

MA English 2019-2020
M. A. (English)

EL 551 Modern English Grammar and Usage 4-0-0-4

Basic Sentence Types: Subject, Predicate, Object, Adjunct	[10]
Coordination and Subordination: Simple Sentence and Complex Sentence	[6]
Different Concepts and Notions: Request, Order, Question, Condition, Purpose, Suggestion, Wish, Hope, Intention, Obligation, Contrast, Commission	[7]
Theme Writing: Development of thoughts, Consistency in writing, Vocabulary	[6]
Fallacies	[6]
Literary Appreciation	[5]
Précis Writing	[5]
Critical Reading Skills	[7]

Suggested Readings:

1. A.S. Hornby: A Guide to Patterns and Usage, (Oxford 1984).
2. CIEFL - Material on Morphology and Phonology from the Distance Education Dept.1992.
3. George Yule: The Study of Language, CUP (ELBS, 2002)
4. Geoffery Leech: English Grammar for Today (Longman, 2004)
5. Praveen K Thaker: Appreciating English Poetry: A Practical Course and Anthology, Orient Lognman,1999
6. Effective English Communication, Krishna Mohan and Meenakshi Rama, Tata McGraw Hill, 2001.
7. Spoken English, V. Sasi Kumar and P.V. Dhamija, Tata McGraw Hill, 2001.

EL 513 Middle Ages to the Seventeenth Century English Literature-I 4-0-0-4

Geoffrey Chaucer: General Prologue to the Canterbury Tales	[10]
Christopher Marlowe: Doctor Faustus	[8]
William Shakespeare: As You Like It, King Lear	[10]
Francis Bacon: Of Envy, Of Love, Of Adversity	[6]
John Donne: The Extasie, The Relique, The Flea	[7]
John Milton: Paradise Lost, Book I	[11]

Suggested Readings:

1.Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd, 1995.
2.Daiches, David: A Critical History of English Literature (vol. I), Delhi, Allied Publishers, 1998.

EL 571 Eighteenth Century to the Twentieth Century English Literature-I 4-0-0-4

John Dryden: Absalom and Achitophel	[9]
Jonathan Swift: The Battle of the Books	[4]
Alexander Pope: The Rape of the Lock	[9]
William Wordsworth: The Prelude, Book I	[8]
S.T. Coleridge : The Rime of Ancient Mariner	[4]
Percy Byssey Shelley: Adonais	[4]
Robert Browning: My Last Duchess	[5]
Gerard Manley Hopkins: The Windhover, Felix Randal.	[5]
Thomas Stearns Eliot: The Four Quarters	[4]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5.A,R, Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.1994.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.1964.

EL 523 American Literature 4-0-0-4

Ralph Waldo Emerson: The American Scholar	[4]
Walt Whitman: Crossing Brooklyn Ferry, Passage to India, I Hear It Charged Against Me	[8]
Sojourner Truth : Ar‟n‟t I a Woman?- Speech to the Women‟s Rights Convention in Akron, Ohio, 1851	[4]
Robert Frost: Birches, Mending Wall	[6]
Wallace Stevens : Thirteen Ways of looking at a Blackbird	[4]
Eugene O'Neill: Emperor Jones	[8]
N. Hawthorne: The Scarlet Letter	[8]
Tony Morrison: The Bluest Eye	[10]

Suggested Readings:

1.Bloom, Harold. ed. EuqueneO‟neill. New York, Chelsea, 1987.
2.Bentley, Eric. in Search of Theatre. New York, Knop, 1953.
3.Baqohee, Shymal. ed. Perspectives on O‟Neil:New Essays. New york:University of Victoria,1988
4.Lewis, Allan. American Plays and Playwrights of the Contemporary Theatre. New York:Crown, 1965.
5.Mukharjee, Sujit, and D.V.K. Raghara-Charyulu eds. Indian Essays in American Literature. 1969.
6.Ford, Boris. ed. The New Pelican Guide to English Literature, Vol. 9.1994.
7. Morrison, Toni. Playing in the Dark, I Chapter.2004.
8. Robert Spiller: Literary History of the United States, (Amerind Publishing Co.2006)
9.Marcus Cunliffe : American Literature to 1900, (Sphere Reference)
10.F.O.Matthiessen. American Renaissance, 1992.
11. George McMichel : Concise Anthology of American Literature.2000.
12. SD Palwekar, Literature and Environment:A Select Study of British, American and Indian Writings, Lambert Academic Publishing, Germany, 2012.

EL 591 Indian Writing in English 4-0-0-4

Raja Rao : Kanthapura	[8]
Anita Desai : Clear Light of Day	[8]
Salman Rushdie: Midnight‟s Children	[10]
A. K. Ramanujan : Is There an Indian Way of Thinking: An Informal Essay	[4]
Toru Dutt : Savitri- Part I	[4]
Nissim Ezekiel : "Goodbye Party for Ms Pushpa T.S., Background, Casually, Night of the Scorpion	[5]
JayantaMahapatra : Evening Landscape by the River, From Temple	[5]
Mahesh Dattani: Tara	[8]

Suggested Readings:

1. Ahmad, Aijaz. In Theory: Classes, Nations, Literatures.1994
2. Devy, G. N. After Amnesia: Tradition and Change in Indian Literary Criticism, 1992.
3. Gopal, Priyamvada. Indian English Novel: Nation,History and Narration, 2005.
4. Guha, Ranajit, ed. The Subaltern Studies Reader (Selected Essays), Delhi: OUP.2006
5. Iyenger, K. R. Srinivasa. Indian Writing in English.1998.
6. King, Bruce. Modern Indian Poetry in English.2002.
7. Khair, Tabish. Babu Fictions: Alienation in Contemporary Indian English Novels.2008.
8. Mukherjee, Meenakshi. The Twice Born Fiction, 2nd edn, 2001.
9. Naik, M. K. A History of Indian English Literature.2000.
10. Naik, M.K. and Shyamala A. Narayan. Indian English Literature 1980-2000: A Critical Survey. 2001.
11. Suleri, Sara. The Rhetoric of English India. 1992.
12. Vishwanathan, Gauri, Masks of Conquest: Literary Study and British Rule in India.1984.

EL 562 Introduction to Linguistics and Phonetics 4-0-0-4

Introduction: Linguistics and its Scope, Branches of Linguistics, Some Basic Concepts in Linguistics	[7]
Language and Communication, Language Variation and Language Change.	[6]
Phonetics and Phonology: Phoneme, Allophone, Human Speech Mechanism, Vowels and Consonants in English	[11]
Syllable structure, Supra-segmental features; GIE, Phonemic Transcription.	[14]
Morphology and Syntax; Morpheme, Word Formation Processes in English	[8]
IC Analysis, Phrase Structure Grammar, Transformation-Generative Grammar	[6]

Suggested Readings:

1.Abercrombie, D. Elements of General Phonetics (Edinburgh University Press, 1967).
2.Balasubramaniam, T. A Textbook of English Phonetics for Indian Students (Macmillan1981).
3.Chomsky, Noam. Aspects of the Theory of Syntax (Cambridge, Mass: MIT Press, 1965).
4.Crystal, David. Linguistics (Penguin, 1971).
5.Hockett, C.F. A Course on Modern Linguistics (New York: Macmillan, 1958).
6.Katamba, F. Morphology (Basingstoke: Macmillan, 1993).
7.Lyons J. 1968. Introduction to Theoretical Linguistics (CUP, 1981).
8.O'Connor, J.D. Phonetics (Penguin, 1973).
9.Robins, R.H. General Linguistics (Longman, 3rd Edition 1980).
10. Saussure, Ferdinand de. A Course in General Linguistics, Trans. Wade Baskin (New York: McGraw Hill), 1998.
11. Verma, S.K. and N. Krishnaswamy. Introduction to Modern Linguistics (OUP, 1993).

EL 572 Middle Ages to the Seventeenth Century English Literature-II 4-0-0-4

Geoffrey Chaucer: The Squire‟s Tale	[10]
Ben Jonson: Every Man in His Humour	[10]
Shakespeare: Othello	[7]
Edmund Spenser: Epithalamion	[8]
John Donne: Forbidding Mourning, Forbidding Weeping.	[6]
John Milton: Paradise Lost, Book II	[11]

Suggested Readings:

1. Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.1995.
2. Daiches, David:A Critical History of English Literature (vol. I), Delhi, Allied Publishers.1998.
3. Grose, M. W.: Chaucer: Literature in Perspective.2002.
4. Broadbrook, M.C.: Themes and Conventions of Elizabethan Comedy.1988.
5. Rudram, Alan: A Critical Commentary on Milton‟s Paradise Lost.1978.

EL 582 Eighteenth Century to the Twentieth Century English Literature-II 4-0-0-4

William Collins: Ode to Simplicity, Ode to Music, Ode to Evening	[9]
Thomas Gray: Distant Prospects of Eton College, Death of a Favourite Cat, Elegy Written in a Country Churchyard	[11]
W. B. Yeats: When You Are Old, A Bronze Head, Lapis Lazuli, Sailing to Byzantium	[9]
W. H. Auden: Sir, No Man‟s Enemy, September 1, 1939, In Memory of W. B. Yeats	[11]
James Joyce: A Portrait of the Artist as a Young Man	[12]

Suggested Readings:

1.R. Humphreys, The Augustan World (London, 1954)
2.J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948)
3.P. Rogers, An Introduction to Pope (London, 1975)
4.R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)
5. A.R. Humphreys, The Augustan World (London, 1964)
6.W.J. Bate, The Achievement of Samuel Johnson (New York, 1955)
7.Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.2004.
8.Hough, Graham: The Romantic Poets, London, Hutchinson‟s University Library.1953.
9.Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harvard University Press.1964.

EL 592 Creative and Technical Writing 4-0-0-4

Study of Literary Works in progress: Analysis of the Creative Writing Components (Poem, Novel, Short Story, Drama, Diary)	[8]
Craft of poetry: Subject matter, theme, rhythm, metre, stanza forms, sub-genres of Poetry	[8]
Fundamental Norms of Writing	[5]
Tools of Technical Writing: Feature Writing and Technical Writing	[5]
Editing & Proof Reading	[5]
Business Correspondence	[5]
Writing for various media: Learning to write scripts for Publishers and Copy Writing, Writing for Radio, Theatre, Television and Films	[8]
Assignment in Creative Writing: Poetry/Fiction/Drama	[8]

Suggested Readings:

1.Corbeff, Edward P. J. The little Rhetorica, Handbook. New York; John Wiley Sons, (1977).
2.Watkins, F. C. and Knight, K. E. Write to Write: Readings on the Craft of Writing. Bouston, HoughtounMifelin, (1966).
3.Mullins, Carolyne J. A Guide to writing and Publishing, New York; John Wiley & Sons, (1987).
4.The Writer‟s Manual, Califirnia; ETC Publications, (1977)
5. Baker, Sheridial. The Practical Stylistics, New York; Harper and Raw, (1977).
6. Vrooman Alan. Good writing An informal Mannual of Style. Athemeum: New York, 1972
7. Belcher, Diane D. (ED.) English for Specific Purposes in Theory and Practice. (University of Michigan Press, 2009).

EL 592 Comparative Literature 4-0-0-4

History of Development of Schools of Comparative Literature (French, American, British & Indian)	[8]
Influence and Reception Study	[8]
Genology, Literary History (Period and Movement Study)	[5]
Thematology	[5]
Comparative Literature and Intercultural Studies	[5]
Comparative Literature and Other Disciplines	[5]
The Future of Comparative Literature	[8]
Assignment in Comparative Literature	[8]

Suggested Readings:

1.Jost, Francois, Introduction to Comparative Literature. (Penguin, 2002).
2.Prawer, S.S. Comparative Literary Studies: An Introduction. (Allied, 1999).
3.Brandt, Corstius J. Introduction to the Comparative Study of Literature. (OUP, 2002).
4.Wellek,Rane & Warren, Austin. Theory of Literature. (OUP, 1998).
5.Weisstein, Ulrich (Ed.) Comparative Literature and Literary Theory: Survey and Introduction, Cambridge, 2002.
6.Susan Bassanett. Comparative Literature: Introduction, (Routledge, 2002).
7.Nagendra, Comparative Literature. Delhi, University of Delhi, OUP, 2004.

EL 661 Principles of Criticism-I 4-0-0-4

Aristotle: Poetics	[9]
Horace: Ars Poetica	[6]
John Dryden: Essay on Dramatic Poesy	[6]
Alexander Pope: Essay on Criticism	[4]
Dr. Samuel Johnson: Preface to Shakespeare	[5]
Samuel Taylor Coleridge: Biographia Literaria	[8]
Thomas Love Peacock: Four Ages of Poetry	[8]
T. S. Eliot: Metaphysical Poets	[6]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. "The Genetic-Structuralist Method in the History of Literature".
4. Gramsci, Antonio. "Hegemony".1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. "Crisis in Orientalism". 1987.
8. Sedgwick, Eve Kosofsky. "Introduction: Axiomatic" from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984.
10. Thiong'o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 671 Literature and Society-I 4-0-0-4

The Middle English Period: Norman Conquest of England	[5]
Manorial System of the Normans	[4]
Crusades in the Middle Ages	[4]
Hundred Years War	[4]
Social Life of England	[4]
England in the Sixteenth to the Eighteenth Century: Reformation and Renaissance in England	[6]
University Wits, Social Life in the Age of Milton	[5]
Puritan Revolution, Glorious Revolution of 1688	[4]
Industrial Revolution	[4]
Main Literary Trends in Poetry and Drama	[4]
Emergence of Novel	[4]
Humanism	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, Gale publication, 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2004.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism, Blackwell, 2013
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2000.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 681 Commonwealth Literature-I 4-0-0-4

Dom Moraes: A Letter	[5]
Gopal Honnalgere: The Donkeys	[5]
Kenneth Slessor: Country Towns	[5]
A.D. Hope: Australia	[5]
Les Murray: The Wilderness	[6]
Gabriel Okara: Were I to Choose	[5]
David Rubadiri: A Negro Labourer in Liverpool	[5]
Wole Soyinka: Death and the King's Horseman	[5]
Ngugi' wa Thiong'O:A Grain of Wheat	[6]
Chinua Achebe: Things Fall Apart	[5]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).
4. Césaire, Aimé. Discourse on Colonialism (1950).
5. Fanon, Frantz. The Wretched of the Earth (1961).
6. Gilbert, Helen and Joanne Tompkins. Post-Colonial Drama: Theory, Practice, Politics (London: Routledge, 1996).
7. Memmi, Albert. The Colonizer and the Colonized (1965).
8. Rushdie, Salman. Imaginary Homelands: Essays and Criticism,1981-1991 (London: Granta, 1991).
9. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
10. Spivak, Gayatri Chakravorty. "Can the Subaltern Speak?"1984
11. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 691 Translation Studies 4-0-0-4

Concept of Translation in the West and in the Indian Tradition	[7]
Types of translation – intra-lingual and inter-semiotic; „word for word‟ or „sense for sense‟; decoding and recoding	[7]
Equivalence – linguistic and cultural; formal and dynamic; Equivalent Effect	[5]
Language and Culture	[5]
Translators' Invisibility – Domestication and Foreignization	[5]
Self-translation (Auto Translation), Transcreation	[5]
Translation of an actual text: a short story / excerpts from a novel or play / poems	[5]
Philosophical Theories of Translation – Steiner‟s Hermeneutic Motion; Ezra Pound and the Energy of Language; The Task of the translator; Walter Benjamin; Deconstruction	[5]
Literary Translation in Nineteenth Century India	[4]
Postcolonial Translation Theory	[4]

Suggested Readings:

1.Bassnett, Susan. Translation Studies (Revised ed 2000).
2.Catford, J.C. A Linguistic Theory of Translation.2002
3.Mukherjee, Sujit. Translation as Discovery and Other Essays, and Translation as Recovery.2004
4.Susan Bassnett and Harish Trivedi, eds. Post-Colonial Translation: Theory and Practice (London & New York: Routledge, 1999).
5.Venuti, Lawrence. Translation‟s Invisibility: A History of Translation.2009.

EL 613 Indian Writing in Translation 4-0-0-4

Munshi Premchand: Godan	[10]
Mohan Rakesh: Aadhe Adhure	[8]
U. R. Ananthamurthy: Samskara	[8]
Saadat Hasan Manto: Toba Tek Singh	[5]
Mahasweta Devi: Draupadi	[5]
Vijay Tendulkar: Kanyadan	[8]
Baby Kamble: The Prisons We Broke	[8]

Suggested Readings:

1. A.K. Mehrotra, The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008.
2. The Norton Anthology of World Literature. Volume F, 2009.
3. P.France, The Oxford Guide to Literature in English Translation (Oxford, 2000).
4. E Grossman, Why Translation Matters, Orient black swan Pvt. Ltd, 2007.
5. The Oxford India Premchand. OUP:Delhi, 1999.
6. Ananthmurthy. Samskara. OUP: Delhi.2000.
7. Collected Stories of Saadat Hasan Manto.2003.
8. Draupadi. Translated by Gayatri Spivak, 2001.
9. Baby Kamble. The Prisons We Broke. Orient Blackswan, Hyderabad.2004.
10. Tendulkar, Vijay. Kanyadaan. Trans. Gouri Ramnarayan. Delhi: Oxford U P, 1996

EL 623 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Autumn Semester of Second year shall be between 5,000 words and 8,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

EL 662 Principles of Criticism-II 4-0-0-4

Northrop Frye : The Archetypes of Literature	[8]
Ferdinand de Saussure : The Object of Study	[8]
Jacques Derrida : Structure, Sign and Play in the Discourse of the Human Sciences	[8]
Elaine Showalter: Towards a Feminist Poetics	[4]
Jean-François Lyotard : Answering the Question: What is Postmodernism?	[5]
Michel Foucault : What is an Author?	[5]
Roland Barthes : From Work to Text	[4]
Homi K. Bhabha : Cultural Diversity and Cultural Difference	[5]
Jacques Lacan : The Agency of the Letter in the Unconscious or Reason since Freud	[5]

Suggested Readings:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2007.
2. Césaire, Aimé. Discourse on Colonialism.2000.
3. Goldmann, Lucien. “The Genetic-Structuralist Method in the History of Literature”.
4. Gramsci, Antonio. “Hegemony”.1999.
5. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002.
6. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987.
7. Said, Edward. “Crisis in Orientalism”. 1987.
8. Sedgwick, Eve Kosofsky. “Introduction: Axiomatic” from Epistemology of the Closet, 2006.
9. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
10. Thiong‘o, Ngugi wa. Decolonizing the Mind.(Muffin, 2004).

EL 672 Literature and Society-II 4-0-0-4

England in the Nineteenth Century: Social and Religious tendencies of the Victorian Age	[6]
Oxford Movement	[5]
Feminist Movement	[5]
The Naughty Nineties	[5]
England in the Twentieth Century: Social and Literary Tendencies of the Early Twentieth Century	[5]
Emergence of the Labour Party	[5]
The Rise of the Problem Plays	[4]
The Stream of Consciousness Technique in Fiction	[5]
Main Trends in Poetry, Drama and Fiction	[8]
Cultural Studies	[4]

Suggested Readings:

1. Literary Movements for the students, second edition, gale publication , 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2002.
3. Cuddon, J C. The Penguin Dictionary of Theory and Criticism , Blackwell, 2004.
4. Coyle, Martin. Encyclopedia of English literature and criticism, 2003.
5. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014.

EL 682 Commonwealth Literature-II 4-0-0-4

George Frederick Cameron: The Future	[5]
J. M. Smith: Ode on the Death of William Butler Yeats	[5]
Margaret Atwood: Journey to the Interior	[5]
Edward Brathwaite: Tizzic	[5]
Edwin Thumboo: Gods Can Die	[5]
Yasmine Goooneratne: There was a Country	[5]
Katherine Mansfield: The Man with the Wooden Leg	[4]
Pankaj Mishra: The Romantics	[9]
Kiran Desai: The Inheritance of Loss	[9]

Suggested Reading:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3. Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).

1991).
4. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978).
5. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984.
6. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

EL 692 Women Studies 4-0-0-4

Rokeya Sakhawat Hussain: Sultana‟s Dream	[8]
Katherine Mansfield: A Cup of Tea	[6]
Charlotte Perkins Gilman: If I were a Man	[6]
Ernest Hemingway: The Short Happy Life of Francis Macomber	[6]
Coventry Patmore: Angel in the House	[6]
Imtiaz Dharker: Purdah, Battle Line, She Must Be From Another Country	[6]
Virginia Woolf: A Room of One‟s Own	[6]
Suniti Namjoshi: The Mothers of Maya Diip	[8]

Suggested Readings:

1. Butler, Judith. Gender Trouble (1990).
2. de Beauvoir, Simone. The Second Sex (1949).
3. Freidan, Betty. The Feminine Mystique (1963).
4. Gardener, Judith Kegan, ed. Masculinity Studies and Feminist Theory: New Directions (Columbia University Press, 2002).
5. Greer, Germaine. The Female Eunuch (1970).
6. Lal, Malashri. The Law of the Threshold (Shimla: Indian Institute of Advanced Study, 1995)
7. Mill, John Stuart. The Subjection of Woman (1869).
8. Sedgwick, Eve Kosofsky. Gender Criticism: What Isn‟t Gender.2002.
9.Tharu, Susie and K.S. Lalita, eds. Introduction Women Writing in India (New Delhi: O.U.P., 1993)
10. Wolf, Naomi. The Beauty Myth (1991).
11. Wollstonecraft, Mary. A Vindication of the Rights of Woman (1792).
12. Woolf, Virginia. Shakespeare‟s Sister from A Room of One‟s Own (1929).

EL 614 World Literature(s) 4-0-0-4

Ibsen: A Doll‟s House	[8]
Brecht: Mother Courage	[8]
Dario Fo: Accidental Death of an Anarchist	[7]
Rabindranath Tagore: Gitanjali	[7]
Albert Camus: The Outsider	[8]
Pablo Neruda: Everyday You Play, I‟m Explaining a Few Things, Ode to a Tomato	[7]

Rainer Maria Rilke: Fear of the Inexplicable, Falling Stars, You Who Never Arrived [7]

Suggested Readings:

1. Kahns, Richards. Tragedy: Contradictions and Repression. Chicago: Chicago University Press, 1993.
2. Ellmann, Richard (ed.). The Modern Tradition: Backgrounds of Modern Literature. New York: Oxford University Press, 1992.
3. Parkar, Emmett. Albert Camus: the Artist in the Arena. New York: Routledge and Kegan Paul, 1965.
4. Northam, John. Ibsen: A Critical Study. London: Everyman, 1970.
5. Hirst, David. Dario Fo and Franca Rame. Hampshire: Macmillan, 1989.
6. Bloom, Harold. Modern Critical Views: Gabriel Garcia Marquez. New York: Chelsea House Publishers, 1989.
7. Metzger, Erika A. & Metzger, Michael M. (eds.). A Companion to the Works of Rainer Maria Rilke (Studies in German Literature Linguistics and Culture). New York: Camden House, 2004.
8. Raymond Williams. Drama from Ibsen to Brecht. London: Chatto and Windus,1968.

EL624 Dissertation 0-0-0-4

The length of the dissertation to be submitted at the end of Spring Semester of Second year shall be between 8,000 words and 10,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The Dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

Session 2020-2021

BA JMC-2020-2021

First Year

Autumn Semester

JM20.101	**Introduction to communication & media**	**3-1-0-4** **Total Lectures: 39**
Prerequisite:	Student should have basic knowledge of communication and its role in masses.	
Objective:	To broaden and deepen the students understanding of the field of communication by introducing them to important aspects and nature of communication. To appraise the students with the use of various modes of communication in carrying out both pure and applied research in this discipline. To help them improve the quality of their communication by making effective use of media.	
Unit 1	**Communication & Media:** Definition, meaning & concept, Different types of communication: Verbal and written, Scope and Process of Communication, Mass Communication: Concept & Characteristics.	08
Unit 2	**History of Mass Media:** Mass Media: Meaning & Concept, Introduction to Indian Press, Brief account of the origin and development of newspaper and magazine in India, History of the development of electronic media in India: Radio & TV.	10
Unit 3	**Mass media & Mass Culture:** Role, objectives functions & achievements of Mass Media, Relation between Mass Media and Mass Culture and their development, Media as fourth pillar of democracy, Mass Media in Rural-Urban divide.	08
Unit 4	**Media and Market and Technology:** Changing trends of Mass Communication under the process of globalization, Private and Public Media, Media and Market: Nature, Relation & Expansion.	06
Unit 5	**Media and Technology:** Technology in the development of Media, Communication in the era of Social Media, Impact of social media on flow of information.	07
Course Outcome:		
1	After the completion of course, the students will have a clear understanding of communication and its need, importance and relevance to media.	
2	They will also understand mass media the historical aspect of various media, importance of audiences, viewers measuring systems and skills which enable them to work efficiently	
3	Access the impact of media on society.	
4	Understand the changing phase of media with the advancement of technology.	
Text Books:		
1	Kumar, Kewal J, Mass Communication in India, Jaico Books, New Delhi.	
2	Kamath M V.Professionaljournalism,Publisher: Vikas Pub House.	
Reference Books:		
1	J.S. Yadava & Pradeep Mathur, Issues in Mass Communication: The Basic Concepts, Kanishka Publishers, Delhi	
2	Shymali Bhattacharjee., Media and Mass Communication: An Introduction, Kanishka Publishers, Delhi	
3	George Rodmann. Mass Media in a Changing World; Mcgraw Hill Publication,2007.	
4	Malti Mehta, Sharma S R(Ed)The development of mass communication,Sarup2013	

JM20.103	Introduction to Journalism	3-1-0-3 Total Lectures: 39
Prerequisite:	Student should have basic understanding of news media.	
Objective:	To introduce students to the basics of journalism. To inculcate the knowledge of elements of journalism. To acquaint them with important aspects of the process of Journalism. To develop the knowledge of skills of journalism. To enhance understanding of the technical terms and jargons of Journalism.	
Unit 1	**Introduction to Journalism:**: Concept, nature, scope, function and types Role of Journalism in Society, Journalism and Democracy, Concept of Fourth Estate. Concept of Mass Communication, Mass Communication in India.	08
Unit 2	**Different Aspects of Journalism:**Journalism: Contemporary Issues in Journalism, Debates in Journalism, Elements of Journalism, Types of Journalism, Alternative Journalism.	09
Unit 3	**Process of Journalism:** Citizen Journalism, Yellow Journalism, Investigative Journalism, Advocacy Journalism.	08
Unit 4	**Skills of journalism:** Convergence, Changing technology, online journalism, New trends in journalism. Technical terms of Journalism, Jargons of Journalism, Introduction to regional Journalism ,Journalism and globalization, Journalism and society	08
Unit 5	**Newsroom:** Collection of data, research, graphics, maps & compilation of News, Desk Copy, Role, functions and responsibilities of Copy editor and others.	06

Course Outcome:	
1	Students would be able to understand the basics of journalism.
2	Students would be able to inculcate the knowledge of student elements of journalism.
3	Students would be able to acquaint them with important aspects of the process of journalism
4	Students would be able to develop the knowledge of skills of journalism.
5	Students would be able to enhance understanding of the technical terms and jargons of journalism.
Text Books:	
1	Natrajan J, History of Indian Journalism, Publications Division, Ministry of Information & Broadcasting, Govt. of India, 1997
2	Ambrish Saxena., Fundamentals of Reporting & Editing, Kanishka Publishers, Delhi.
Reference Books:	
1	Parthasarthy, Rangaswami., Journalism in India, Sterling Publishers Pvt. Ltd., New Delhi.
2	Aruna Zachariah., Print Media, Communication and Management : Elements, Dimensions and Images, Kanishka Publishers, Delhi
3	George A. Hough., News Writing, Kanishka Publishers, Delhi
4	Suhas Chakravarty.,News Reporting & Editing : An Overview, Kanishka Publishers, Delhi.

JM20.105	Project & Presentation of Print	0-0-4-2 Total Lectures: 39
Prerequisite:	Student must have understanding of news and basic computer skill.	
Objective:	To introduce students about the different aspects of newspaper & magazine. To develop the skill of understand news values. To understand the different steps of making project. To develop the skill of dibate and discussion. To acquaint them with important personalities in different field.	
Unit 1	**Themes for the Project:**Newspaper & Magazine. Critical and analytical review of issues and trend in Media, Collection of information and data relating to the topic and analysis of the same.	06
Unit 2	**Steps of Project Report:** Selection of the topic, Suitability of the topic, Relevance of the topic, comparative study of the topic.	06
Unit 3	**Presentation:** Make a presentation based on project followed by question answer session.	06
Unit 4	**Discussion & Debate:** Group discussion within the group on current affairs topic and review the analysis and editorial of different news paper.	05
Unit 5	**Thumbnail sketches:** Make a profile of different prominent personalities in different field.	03
Course Outcome:		
1	Students would be able to understand the story format of print media.	
2	Students would be able to identify news as per their news values.	
3	Students would be able to prepare good presentations with their current impact on audiences.	
4	Students would develop the skill of debate and discussion.	
Assignment & Practical:		
1	Choose the national and international prominent news and collect all cutting of news paper & magazine. 15 news from different field.	
2	Class room PPT presentation of given topic followed by QA and discussion.	
3	Debate on different current topics frequently.	
4	Prepare a project on international & national personalities from different field.	
5	Collect real time data on public opinion on any current event or news.	

JM20.107	News & Contemporary Issues- I	4-1-0-5 Total Lectures: 52
Prerequisite:	Student should have knowledge about the different news category.	
Objective:	To impart the extensive knowledge about the national issues, court proceedings and other related news. To inculcate the extensive knowledge about general awareness and contemporary activities at national and international level issues. To understand the news and basic concept of economics for understanding the economic health of country. To develop the critical understanding of current issues and discuss on them extensively.	
Unit 1	**National News:** Daily national news, Background to the news items, coverage of social media, Important bills, acts and Constitutional amendments passed by Indian Parliament, Important Supreme Court rulings.	12
Unit 2	**International News:** Daily international news, Background to the daily news. Thumbnail sketches of chief personalities figuring in current news reports Relevance of these reports to India and the world community or why they are considered to be important, Important actions taken under the UN umbrella, Regions of conflict in the world.	12
Unit 3	**Economic News:** Concept of economics, economic terms such as GNP, GDP, Per capita income, inflation, deflation and growth rate etc. Daily national economic news.	09
Unit 4	**National & International Trade Scenario:** Contemporary issues in public and trade sector. Foreign direct investment, foreign exchange rate related issue. International trade and its financial implication in India, issues in labor market-Migration, Unemployment and its impact on Indian economy.	09
Unit 5	**Issues for Discussion:** Globalization, The environment, US dominated world order – politically, culturally and economically, Parliamentary versus Presidential government, Indian Constitution – does it need a change? Naxalism and Marxism, Clash of civilizations, Should the nuclear club remain exclusive? Criminalization of politics, Reservation, Restructuring the UN	10

Course Outcome:	
1	Students would be able to understand the national issues, court proceedings and other related news.
2	Students would be able to inculcate the extensive knowledge general awareness and contemporary activities at national and international level issues.
3	Students would be able to develop the understanding of basic concept of economics for understanding the economic health of country.
4	Students would be able to impart the extensive knowledge about national and international trade and business issues.
Text Books:	
1	'Arihant Current Affairs'(Latest edition)'Basic General Knowledge' (Latest edition).By V.V.K.Subburaj.Publication of Sura College Competetion.
2	'Basic General Knowledge' (Latest edition).By V.V.K.Subburaj.Publication of Sura College Competetion.
Reference Books:	
1	Daily News Paper & Magazin
2	Prime time TV News Bulletin
3	'General knowledge' (Latest edition): India & World. By Saumya Ranjan Behera. Maxcurious Publication
4	'General Knowledge' (Latest edition) By Manohar s Pandey (Online publication). 'Manorama'(Latest edition) .

JM20.109	Writing for media-I	3-1-0-4 Total Lectures: 39
Prerequisite:	Student should have understanding of basic skills of writing.	
Objective:	Understand the techniques, formats and style of news story breakdowns, outlines etc. Perform basic reporting techniques, including conducting interviews and using online databases to gather information. To write a basic news story. To cover various University and Departmental activities and events and prepare news reports. To generate their story ideas and write articles, feature for the Departmental newspaper.	
Unit 1	**Essentials of Good Writing:** Art of Writing, Kinds of Media Writing: Inform, Describe & Persuade, The ABCD of Media Writing: Accuracy, Brevity, Clarity& Discernment.	06
Unit 2	**Writing for Print Media:** Basic principles of writing for print, Elements and Importance of News writing, Steps & elements of writing: editorial features & review.	06
Unit 3	**Writing for Electronic Media:** Basic principles of writing for electronic media: Radio & TV, Elements and Importance of News writing for Radio & TV, Steps & elements of writing for Radio & TV: editorial features & review.	04
Unit 4	**Translation in Media:** Concept & Definition of Translation, Nature & Norms of Translation, Types of Translation: Word to Word Translation, Literal Translation, Summarized Translation, The need and importance of Translation in Journalism, Guidelines for Translation.	06
Unit 5	**Writing Techniques for News Media:**-Prepare news from Press Release, Draft Press Release, Convert Print story to Electronic & Vise Versa. Synchronization of Audio & Visuals.	04
Course Outcome:		
1	The students will be able to write a hard news/summary that incorporates at least 3 of the 5 Ws, is 30 words or less.	
2	Upon completion of the course, students will demonstrate the ability to research and evaluate appropriate sources and background materials for a news story.	
3	The students will be able to write a complete hard news story using the inverted pyramid form and feature story.	
4	Students will understand and demonstrate the skill of writing for electronic media.	
Text Books:		
1	K.K. Rattu, Translation through media in New Millennium, Surubhi Publication, Jaipur.	
2	Thomas S. Kane, Oxford Essentials Guide To Writing.	
Reference Books:		
1	Pal Rajenda and J.S Koriahalli. Essentials of English and Business Communication, S. Chand.	
2	Robey, L Cora New Handbook of Basic Writing Skills, Hardcourt College Pb. Orlando.	
3	George.A.,Hough News Writing , Kanishka press	
4	Robert Mc. Lesh, Radio Production , Focal Press.	

HN20.101	□□□□□□□□□□□□□□□□□□ (**Applied/ Communicative Hindi**)	**3-0-0-3** **Total Lectures: 39**
Prerequisite:	Student should have knowledge of Hindi	
Objective:	To strengthen oral communication skills in Hindi Language. To develop the knowledge of written in Hindi Language. To improve vocabulary in Hindi Language. To enrich the knowledge of synonyms, antonyms, idioms and phrases. To inculcate the knowledge of grammar in Hindi Language	
Unit 1	□□□□□□□□□□□□□□- □□□□□□□□□-□□□□□□, □□□□□□□□□-□□□□□□, □□□□□□□□□□□□□□□□□- □□थ□ ततएवच □न□ततय□, □□□□□□□□म□□□□□□□□□□परकअ□□□सब□□□□□	06
Unit 2	□□रय□जन्मल क्ह□□द□-□□□□□□□□य □, अवश□यकत□, जन्मस्च□□□□□□□यमऔ□□□□□□□भ□□□□□□□□□□□□य□□□भ□व□□□□□र□य□□□ □ई□□□य□ग।	06
Unit 3	□□□□□□□□□□□□□□□-□□□□□□□□□□□□□□□□□□□□□, □□□□□□□□□□□□□□□□□□□, □□□□□□□□□□□□,□□□□□□, □□□□□□, □□□□□□□□□, अन□ □ □ □ □श□□द,ह□ न□द□क□□रय□ग□त□मक□□ह□ □य□□।	04
Unit 4	□□□□□□□□□हत□य□□□□ □ □□□□□तत्वह□□- ह□ □□द□स□ह□ त□यक□अथत नक□ □□रव□ त□तय□□, □□□□□□□□□□□□□□□□□□□यकवक्य□अके □□□□□□□, □□□□□□□□□□य, □□□□□□□□□□य।	06
Unit 5	मह□ □तम□ध□यमऔ□ह्ह□□द□- र□□□य□□□□□□ष□, □□ □□ □ववजन□□□□□□,□□□□□□□न□□□□ष □, □□□□□□□□□□□□□□□□□□□□	04
Course Outcome:		
1	Students would be able to strengthen oral communication skills in Hindi Language.	
2	Student would be able to develop the knowledge of writing in Hindi/ Regional Language.	
3	Students would be able to improve vocabulary in Hindi Language.	
4	Students would be able to enrich the knowledge of synonyms, antonyms, idioms and phrases.	
5	Students would be able to inculcate the knowledge of grammar in Hindi/ Regional Language.	
Practical/Assignment:		
1	Go through the newspaper of a week and point out the mistakes by preparing a list of it in text and headlines.	
2	Translate 2 editorials	
Reference Books:		
1	□□□□□□, □ □. क□ □□□□□□□द, अन्नव□ □दक□ □: लसद□□□तऔ□□रय□ग, □□□□□□□□□□र□□□न, नईहद□□□□□	
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4	क□ म□र च□द, जन्मस्च□□□□□□य□□□म□□□□□□□□, □□ □ □लस्क□ प□□□□ □ लशग क□□पन□, हद□□□□	

JM20.111	Practical-Computer Application for Mass Media	0-0-4-2 Total Lectures: 26
Prerequisite:	Student should have interest in computer and design.	
Objective:	To familiarise students with computers and Microsoft Windows. To train the students in word processing especially typing in Hindi/English. To make the students familiar with basic of computer operations and keyboard.	
Unit 1	**Ascessing the internet:** Going to a specific website and bookmarking, Understanding how to search/Google effectively, Copy and paste Internet content into your documents and email, Demystifying the Cloud, Understanding social media platforms such as Facebook and Twitter, Computer security best practicesPageMaker/Quark express.	06
Unit 2	**Page designing**: Describe DTP software used for design and layout.	06
Unit 3	**Exercises and Assignment:** Design and create layout using DTP software.	04
Unit 4	**Exercises and Assignment:** Design a visiting card, postcard, poster, brochure.	06
Unit 5	**Exercises and Assignment:** Design a magazine. Prepare front page of newspaper.	04
Course Outcome:		
1	Navigate the operating system and start applications. Perform basic functions of file management.	
2	Perform basic functions in a word processor and spreadsheet. Manage print settings and print documents	
3	Students can create poster, card, brochures & newspaper page.	
Practical/Assignment:		
1	Front page design of magazine.	
2	News paper/Tabloid design.	
3	Poster for social media campaign.	
4	Plan overall campaign through all media on any topic.	

EL20.109	Foundation Course in English	2-0-0-2 Total Lectures: 26
Objective:	Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.	
Unit 1	**Sentence Structure:** Elements of a sentence (Subject, verb, object, complement and adjunct) **Articles:** Definite and Indefinite & omission of articles	5
Unit 2	**Transformation of Sentence Structure:** Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	5
Unit 3	**Correct Usage of Language:** Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need) **Common Errors in Effective Communication:** How to avoid common sentence – structural errors, vocabulary and pronunciation	6
Unit 4	**Writing Skills:** Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing	6
Unit 5	**Reading Comprehension:** Efficient reading and note taking	4
Course Outcome: The student will be able to:		
1	Learn the essentials of English Grammar.	
2	Apply the rules of grammar to use flawless English in speech and writing.	
3	Analyze, identify and rectify the common errors in speech and writing.	
4	Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.	
5	Evaluate a piece of writing keeping in mind all the rules of grammar studied.	
6	Read and comprehend English	
Text Books:		
1	Wren & Martin: English Grammar & Composition, S.Chand& Co, Delhi (Latest edition)	
2	Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.	
Reference Books:		
1	Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.	
2	Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.	
3	Quirk &Greenbaum: University English Grammar, Longman Publications, 1973.	
4	Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).	

Spring Semester

JM20.102	**Theory of Communication**	**4-1-0-5** **Total Lectures: 52**
Prerequisite:	Student should have understanding of basic communication process.	
Objective:	Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others. Students will understand the research methods associated with the study of human communication and its evolution, and apply at least one of those approaches to the analysis and evaluation of human communication.	
Unit 1	**Communication:** Definition, meaning, concept, elements, process, functions and scope, Types and forms of communication, Barriers to communication, 7 C's of communication.	08
Unit 2	**Communication theory:** Need & importance, Two Step and Multi Step Theory, Hypodermic needle theory.	08
Unit 3	**Communication model:** Need & importance, SMCR Model, Shannon and Weaver Model, Harold D. Lasswel's Model, Charles E Osgood's, Wilbur Shramm's.	08
Unit 4	**Sociological Theory of Communication:** Cultivation Theory, Agenda-Setting Theory, The Uses and Gratification Theory, Dependency Theory.	13
Unit 5	**Normative Theory of Communication:** Authoritarian Theory, Free Press Theory, Social Responsibility Theory, Communist Media Theory, Development Communication Theory, Democratic Participant Theory & Mass Society Theory, Political Economic Media Theory.	15
Course Outcome:		
1	Students will be able to understand and apply knowledge of human communication.	
2	Students will be able to understand and evaluate key theoretical approaches used in the interdisciplinary field of communication.	
3	Students will be able to find, use, and evaluate primary academic writing associated with the communication discipline	
Text Books:		
1	De Fleur, M ,Theories of Mass Communication, 2nd Edition, New York; David Mc Kay	
2	McQuail's Mass Communication Theory, 6th Edition, SAGE Publication, New Delhi	
Reference Books:		
1	Taylor, Rosegrant, Meyrs Communicating, Prentice Hal	
2	Allan and Barbara Pease, The Definitive Book of Body Language, Munjal Publishing House	
3	D.M. Silviera, Personal Growth Companion, Classic Publishing.	
4	Dan LaugheyKey ,Themes in Media Theories, Rawat Publication.	

JM20.104	Reporting & Editing for Print-I	3-0-0-3 Total Lectures: 39
Prerequisite:	Students should have interest in field work or public interaction.	
Objective:	To understand the working pattern of various print media platforms To familiarize the students with the basics of writing and reporting of print media. To create understanding of various print media content. To develop the knowledge of news agency. To inculcate the knowledge of editing.	
Unit 1	**BasicsofReporting:**BasicsofReporting:principles ofreporting,functions andresponsibilities.Writingnews: Lead-typesoflead,body.Reporting: Newspapers,NewsAgenciesandMagazines. Techniques of re writing news agency copy, reporting technique	08
Unit 2	**Reporters:**Qualitiesand Responsibilities.Reporting fordifferentbeats. Reporting forNewspapers–Reporting theexpected &unexpected.Reporting Skills- Nose forNews, Observation (listening &seeing) Taking notes finding, checking, verifying, analyzing& interpreting information.	08
Unit 3	**Types of Reporting:** Reporting- crime,courts,society,culture,education, politics,sports,commerceandbusinessandlifestyle. Extracting Storiesfrom outsidesources:Citizens, Pressreleases,Institutional sources, Ministers & Govt. Departments etc. Pitfalls and problems in reporting.	08
Unit 4	**Editing:** Natureandneed forediting,Principlesofediting.Functionsof editorial desk. Copy editing. Preparation ofcopyforpress, stylesheet. Editingsymbols, proofreadingsymbols andtheir significance.	08
Unit 5	**Newpaper & Magazine:** Difference between writing for a Newspaper and Magazines. Various types of Magazines and their writing styles (lifestyle, developmental magazines, etc.) Writing a Travelogue. Writing for a Magazine	07
Course Outcome:		
1	Students would able to understand the working pattern of various print media platform.	
2	Students would be able to familiarize themselves with the basics of writing of print media.	
4	Students would be able to create understanding of various print media content and reporting skill.	
5	Students would be able to develop the knowledge of news agency.	
6	Students would be able to inculcate the knowledge of book editing.	
Text Books:		
1	Kamat, M. V.**(1980).** *TheProfessional Journalism.* New Delhi:Vikas Publishing	
2	PTI Style Book Modern Journalism: Reporting and Writing, Diwakar Sharma, Deep and Deep Publications, New Delhi..	
Reference Books:		
1	Hough, G. (1995). *NewsWriting*. New Delhi:KanishkaPublishers	
2	Robey, L Cora. (1992). *New Handbook ofBasic Writing Skills.* Orlando:HarcourtCollege Publication.	
3	Reporting for the Media, Fred Fedler and John R. Bender, Oxford University Pressur's Handboo Richard Keeble, Routledge Publication.	
4	Principles of Editorial Writing, MacDougall and Curtis Daniel, W.C. Brown Co. Publishers	

JM 20.106	Design & Graphics lab	0-0-4-2 Total Lectures: 26
Prerequisite:	Student should have interest in design and basic knowledge of computer.	
Objective:	To make the students proficient about the aesthetics of design. To make the students understand the layout of Newspapers. To provide hands on training on software - Adobe Photoshop and QuarkXpress.	
Unit 1	**Principles of Design & Graphics:** Basics of Design and Graphics, Element of principles of design. Typography: physical form, aesthetics and classifications. Color: physical forms, psychology, color scheme and production.	06
Unit 2	**Layout:** Components of layout and layout planning, advertisement layout, broadcast and tabloid layout, magazine and book layout	06
Unit 3	**Exercises and Assignment:**To work with different textures, color schemes and other elements on different topics/themes.To work on various types of signo-graphic, calligraphic and typographic letterforms.	04
Unit 4	**Visual and Design:** Visuals: Physical forms, functions and editing, poster design, logo design, brochure design.	06
Unit 5	**Exercises/ Assignment:** Design a logo. Design flash cards. Design and develop a booklet (story/rhymes/play/comic or any other) Visit a printing press. Designing layout of newspaper on QuarkXpress software.Editing of captured images with the help of Photoshop.Rewriting and editing of news stories as per news value and requirement of design.	04
Course Outcome:		
1	Students will be ready to become newspaper designers.	
2	Students will become proficient in photo editing.	
3	Students will understand the elements and designing of newspaper.	
4	Students will be able to design logo, poster and brochures.	
Text Books:		
1	N.N. Sarkar, Art and Production, Sagar Publishers, new Delhi 2001	
2	N.N. Sarkar, Designing Print Communication, Sagar Publishers, new Delhi 1998	
3	A.K. Dhar, Printing and Publishing	

JM20.108	News & Contemporary Issues-II	3-1-0-4 Total Lectures: 39
Prerequisite:	Student should have understanding of different news segments.	
Objective:	To impart the extensive knowledge about general knowledge, general awareness and contemporary activities at local, regional, national and international level. To develop the extensive knowledge about general awareness and contemporary activities at local, regional, national and international level about socio-political issues. To inculcate the extensive knowledge about contemporary activities at local, regional, national and international level about trade and business issues. To develop the skill of discussion and debate on different current issues.	
Unit 1	**National & International News:** Daily national & international news, Background to the news items. International news and its impact on India. India foreign policy etc.	08
Unit 2	**Social Issues:** Understanding society, social issues, change & development, social issues relating the problem of women, children, youth, Dalits, Tribal, LGBT community & other marginalized sections. Critical contemporary debates around the social issues, Media coverage of these issues etc.	08
Unit 3	**Economic News:** Regional economic groupings of the world and their functioning, The European Union and its expansion.	07
Unit 4	**Trade & Market:-** The World Bank, The Asian Development Bank, World Economic Forum, Profile of the Indian economy (industry, agriculture, infrastructure, growth rates, world ranking, role of planning, budgets and government policies), The world's top 10 economies.	07
Unit 5	**Issues for Discussion:** Current political, social & economic issues. Environment & Global warming, Rise of Asian countries & India. Role of ASEAN & BRICS etc.	09
Course Outcome:		
1	Students would be able to impart the extensive knowledge about general knowledge, general awareness and contemporary activities at local, regional, national and international level.	
2	Students would be able to develop the extensive knowledge about general knowledge, general awareness and contemporary activities at local, regional, national and international level about socio- political issues	
3	Students would be able to inculcate the extensive knowledge about general knowledge, and contemporary activities at local, regional, national and international level about business and economic issues.	
4	Students would be able to develop the extensive knowledge about national and international level about media related issues and debate with different views and opinions.	
Text Books:		
1	'Arihant Current Affairs'(Latest edition)'Basic General Knowledge' (Latest edition).By V.V.K.Subburaj.Publication of Sura College Competetion.	
2	'Basic General Knowledge' (Latest edition).By V.V.K.Subburaj.Publication of Sura College Competetion.	
Reference Books:		
1	Daily News Paper &Magazine and prime time news on TV	
2	Yojna & Kurukshetra magazine by Niti aayog.	
3	Frontline & outlook magazine.	
4	'General knowledge' (Latest edition): India & World. By Saumya Ranjan Behera. Maxcurious Publication	

JM20.110	Writing For Media -II	3-1-0-4 Total Lectures: 39
Prerequisite:	Student should have interest in writing and understanding of news.	
Objective:	Understand the techniques, formats and style of news story breakdowns, outlines etc. Perform basic reporting techniques, including conducting interviews and using online databases to gather information. To write a opinion and views for news paper and magazines. To prepare feature/ special stories for university newsletter and other online media. To prepare their own news capsule in audio visual format.	
Unit 1	**Writing News for Newspaper:**Hard News vs. Soft News, 5W's & 1H Formula, Basic components of a news story- Brevity, Dateline, Credit Line, Byline.	08
Unit 2	**Newspaper Writing:** News writing vs. Opinion writing, Reading and reviewing Newspapers and Magazine.	09
Unit 3	**Feature Writing:** Human interest, Backgrounder, Sports, Entertainment feature writing. Editorial, Article writing	08
Unit 4	**Writing for Electronic Media:** Format of TV news writing. Writing for Radio & TV-Interviews, news, discussion.	08
Unit 5	**Format of Electronic Media:** Format of news Bulletin, Audio-Visual combination & synchronization.	06
Course Outcome:		
1	The students will be able to write a hard news/summary and crime or political story	
2	Upon completion of the course, students will demonstrate the ability to research and evaluate appropriate sources and background materials for a news story.	
3	The students will be able to write different feature stories and opinion.	
4	Students will demonstrate the skill of preparing capsule for electronic media.	
Text Books:		
1	Bruce D. Itule and Douglas A. Anderson. *News writing and reporting for today's media;* McGraw Hill Publication, 2000	
2	George Rodmann. *Mass Media in a Changing World*; Mcgraw Hill Publication,2000	
Reference Books:		
1	Richard Keeble. *The Newspaper's Handbook*; Routledge Publication,2006.	
2	Jitendra Gupt and Priyadarshan Patrakarita Mein Anuvaad, Radha Krishna Prakashan, N.Delhi.	
3	Laxmikant Pandey, Translation, Objects and Methods.	
4	M.L. Stein, Susan Paterno& R. Christopher Burnett. News writer's Handbook: An Introduction to Journalism; Blackwell Publishing,2006.	

JM20.112	Practical-Reporting & Editing for print	0-0-4-2 Total Lectures: 26
Prerequisite:	Student should have interest in writing and story telling.	
Objective:	Understand the techniques, formats and style of story breakdowns, outlines, treatments, and story plotting. Identify current trends and major practitioners of the writing craft. To train the students in reflecting critically on the conventions of storytelling.	
Unit 1	**Introduction to dramatic storytelling / generating ideas:** Specific techniques for generating ideas. **The drafting process:**Techniques for approaching the first draft	06
Unit 2	**Characterization:** Techniques for creating effective characters. **The art and craft of dialogue:** Dialogue writing exercise (dialogue as dramatic action) Dialogue writing exercise (subtext) Dialogue writing exercise.	06
Unit 3	**Story Plot structure:**Discussion on anatomy of a well-crafted scene. Analysis of key scenes from viewed films or stories.	04
Unit 4	**Rewriting & Editing:** Techniques for evaluating your draft. The rewriting process – tips and techniques. Edit the story with the help of editing symbols.	06
Unit 5	**Exercises and Assignment:**Story creation- feature, drama, crime, social awareness etc.	04
Course Outcome:		
1	Students will be able to write with the rigorous discipline of the committed writer.	
2	Students will be enabled to work on both self-assigned and commissioned stories.	
3	Students will understand the role of writers and others in the industry, and how to present story ideas to industry gatekeepers.	
Text Books:		
1	Kamat, M. V.**(1980).** *TheProfessional Journalism.* New Delhi:Vikas Publishing.	
2	PTI Style Book Modern Journalism: Reporting and Writing, Diwakar Sharma, Deep and Deep Publications, New Delhi.	
Reference Books:		
1	Hough, G. (1995). *NewsWriting*. New Delhi:KanishkaPublishers	
2	Robey, L Cora. (1992). *New Handbook ofBasic Writing Skills.* Orlando:HarcourtCollege Publication.	
3	Reporting for the Media, Fred Fedler and John R. Bender, Oxford University Pressur's Handboo Richard Keeble, Routledge Publication.	
4	Principles of Editorial Writing, MacDougall and Curtis Daniel, W.C. Brown Co. Publishers.	

HN20.102	□□□□□□□□□□□□□□□□□□II- □□□□□□□□□□□□ **(Applied/ Communicative Hindi II- Practical)**	**0-0-4-2** **Total Lectures: 26**
Prerequisite:	Student should have understanding of Hindi writing and language.	
Objective:	□□□□□□□□ □ थ □□म□□□□□□□□□□□□□□□रण□□ □ □ □ न्ना□□□□षमत□ववकसतकरन□□ सर क□र □द□तनक्क□मक□जम□□□□रय□ त□ □न□व□ □ श□□द□व □ स□पररर□चतकर व□न□। □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□□□□	
Unit 1	□□□□□□□यतनगतप□□र, □□□□□न, पररप□□र, अद्द□श, सच न□ए□एवत□ नववद□ □ □ □ न।	08
Unit 2	□□□□□□□म□□वव□□□□□न□ □ □ □ □	09
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Unit 4	□□□□□□□म□□□□□□सववि□□□ततबन□न□□	08
Unit 5	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□	06
Course Outcome:		
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EV20.102	Environmental Studies	4-0-0-4 Total Lectures: 52
Objective:	To develop the conciseness among the students for Environmental Conservation and Sustainability and to connect the students directly with nature and nature conservation for becoming a responsible citizen of India.	
Unit 1	Multidisciplinary nature of environmental studies; components of environment – atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	9
Unit 2	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	10
Unit 3	Natural Resources: Renewable and Non-renewable Resources: Land Resources and land use change; Land degradation, soil erosion and desertification.Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation.Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	08
Unit 4	Biodiversity and Conservation: Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. India as a mega-biodiversity nation; Endangered and endemic species of India Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	08
Unit 5	Environmental Pollution: Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution. Nuclear hazards and human health risks. Solid waste management: Control measures of urban and industrial waste. Pollution case studies.	8
Unit 6	Environmental Policies & Practices. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture. Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	7
Unit 7	Human Communities and the Environment: Human Communities and the Environment. Human population and growth: Impacts on environment, human health and welfares. Carbon foot-print. Resettlement and rehabilitation of project affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	6
Unit 8	Field work: Visit to an area to document environmental assets; river/forest/flora/fauna, etc. Visit to a local polluted site – Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems-pond, river, etc.	5
Course Outcome:		
	Aftercompletion of the course, students would be able to understand the environment and ecological process to sustain the life on earth. Students will also be able to apply the earned knowledge in conservation of nature and prevention of environmental pollution.	

Text Books:	
	1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt. 2. Gadgil, M., &Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press. 3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge. 4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press. 5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006. 6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-37. 7. McCully, P.1996. Rivers no more: the environmental effects of dams(pp. 29-64). Zed Books. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
Reference Books:	
	1. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons. **2.** Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent. **3.** Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders. **4.** Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton. **5.** World Commission on environment and Development. 1987. Our Common Future. Oxford University Press. **6.** www.nacwc.nic.in 22.www.opcw.org

Second Year
Autumn Semester

JM20.201	**Reporting & Editing for Print-II**	**3-0-0-3** **Total Lectures: 39**
Prerequisite:	Student should have understanding of news and its structure.	
Objective:	To develop an understanding among the student about the set up of a daily newspaper and reporting and editing jobs performed in it. To tell them in particular about Newsroom operations and it's functioning in the Local/ National context. To apprise the students with the role of design in the process of communication. Typography, image, space, colour, and form will be integrated as the term progresses.	
Unit 1	**Covering News:** Reporter- role, functions and qualities; General assignment reporting/ working on a beat; news agency reporting, Covering Speeches, Meetings and Press Conferences; Covering of beats- crime, courts, city reporting, local reporting, MCD, hospitals, health, education, sports.	08
Unit 2	**Interviewing /Types of News Leads Interviewing:** Doing the research, Setting-up the interview, Conducting the interview, News Leads/intros, Structure of the News Story– Inverted Pyramid style, Lead: importance, Types of lead,Body of the story, Features, Types of features and Human interest stories, Difference between articles and features.	10
Unit 3	**The Newspaper Newsroom:** Organizational setup of a Newspaper, Editorial Department, Introduction to editing, Principles of editing, Headlines, importance, Functions of headlines, Typography and Style, Language, Types of headline, Style sheet, Importance of pictures, Selection of News Pictures.	08
Unit 4	**Editorial Page:** Structure, Purpose, Edits, Middles, Letters to the Editor, Special Articles, Op. Ed Page;Role of Sub/Copy-Editor, News Editor and Editor, Chief of Bureau and Correspondents.	06
Unit 5	**Special Assignment :** special stories for special or additional addition of newspaper. Structure and necessity of special edition. Difference of regular and special edition.	07
Course Outcome:		
1	After the completion of course, the students will learn the essential skills of reporting, feature writing, subbing, interviewing, researching, designing and layout.	
2	They will also be able to demonstrate the ability to research and evaluate appropriate sources and background materials for a news story and write a complete hard news story using various writing styles.	
3	The students will be sensitized to the art and craft of editing and inculcate the qualities required to be a competent and responsible Sub-editor.	
Text Books:		
1	Dynamics of Journalism and Art of Editing, S.N. Chaturvedi, Cyber Tech Publications	
2	Kamat, M. V.**(1980).** *TheProfessional Journalism.* New Delhi:Vikas Publishing	
Reference Books:		
1	The Art of Editing, Baskette and Scissors, Allyn and Bacon Publication	
2	News Writing and Reporting for Today's Media, Bruce Itule and Douglas Anderson, McGraw Hill Publication	
3	Modern newspaper practice: A primer on the press, F.W. Hodgson, Focal Press	
4	News Reporting and Writing. Mencher, Melvin. MC Graw Hill, NY. 2003	

JM20.203	Media Laws & Ethics	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have interest in law and fundamental rights.	
Objective:	To enhance the knowledge of the students regarding press laws vis-à-vis media. To develop knowledge and understanding of the principle and concepts of media ethics. To apply relevant ethical frameworks to case studies from the media.	
Unit 1	**IntroductionofIndianConstitution:**IndianConstitutionandfreedom of press,reasonablerestrictions,privileges, lawsdefamation,contemptof legislature,and court, censorship,need fora freepressin a democracy.	10
Unit 2	**MediaEthics:**Whatis Media Ethics?WhyMedia Ethics? Media's ethicalproblemsincluding privacy,right toreply,sting operations,media ownership, paid news, AccountabilityandIndependenceofMedia– Self Regulation.	07
Unit 3	**ActsandLaws:** ThePressCouncilActs,FunctionsofPresscommission,C o pyri ght Act1957, OfficialSecretsAct1923, RighttoInformation Act2005,66AofITAct, PressRegistrationofBooks Act.1867.Cable TelevisionActandRules, Cinematography Act, Cyber Laws etc.	08
Unit 4	**OfficialSecrets:** Officialsecrets– sedition–DrugsandMagicRemedies (Objectionable) Advertisements Act, 1954, obscenity, copyright, monopolies and restrictive trade practices, Press Council, ombudsman, right to information, right to reply, codes of ethics, confidentiality of sourcesofinformation.	08
Unit 5	**Press Commission:** Formation and Recommendations; Mc Bride Commission;Press Council of India (Working, Composition and Powers); Press Committees: Sengupta Committee, Verghese Committee, Joshi Committee, Chanda Committee; PrasarBharati Act: Constitution of PrasarBharti Board and its constitution.	06
Course Outcome:		
1	Students will gain knowledge of Laws and Ethics related to media.	
2	Ability to solve problems of competing values, both news values and social values, when making writing and publishing decisions.	
4	Ability to collect and analyze news, information and documents in a way that complies within law but also maintains the boundaries of press freedom and responsibility.	
Text Books:		
1	Rayudu, C. S. and NageshwarRao, S. B.(2014). *MassMedia Laws &Regulations HimalayaPublishing House.* Bombay:Himalaya PublishingHouse.	
2	Ravindran,R.K.(1997).*PressintheIndianConstitution.*NewDelhi*:*IndianPublishers Distributors.	
Reference Books:		
1	Thakurta,P.G.*MediaEthics-MakingandBreakingNews*.NewDelhi:OxfordUniversity	
2	Hakemuldar,J.R.,Jouge, F. A.C. D. and Singh, P. P. (1998)*Principles&Ethicsof Journalism*. New Delhi: AnmolPublications.	
3	RaminderKaur, William Mazzarella, Censorship in South Asia: Cultural Regulation from Sedition to Seduction	
4	Thakurta, ParanjoyGuha, Media Ethics, Oxford University Press, 2009	

JM20.205	Photo Journalism	3-1-0-4 Total Lectures: 39
Prerequisite:	Student should have interest in photography.	
Objective:	Impart basic concepts and importance of Photography. Prepare photo journalist. Encourage self employment. Encourage creative skills. Develop interest in photo journalism.	
Unit 1	**Introduction to Photography:** IntroductiontoPhotography,BriefHistory of photography, what is photography. The role & importance of photography.PrinciplesofPhotographic composition. Various typesof photography:Portrait, Wildlife,Nature,Photo Journalism,Advertising and Night Photography.	08
Unit 2	**Camera:** BasicPartsoffilm&digitalcamera:- Lens,Aperture,Shutter, View finder, Memory. Cameraformats. Photographiclenses–prime &zoomlens, angleofview.Aperture,Depthof focus,Depth ofFieldandhowthey work.Lensperspective,filmspeed,flashgun,lightmeter, Exposure Control – relationship between shutter speed and aperture.	08
Unit 3	**LightforCamera:** PrinciplesofLight,Variousequipment'soflighting, Sourcesof light: Natural & artificial, different types of lighting used in videography. Nature and physical properties of light direction and angle of light: front, side and back. Lightingcontrastanditscontrolbyfillin lights:One, two& three point lighting. Key, fill and back light, use of filter and reflectors.	08
Unit 4	**Editing:** Photograph Editing Techniques -Cropping, Enlarging & reducing Clubbing/Grouping, Colour composition, Filter, length, focus, Shots	08
Unit 5	**Branches of Photography:** Needand importance. Advertising photography, Modeling & portfolio, Wildlife Photography, Photography and Ethics.	07
Course Outcome:		
1	Student would learn the concepts and importance of photography.	
2	Learner would be able to understand photo coverage and photo Journalism .	
3	Student would be to ready to join any media organization as photo Journalist.	
4	To understand the importance of photo features.	
5	student would know the different branches of photography and may be self-employed.	
Text Books:		
1	Sharma,O.P.*PracticalPhotography*.(2003).NewDelhi:HindPocketBook	
2	Langford,M.(2000).*Basic Photography*.New Delhi:FocalPres	
Reference Books:		
1	Folts,J.A. and Lovell, R. P.*HandbookofPhotography*.	
2	Practical Photography Digital Camera School : The Step-by-step Guide to Taking Great Picture- By Publisher Carlton Books Ltd. (London)	

JM20.207	Practical Photography	0-0-4-2 Total Lectures: 26
Prerequisite:	Student should have basic understanding of photography.	
Objective:	Learn the handling of Digital SLR Camera. To understand the composition and Shoot in different lighting conditions. Demonstrate the skill to make a photo feature on a specific topic. Develop creative skills. Understand photography and develop interest in photo journalism.	
Unit 1	Digital portfolio with print, photoshop & photo editing.	06
Unit 2	Nature photography, natural light and shadow	06
Unit 3	Candid photography	04
Unit 4	Product photography	06
Unit 5	Architecture photography.	04
Course Outcome:		
1	At the end of this subject the students will be able to understand the basics and techniques of Camera operation, and photography.	
2	They will also be able to understand the usefulness of photo journalism in the various platforms of media and communication.	
3	Students will be able to work as free-lance photojournalist.	
4	Students would be able to peruse their hobby and do some out of box photography.	
Assignment:		
1	Outdoor Shoot: Using Digital SLR and Mobile camera/developing an idea and practice.	
2	Making a Photo feature on a specific topic by using self-clicked photographs from Digital Camera.	
3	Studio Photo Shoot: Shooting exercise in artificial lights.	
4	Effective ways of taking pictures of different types. Landscape, Portraits and Photo Feature: Selection and framing the Subject, Landscape (scenic, people, birds/animals, monuments), Portraits, Silhouette, Freezing movement, Montage.	

JM20.209	Introduction to Broadcast Media	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have interest in electronic media or TV.	
Objective:	To learn how is radio different from other media. To teach and demonstrate the ability to effectively apply oral presentation techniques in various communication settings Apply the principles of intrapersonal communication in collaborative production work.	
Unit 1	**Visual Language:** Perception; Composition; Classification of Shots; Video Camera: Parts of a Video Camera; Working of a Video Camera.	06
Unit 2	**Visual:** Characteristics of Television as a Medium, Still Image, Television image, Digital image, Edited image, Changing ecology of images today, Visual perspective, Visual grammar, Camera movement, Types of shots, Concept of continuity, Imaginary line.	08
Unit 3	**Camera:** Structure of camera, Single & 3 CCD, Camera Basics; Viewfinder, Camera Lens systems and control, White balance, Handling the Camera; Contrast ratio, aspect ratio, Exposure and Zebra, Shutter Speed, Focus; Selective Focus, Follow Focus, Rack Focus, Depth-of-field. Camera Features and their Effects: Optical Zoom, Digital Zoom, Neutral Density Filter, Image Distortion, Shooting Frame Rate.	10
Unit 4	**Production Format:** Single camera shoot, Multi camera shoot, Elements of a TV news story; Gathering, Writing, Reporting, Elements of a TV news bulletins, Basics of editing; Basic software and its techniques, Basics of Recording and editing sounds.	06
Unit 5	**Role of Radio & TV in social change, education & entertainment;** T.V Channel Structure and Working,Functioning of a TV Studio, Packaging Design and Capsule. Video production team, Role of producer, director; cameraman, floor manager, editor etc., Radio Production team.Production Process: Pre-Production, Production and Post Production.	09
Course Outcome:		
1	Students will be sensitized about the development of concepts for documentaries and television programs, scripting, directing, camera handling, programming and editing.	
2	Students will understand the basic concepts and terminology specific to the media of radio and television.	
4	Students will have practical knowledge to conduct research in radio and TV communication.	
Text Books:		
1	P.C. Chatterjee, Broadcasting in India, New Delhi, Sage Publication.	
2	Martin Conboy, Broadcast Technology and Journalism, Sage Publication	
Reference Books:		
1	Robert c Allen and Annette Hill (Ed- 2004), The Television Reader, Routledge (Pgenos: 10- 40)	
2	Zettl Herbert, Television Production Handbook. (Pgenos: 20-80, 85-135)	
3	The Radio Handbook, by Carrol Fleming, Rout ledge (London & New York 2002) (Pgenos: 47- 105)	
4	Jane Chapman, Marie Kinsey, Broadcast Journolism-A critical Introduction, Routledge, 2009	

JM20.211	Film Appreciation	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have interest in cinema.	
Objective:	To learn how to read and analyze film as you would a novel, a poem or a short story. To familiarize the students with certain theoretical ideas presented by major film theorists. To explore the major aesthetic trends in the history of cinema.	
Unit 1	**Language of Cinema I:**Focus on Visual Language, Shot scene, Deep focus, Continuity editing, Montage, Watching films and understanding the concept practically.	08
Unit 2	**Language of Cinema II:** Focus on sound and color, Diegetic and Non Diegetic sound, Off scree sound, sync sound, use of color as a stylistic element, Difference between story plot, screenplay, watching relevant film.	08
Unit 3	**Alternative Vision:** Third cinema and non-fiction cinema, Introduction to Feminist film theory, special focus on Satyajit Ray and Guru Dutt, watching relevant film.	08
Unit 4	**Globalization:** Globalization and Indian Cinema, The multiplex era, Film culture, watching relevant film.	06
Unit 5	**Hindi Cinema:** Early Cinema and the Studio Era; 1950s - Cinema and the Nation (Guru Dutt, Raj Kapoor, Mehboob); The Indian New- Wave; Globalisation and Indian Cinema; Film Culture.	09
Course Outcome:		
1	Students will be able to recognize formal elements; they acquire and apply tools (terminology, methods) to carry out rigorous formal analysis of film.	
2	Students will understand how film has changed over time as an aesthetic form, as an industry, and as a social institution.	
3	IT will construct focused knowledge in one area and reflect on its relation to Film Studies as a field ofinterdisciplinary inquiries about cinema.	
Text Books/ Recommended Screening:		
1	Germany Year Zero directed by Roberto Rosselini (Italian Neo Realism) Metropolis by Fritz Lang/Double Indemnity by Billy Wilder (German Expressionism and Film Noir).	
2	Rear Window by Alfred Hitchcock (Language of Cinema). PatherPanchaliby Satyajit Ray. The hour of the Furnaces by Fernando Solanas Nishantby ShyamBenegal/Aakrosh by GovindNihalani (Indian New wave). Pyaasaby Guru Dutt.	
Screening/Reference Book:		
1	Andre Bazin, “The Ontology of the Photographic Image” from his book What is Cinema Vol.I	
2	Battelship, Potempkinby Sergei Eisenstin (Language of Cinema)	
3	Man with a Movie Camera by Dziga Vertov/ Germany Year Zero directed by oberto Rosselini	
4	Berekeley, Los Angeles and London: University of California Press: 1967, 9-16	

JM20.213	Media Management	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have basic interest to understand the media & the world.	
Objective:	To learn the process of infusing management theories and principles in media business. To understand the managerial work involved in the ever-growing media industry and to initiate team spirit, development for creative work among students. To learn about media economics, strategic management and marketing.	
Unit 1	**Media Management: An Introduction:-**Media as an industry and profession Journalists becoming managers, Ownership patterns of mass media: Print and Broadcast Media, Organizational structure: Different Departments, General Management, Control and co-ordination, Hierarchy.	08
Unit 2	**Contemporary Practices in Media Management:-** Media ventures: Growth of Indian Print Media Business, Growth of Indian TV Industry, Resurgence of Radio Industry, The Indian Film Industry-Problems, process and prospects of Indian Media Business Media Industry: Changing commercial equations vis-à-vis market and audience	08
Unit 3	**Media and Globalization:-**Foreign equity in Indian media, The concept of global media, Global Media Giants and their selected holdings, Globalization of media and its impact.	06
Unit 4	**Media & Digitization**: - Rise of Social & digital media, its impact on society & traditional media. Management of social media, Opinion formulation, setting market trends etc.	08
Unit 5	**Media Economics, Stratagies, Management and Marketing :** Understanding Media Economics- Economic thought; Theoretical foundations, issue and concerns of media economics; Capital inflow, Budgeting, Financial management, and personnel Management, Strategic Management, Market forces.	09
Course Outcome:		
1	After the completion of this course the students will be able to understand the management matrix applied in media industry.	
2	To understand the trends, strength and revenue resources and its administrations.	
3	Students will be conversant about the structure of news media organizations.	
Text Books:		
1	Rayadu CS, Media and Communication Management, Himalaya Publishing House	
2	George Rodmann. *Mass Media in a Changing World*; Mcgraw Hill Publication,2007.	
Reference Books:		
1	Richard Keeble. *The Newspaper's Handbook*; Routledge Publication,2006.	
2	Rucker & Williams, Newspaper Organization and Management, Books On Demand Sindhwani, Newspaper Economics and Management, Ankur Publishing House	
3	Mocavati& Pringle, Electronic media Management, Focal Press	
4	Bruce D. Itule and Douglas A. Anderson. *News writing and reporting for today's media;* McGraw Hill Publication, 2000.	

JM20.215	Multimedia Journalism	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have basic knowledge of internet media.	
Objective:	Explain the uses of cyber media for journalistic purpose. Understand the applications of the uses of online tools for communication. To train the students about design aesthetics for web news production.	
Unit 1	**Web Journalism:** Definition, origin, development and contemporary relevance; differences from traditional journalistic practices Audiences of Web Journalism, web broadcasting, search engine optimization.	08
Unit 2	**Writing for the Web:** Online editions of newspapers, Online reporting-tools for newsgathering, principles, limitations and new trends; Editing of web content; Management and economics of online editions; online advertisements and their types.	10
Unit 3	**Promotional writing for the Web:** Sales latter, create funnel through writing. Direct or indirect promotion of products or issues. Awareness drive among masses.	06
Unit 4	**Characteristics of the Web:** Interactivity, sociability, multimedia content, autonomy, playfulness, privacy, personalization, digitization and convergence Themes and issues in Web Journalism: Security issues on the Internet- social, political, legal and ethical issues related IT and CT.	07
Unit 5	**Design aesthetics:** Graphic design- meaning, nature- art/ craft, Design elements Design Process, Principles, stages of designing, typography, layout, design identity.	08
Course Outcome:		
1	The students will understand the difference between traditional journalistic practices and web news production.	
2	The students will be able to create effective stories for online media.	
3	The students will become proficient editing and managing the web content.	
Text Books:		
1	Ambrose, G., & Harris, P. (2009). Basics design 08: design thinking (Vol. 8). Ava Publishing.	
2	Samara, Timothy. (2008). Publication Design Workbook: A Real-World Design Guide. Delhi: Orient Longman.	
Reference Books:		
1	Wood, Allan. (2010). The Graphic Designer's Digital Toolkit, London: Focal Press.	
2	Ambrose, G., & Harris, P. (2006). The visual dictionary of graphic design. AVA Publishing.	

Spring Semester

JM20.202	**Introduction to TV Journalism & Production**	**3-1-0-4** **Total Lectures: 39**
Prerequisite:	Student should have interest in TV news and its making.	
Objective:	To learn the basics of TV reporting writing and getting the visuals. To understand the basics of TV programme packaging and production. To demonstrate the ability to effectively apply the synchronization of audio visual medium. Apply the principles of intrapersonal communication in collaborative production work.	
Unit 1	**Reporting forTV:**NatureandLanguageofTV, TVNewsscriptformat, FundamentalsofTVreporting:Reporting skills,EthicsforTVreportingand sting operations. Writing andReporting forTV:Finding thestory and developing thesources, gathering the facts (getting right visuals, facts and figures)	08
Unit 2	**Packaging forTV:**TypesofTVPrograms,ConceptofBreaking News, ScriptingforFiction/NonFictionFormats. TalkShow,Paneldiscussion, Recorded Programs.Interview– typesofnews interview, artofconductinga good interview, Packaging, Anchoring.	08
Unit 3	**TVProgramme Production:** Stagesofproduction- pre-production, productionandpost-production.Theproductionpersonnel,Singlecamera andMulticameraproduction, use of graphics and special effects, basics of editing.	08
Unit 4	**TVProgrammeEditing:** Typesofediting- linearandnonlinearediting, onlineandofflineediting.Editing ondifferentsoftware.Processof visualization andits importance. Visual grammar and language.	08
Unit 5	**TVProgramme Packaging:**Format Of packaging- fiction, non- fiction. Ingredients of news packaging- graphics, Aston, ambience, music, voice over, sound and visual correction.	07
Course Outcome:		
1	Students will be sensitized about the development of concepts for documentaries and television programs, scripting, directing, camera handling, programming and editing.	
2	Students will understand the basic concepts and terminology specific to the media of television.	
4	Students will have practical knowledge of TV production.	
5	Students will demonstrate the skill of producing fiction and non-fiction programmes.	
6	Students will understand the impact of audio visual media on masses.	
Text Books:		
1	Bhat,S.C.(1993).*BroadcastJournalism:BasicPrinciples*.Delhi:HaranandPublications.	
2	Zettl, H.(2011).*Handbook ofTelevisionProduction*. Cengage Learning.	
Reference Books:		
1	De Fleur, M.(1982). *TheoriesofMass Communication*. New York:David McKay.	
2	Jan, R. H., RayA.CdeJonge andSingh,P.P. *BroadcastJournalism*.New Delhi: Anmol Publication.	
3	Donald, R.andSpann,T. (2000). *Fundamentals ofTelevision Production*. New Delhi: SurjeetPublication.	
4	Burrows,T.D. andGross,L. S. *Video Production*. New York: McGrawHill.	

JM20.204	Advanced Broadcast Media	3-1-0-4 Total Lectures: 39
Prerequisite:	Student must have basic understanding of TV production.	
Objective:	To learn the basics of broadcasting technology and its evolution. To understand the basics of TV transmission technology. To demonstrate the appropriate use of lighting in shooting. To understand the advance level of TV programme packaging and production. To demonstrate the skill of post-production.	
Unit 1	**Video and Broadcast Technology:**Analogue and Digital technology, Frame and field, Scanning process, Interlaced and progressive scanning, composite video signal, component video signal, Resolution, Aspect ratio, CCU, color bars, Vector scope, Waveform monitor, broadcast monitor, broadcast standards – NTSC, PAL, SECM, HDTV, Telecine.	08
Unit 2	**Transmission Technologies:** Terrestrial transmission, Satellite and cable broadcasting, up linking and downlinking, conditional access system, DTH, IPTV.	06
Unit 3	**Introduction to Lighting:** Why do we need light, mandatory light, creative light, characteristics of light, quality, quantity, colour temperature, three point lighting, natural lighting, sunlight and the realities, cyclorama, soft and hard light sources.	08
Unit 4	**Production:** Production personnel and their role and responsibilities in Radio and TV. Motion picture production. Three phases preparation of budget for various types of radio and TV programme, preparation of script breakdown, artiste, location/ setting, preparation of shooting schedule.	10
Unit 5	**Post Production:**Linear and non-linear editing, matching tone, cut in, cut away, jump out, compression and expression of time, cross cutting, circular and non- linear cutting, axial cut.	07
Course Outcome:		
1	Students will be sensitized about the development of broadcast technology.	
2	Students will understand the basic TV transmission technology.	
4	Students will have proper skill of lighting.	
5	Students will demonstrate the skill of producing fiction and non-fiction programmes.	
6	Students will create their own audio visual programme.	
Text Books:		
1	Television Production Handbook, Herbert Zettl, Akash Press 2007, Delhi	
2	Radio in New Avatar- AM to FM, Ambrish Saxena, Kanishka Publication, New Delhi	
Reference Books:		
1	Glen Creeber, Toby Miller and John Tulloch, The Television Genre Book (London: British Film Institute, 2009)	
2	Robert B Musburger and Gorham Kindmen, Introduction to Media Production, (Elsevier, Focal Press)	
3	Mc Leash, Robert, Radio Production (US: Taylor & Francis)	
4	Facilitating Community Radio in India:- Profiles of NGO's and their Community Radio Initiatives Other Voices. F. Vinod Pavarala, Kanchan K Malik, Sage 2007, New Delhi	

JM20.206	Practical: Advanced Broadcast Media	0-0-4-2 Total Lectures: 26
Prerequisite:	Student must have interest in production of TV program.	
Objective:	To create own script from any scratch idea. Student will be able to prepare script on their own idea. Student will understand the skill of production. Student will be able to create their own programme.	
Unit 1	**Pre - Production:**TV News Bulletin, Developing Run Down Sheet. Preparing a Package – Script writing, Chroma set up, Lighting setup and editing setup.	06
Unit 2	Script Design, Script formatting, Shooting script, script elements, writing dialogues, point of view, use of sound in script, screenplay and storyboard.	06
Unit 3	**Production Phase:** Preparing Talk show, Talk show formats, techniques of talk show, content development for talk show, camera set up, multi camera set up, Framing, Movement, lighting set up and editing.	04
Unit 4	**Assignment**:- Students will be given at least one script and one practical exercise to be performed.	06
Unit 5	**Assignment**:- Students will be given to host one talk show in single camera and multi camera set up.	04
Course Outcome:		
1	Students will learn the formation of idea in creative form.	
2	Student will demonstrate the writing skill.	
4	Student will create their own audio visual programme.	
Assignment:		
1	Prepare on feature story along with anchor link.	
2	Prepare a 10 minute news capsule.	
3	Prepare a special story on any interest area like – lighting, editing, camera, sound, gfx	

JM20.208	Development Communication	4-1-0-5 Total Lectures: 52
Prerequisite:	Student should have interest in development of any country.	
Objective:	To understand role and use of media in development communication To understand various aspects of society, its place in the world, its major development issues and how communication can help to bridge the gap. To highlight the linkages between development and communication.	
Unit 1	**Concept of Growth & Development:**Measurement of development- PQLI and HDI, UN millennium development goal. Models:- Participatory Model, Mechanistic Model, Nehruvian Model, Gandhian Model of development. Basic minimum needs and priority areas in Development.	12
Unit 2	**Indicators and approaches of development:** Economic & Social Indicators of Development: living standard, GDP, HRD index etc, Social and Economic Barriers to Development Communication: literacy, Living standard, Traditions etc, Communication as an Indicator of Development, Approaches of Development Communication, development policy and development planning.	12
Unit 3	**Development Communication:** Concept and approaches, sustainable development, participatory development and inclusive development. Development support communication; definition, genesis, Wood's Triangle.	10
Unit 4	**Role of Media:** Role of Print, TV, Radio and traditional media in development, Role of developmental agencies and NGO's. Cyber media and e-governance, e-choupal, national knowledge network and NitiAayog.	10
Unit 5	**Development Journalism & Rural Reporting:** Information needs in rural areas, use of traditional media for development in rural areas, community newspaper and radio. Critical appraisal of mainstream media's reportage on rural problem and issues, Panchayati Raj in India. Relevance of Traditional Media in Development Communication.	08
Course Outcome:		
1	The students will be able to engage in learning and understanding the need to keep abreast of socio-economic developments.	
2	They will understand the development scenario and role of communication in the development process.	
3	Students will be able to distinguish between communication and development communication.	
4	Students will be able to describe use of different media in development communication.	
Text Books:		
1	Dr. Anil Kumar : Mass Media and Development Issues, BhartiPrakashanUpadhyay Varanasi, 2007.	
2	SrinivasR.Melkote& H. Leslie Steeves: Communication For Development In The Third World, Sage Publications.	
Reference Books:		
1	UNDP: Human Development Report (published every year), Oxford University Press, New Delhi.	
2	AmartyaSen : Development as freedom, Alfred A Knopf, New York.	
3	Wilbur Schramm : Mass Media and National Development- the role of information in developing countries, UNESCO/ Stanford University Press, 1964.	
4	Yojna&Kurukshetra Magazine (Monthly published by NitiAayog, New Delhi)	

JM20.210	Documentary Production	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have understanding of writing & production	
Objective:	To make the students understand ethical issues related to documentary production. To make the students understand types of documentary fiction. To train the students to produce, direct, film and edit documentary productions.	
Unit 1	**Understanding the Documentary:**Six modes of Documentary Representation- Participatory, Expository, Observational, Performative, Reflexive and Poetic. Introduction to shooting styles. Introduction to Editing styles, structure and scripting the documentary.	08
Unit 2	**Pre Production:** Documentary production, pre-production, researching the documentary- library, archives, locations, life stories, ethnography. Writing a concept-telling a story, treatment, writing a proposal and budgeting.	08
Unit 3	**Production Phase:** Planning and managing crew, lighting- natural and artificial, understanding use of microphones, sound recording, voice over. Shooting schedule- shot breakdown and call list, production team, meetings, checklist, crowd management.	08
Unit 4	**Post Production:** Grammar of editing, rough cut, transitions, scenic realism and sound effect and visual effect, finalizing the film, graphic and title, distribution and exhibition spaces (Traditional and online)	08
Unit 5	**Packaging:** Programme packaging, graphics, audio mixing and leveling, montage, aston. Essential steps before Final packaging of programmes.	07
Course Outcome:		
1	Students will critically evaluate documentary forms and production techniques.	
2	Students will be able to effectively research and write documentary proposals.	
3	It will enable the students to reflect upon and analyse the documentary form.	
Text Books:		
1	Charles Musser " Documentary" in Geoffrey Nowell Smith, the oxford of world cinema, oxford university prees, 1996	
2	Trisha Das, How to write a Documentary. Double take by PSBT	
Reference Books:		
1	Hampe, Barry. Making Documentary Films and Videos: A Practical Guide to Planning, Filming, and Editing Documentaries. Henry Holt: 2007	
2	Betsy A. McLane.A New History of Documentary Film: Second Edition. Bloomsbury.2012.	
Screening		
1	Films by PSBT	
2	City of Photos by Nishth Jain	
3	Bombay our city by Anand Patardhan	
4	Web series	

JM20.212	International Communication	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have understanding of basic international scenario.	
Objective:	To create understanding of the world in context of flow of information. To create understanding of the world politics and economics. To impart knowledge of writing on global issues. To inculcate the knowledge of international important developments. To develop the knowledge of India's foreign policy.	
Unit 1	**International Communication System:**International news systems, International news flow. Political, economic and cultural dimensions of international communications. Communication and information as a tool of equality and exploitation. UN universal declaration of Human Rights and communications.	08
Unit 2	**News Flow:** Impact of new communication technology on news flow. UNESCO's efforts in removal imbalance in news flow. Debate on new international information and economic order. MacBride Commission's Report-nonaligned news agencies news pool-its working, success, failure.	08
Unit 3	**International Relations:** Indo-US, Indo-Russia, Indo-China, Indo-Pak relations, India & the United Nations, Global security issues, environment and food security challenge.	08
Unit 4	**Scenario of International Communication:** Democratization of information flow and media systems- professional standards. Transnational media ownership and issues of sovereignty and security. Role of international institutions in foreign affairs such as UN. IMF, World Bank, WTO etc.	08
Unit 5	**Challenges of International Communication:** Satellite Invasion, Information war, Technological Aggression. India's Media Response to International affairs Coverage of Events, Developments. Editorial by National Dailies, Magazines and Journals and Electronic Medium Non-English Media's Understanding of International Issues and Challenges (Reference, Hindi and Other Prominent Regional Languages, Newspaper)	07
Course Outcome:		
1	Students will be able to have understanding of the world in context of flow of information.	
2	Students will be having the understanding of the world politics and economics.	
3	Students would have the knowledge of writing on global issues.	
4	Students would have the knowledge of international developments.	
5	Students will know about India's foreign policy.	
Text Books:		
1	The Communication Revolution. Menon, Narayana, National Book Trust.	
2	Handbook of International Communication. William B. Gudykunst Bella Mody, Sage Publication, New Delhi.	
Reference Books:		
1	Many Voices One World; Report of the McBride Commission.	
2	Twilight of the Bombs; Recent Challenges, New Dangers and the Prospects for a world without nuclear weapons, Richard Rhodes.	
3	Global Communications and International Relations. Federick, Howard H. Wadsworth Publications.	

JM20.214	Corporate Communication	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have understanding of different media skills.	
Objective:	Define corporate and Corporate Communication. Describe shift from PR to Corporate Communication. Utilize knowledge gained for Corporate Branding.	
Unit 1	**Understanding Corporate Environment:** Contemporary Corporate Environment: an overview. Forms of Corporate Constituencies. Brand Identity, Brand Image and Brand Reputation. Corporate Philanthropy and Social Responsibility.	10
Unit 2	**Introduction to Corporate Communication:** Corporate Communication: Definition, Concept And Scope. Shift from PR to Corporate Communication. Structure and forms of Corporate Communication: Management, Marketing, Organizational. Corporate Communication as Branding strategy: Monolithic, Endorsed, Branded	08
Unit 3	**Corporate Communication in Practice:** Developing a Communication Strategy. Perspectives on Organizing Communication: Vertical, Horizontal and Lateral. Corporate Identity Audit: Concept And Steps. Corporate Advertising: Concept and Functions.	08
Unit 4	**Application of Corporate Communication:** Media Relations: Tools and Techniques, Media Monitoring and Research (Gate keeping research and output analysis). Internal & External Communication: Concept and Tools. Guidelines and Ethics for Corporate Communication. Crisis Management: Concept and Case Studies (Infosys Crisis and Nestle Maggie).	08
Unit 5	**Press release for Corporate Communication:** Media promotion and press release. Promote brand value, media visibility, spread the awareness with social cause, understand market and user.	05
Course Outcome:		
1	Student will be able to understand the corporate communication and its uses.	
2	Student will be able to differentiate PR to corporate communication.	
3	Student can use the different PR tool for promotion and branding.	
4	Students will be able to write Press release for brand promotion and learn how to place it in media.	
Text Books:		
1	Argenti, P. A. (2009). Strategic Corporate Communication: A Global Approach for doing Business in the New India. New York: McGraw-Hill.	
2	Cornelissen, J. (2008). Corporate Communication: A guide to Theory and Practice. Los Angeles: Sage Publications.	
Reference Books:		
1	Jethwaney, J. (2010). Corporate Communication: Principles and Practice. Oxford: Oxford University Press. 4. Oliver, S. (2004).	
2	A Handbook of Corporate Communication and Public Relations: Pure and Applied. London: Routledge.	

Third Year
Autums Semester

JM20.301	**Radio Journalism**	**3-0-0-3** **Total Lectures: 39**
Prerequisite:	Student must have the knowledge of writing and understanding of audio.	
Objective:	To develop knowledge and understanding of Techniques of Radio. To develop the skill of news and programme writing. To develop the practical skills of Presentation & production in Radio. To understand the importance of voice modulation in Radio Jockeying.	
Unit 1	**Radio:**Asamedium ofmasscommunication in today'scontext, Characteristicsofradio,Limitationsofradio, ThreeModesoftransmission: AM, SW and FM. Commercial, community and educational radio.	08
Unit 2	**RadioWriting:**Writing fortheEar;Introduction,Characteristicsofspoken word, Knowing youraudience,Developing your style,Writing fordifferent formats and messages.	08
Unit 3	**Radio Formats:** Why formats,Simpleannouncements,Radio talks/commentaries/comments, interviews,paneldiscussions.Radio ads/commercials. Music onradio, fictionPhoneinprogrammes, RadioNews-Radio News defined, Main characteristicsofRadio News asagainst news inothermedia, Non-fiction Phone-in Programs.	06
Unit 4	**RadioProduction:** Introduction,Elementsofradioproductions- Acoustics, Perspective,Sound effects,Music.Distort/Filter.Different typesof microphones, RecordingandEditing.	08
Unit 5	**Radio jockeying essentials:** Importance of Voice modulation and quality of voice in Radio presentation; Importance of Tone, Base, Breathing and resonance in Radio Presentation; On air essentials of Radio presentation; Importance of exercise and improvement of voice in Radio presentations.	09
Course Outcome:		
1	At the end of this subject the students will be able to identify the various nuances of Radio jockeying.	
2	Students will be able to prepare script for programs and news.	
3	They will also be able to develop the practical skills of a Presenter and will make them Industry ready.	
4	Students will be conversant with different formats of Anchoring and Radio Jockeying.	
Text Books:		
1	Radio in New Avatar- AM to FM, Ambrish Saxena, Kanishka Publication, New Delhi	
2	Luthra, H.R. (1986).*IndianBroadcasting*. New Delhi: Publication Division.	
Reference Books:		
1	Alburger,J. R.*The ArtofVoiceActing*. New Delhi: FocalPress	
2	Liesh, R. M.(2005).*Radio Production*. New Delhi: FocalPress.	
3	ParthasarthyRangaswami, Here is The News Reporting for The Media, Sterling Publishers, private Limited.	
4	Kalraricha, ABC of News Anchoring, Pearson Educations	

JM20.303	Public Relation & Advertising	3-0-0-3 Total Lectures: 39
Prerequisite:	Students must have all the media writing skill and know about the working of mass media and interest in public relation.	
Objective:	To understand the reach and impact of Advertising as a tool of mass communication. To understand current developments and problems concerning advertising, organization and structure of advertising agencies and various bodies associated with it. To deal with theory and practice of Public Relations and Corporate Communication, essential and crucial for building an image of any corporate entity To communicate effectively with audiences, and prepare public relations and marketing communication strategies in an appropriate style.	
Unit 1	**BasicsofPR:**ConceptsandDefinitions,Persuasion andPublicOpinion, Employeecommunication,PRasdistinguishedfrom Marketing,Sales Promotion andAdvertisingandPRTechniques.	08
Unit 2	**RoleofPR:**Relationship anddutiesof thePRPractitioner.FunctionsofPR Department.ExhibitionPRanditsPlanning,UsesandkindsofExhibition PR.PR inDeveloping Countries,PR forNGOs,PR forGovt.organizations and communications.	08
Unit 3	**Writing For PR:** PressRelationand itsprinciples, TheNewsRelease-Seven pointformula& itsimportance, Writing techniques,PressEventsand organizingthem.	08
Unit 4	**Digital advertising &PR:** online writing & content for PR campaign, online copy designing for social media or online media advertisings.	08
Unit 5	**Advertising** definition, historical development, social and economic benefitsofadvertising, massmediaand advertising.Copy writing and advertisingproductiontechniques,print,radio,television,films, outdoor, ideation,visualization.Creativity,mediaselection, n e w s p a p e r s ,magazines, radio, television, outdoor, strategy, planning, media budget, campaign planning, adverting agencies and their functions.	07

Course Outcome:	
1	At the end of this subject the students will be able to understand basics of Public Relations and their role in organizations/corporations.
2	They will also be able to develop corporate communication strategies, understand corporate identity, vision and values, and how to enable organizations to achieve marketing and corporate objectives.
3	Students will be able to understand advertising and its role in Sale promotion, Social outreach and Cultural bonding. The impact of different forms of advertising in global scenario.
4	They will also be able to evaluate and recognize artistic creativity, body copy writing and technical aspects and how a campaign is made keeping in view varied objectives and audiences.
Text Books:	
1	Roy, S.K. *Corporate image ofIndia.*
2	Seital, F. P.(2016).*ThePracticeofPublic Relations.*New Delhi:Pearson Education.
Reference Books:	
1	ScottM.C.,Genter,A.H.andBroom,G.M.().*EffectivePublicRelations*.NewJersey:Pearson Education.
2	Broom,G.M. andDozier,D. M. (1990).*Using research in Public Relations.*NewDelhi:Prentice-Hall.
3	McDonough William, Cradle to Cradle: Remaking the Way We Make Things. North Point Press.
4	Anderson Ray, Mid-Course Correction: Toward a Sustainable Enterprise: The Interface Model. Chelsea Green Publishing Company.

RM 20.301	Research Methodology	2-0-0-2 Total Lectures: 26
Prerequisite:		
Objective:	To acquire fundamental knowledge of research methodology and apply in sciences and applied sciences.	
Unit 1	Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
Unit 2	Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
Unit 3	Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
Unit 4	Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation -Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
Unit 5	Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome:	
1	Get basic idea about research and its major components.
2	Understand how to plan research/ write hypothesis.
3	Get to know the how to collect data.
4	Understand how to develop and apply the tools and techniques in research.
5	The students will be able to apply the knowledge of research methodology in sciences, arts and applied sciences to solve curriculum problems.
6	Will be able to write research paper/dissertation in correct format.
Text Books:	
1	Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2	Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
Reference Books:	
1	Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
2	Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
3	Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
4	Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India.
5	Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

JM20.305	Summer Term Project	0-0-0-5
Prerequisite:	Student must complete the industrial training or internship after 4th semester during summer vacation.	
Objective:	Student will be able to get the hand on experience in their respective field. Student will be able to understand the work culture and pattern of industry. To make them ready for media industry with desired skills. .	
Unit 1	Submit the detailed report of their internship.	
Unit 2	Prepare portfolio according to their respective industry.	
Unit 3	Submit the copy of assignments during internship.	
Unit 4	Prepare one specific portfolio as per the industry.	
Unit 5	Viva	
Course Outcome:		
1	Students will learn the nuances of media industry.	
2	Student will equip will all the skill which is required for industry.	
3	Project report will enhance their portfolio for better job opportunity.	

JM20.307	Media, Gender & Human Rights	5-1-0-6 Total Lectures: 65
Prerequisite:	Student should have interest in human right issues and relation of media and society.	
Objective:	To understand the media impact on society. To understand the relationship of media and gender and its sensitivity. To critically analyze the role of media in different social structure. To understand the different institution of human right and its role.	
Unit 1	**Media and the Social World:**Media impact on individual and society. Democratic polity and mass media, media and cultural change, grass root media.	12
Unit 2	**Gender:** Conceptual frameworks in Gender studies, Feminist Theory. History of Media and Gender debates in India (case studies), Media and Gender – Theoretical concerns. Media and Masculinity.	12
Unit 3	**Media – Power and Contestation:** Public sphere and its critique. Media and Social difference: class, gender, race etc. Genres- Romance, Television, Soap opera, sports. (Case Studies – watch a Indian TV soap opera/reality show for a week and for representation of family)	16
Unit 4	**Media and Human Rights:** Human Rights: Theoretical perspective, Critique. Universal Declaration of Human Rights. Human rights and media. (Case Studies: Human right issues and violations in national & international media).	13
Unit 5	**Human Rights Institutions:** Amnesty International; NGOs;Major Human Rights Issues in India; Presentation: Human Rights issues and violations in International scenario and media operations.	12
Course Outcome:		
1	Student will analyze the society their need and use the media accordingly.	
2	Student will prepare gender sensitized story with more sensitivity.	
3	Student will form their views in the form of news as per the different social structure.	
4	Student can write the story related to human right with different aspects.	
Text Books:		
1	Ninan, Sevanti. *Headlines from the heartland: Reinventing the Hindi public sphere*. SAGE Publications Pvt. Limited, 2007.	
2	Curran, James. "Rethinking mass communication." *Cultural studies and communications. London: Arnold* (1996).	
Reference Books:		
1	Street, John. *Mass media, politics and democracy*. Palgrave Macmillan, 2011.	
2	McQuail, Denis. *Mass communication theory: An introduction*. Barcelona, 1991.	
3	Berger, Arthur Asa. *Media and society: A critical perspective*. Rowman& Littlefield.	
4	Mackay, Hugh, and Tim O'Sullivan, eds. *The media reader: continuity and transformation*. SAGE Publications Limited, 1999. 13-28, 43-73, 287-305.	

JM20.309	Practical: Radio Programme Production	0-0-6-3 Total Lectures: 39
Prerequisite:	Student must have the knowledge of radio.	
Objective:	To teach students about Radio, its functioning and the industry associated with it. To understand concept, reach, presentation and impact of audio media. To develop in the student the skills, techniques and art of radio news through sound and the spoken word.	
Unit 1	**Exercises and Assignment:** Use different types of microphones for radio/audio productions. Recording and editing exercise in the studio.	08
Unit 2	Writing exercises. Research and scripting of radio documentary/ feature/ drama.	08
Unit 3	Interviews – simulated and actuality.	08
Unit 4	Production of radio discussion. Production of social messages.	08
Unit 5	Preparation of audience profile. End product.	07
Course Outcome:		
1	The students will be able to develop a practical knowledge of Radio and its backhand working.	
2	The students will also be able to work in the radio industry after having a clear view of various radio programme formats and writing for the same.	
3	The students will know the techniques of audio tape editing, especially for use in radio news.	
Assignment:		
1	Prepare a news capsule 10-15 min.	
2	Prepare any entertainment programme 10-15 min.	
Reference Books:		
1	McLeish, R. (2012). Radio Production. CRC Press.	
2	Stewart, P. (2010). Essential Radio Skills: How to Present a Radio Show. A&C Black.	
3	Fleming, C. (2009). The Radio Handbook. Rutledge.	
4	McInerney, V. (2001). Writing For Radio. Manchester University Press.	

JM20.311	Practical: PR & Advertising	0-0-6-3 Total Lectures: 39
Prerequisite:	Student must have understanding of PR and advertising activity.	
Objective:	To provide hand-on practice on various tools of Public Relations & advertising. To develop understanding on reach and impact of Public Relations towards creating brand identity. To demonstrate the reach and impact of Advertising as a tool of mass communication. To conversant the students with techniques of PR campaigns. To understand & create the techniques of social media and outdoor advertisements.	
Unit 1	Copy writing for different types of Advertising and PR tools.	08
Unit 2	Planning and designing of Advertisement & PR Campaign.	08
Unit 3	Development of Concept, Story Board, Body copy. Pre and post preparation of Press Releases and Press Conference Materials.	08
Unit 4	Jingle writing, colour combination, importance of visuals and product packaging in Advertising. CorelDraw: Designing of Logos, pamphlets, brochures, house journals and other publicity materials. Hands-on practice on designing Advertisement.	08
Unit 5	Social Media advertising campaign. Placement of advertisement in outdoors and its technicalities. Cross Cultural and International Advertising & PR copy. Social Media PR campaign.	07
Course Outcome:		
1	The student will be ready to work in advertisement & PR agencies.	
2	They will also be able to evaluate and recognize artistic creativity, body copy writing and technical aspects of advertising & PR.	
3	The student will learn how to launch an advertisement campaign keeping in view varied objectives and audiences.	
4	The student will be able to launch an PR campaign to get the desired result as per brand requirements.	
Assignment:		
1	Assignment on the usage of tools of Public Relations.	
2	PR campaign-planning, execution, evaluation.	
3	Presenting slides show on PR and Crisis Management.	
4	Publications – Developing Press Releases and detailed report for variety of events.	
5	Case Studies- Public and Private ventures.	

Spring Semester

JM20.302	**Cyber Journalism / New Media**	**3-0-0-3** **Total Lectures: 39**
Prerequisite:	Student should have all the skills of basic journalism and interest in cyber world.	
Objective:	Acquire an understanding of the historical context, current trends and future projections of digital communication methods. Develop an awareness of unintended consequences of new technology. To make the students conversant with Linear and Non Linear writing skills.	
Unit 1	**Cyber Space:**Meaning; Information Super Highway; Internet and InformationRevolution,Fundamentals of Cyber Media,Cyber MediaVs Print,TVand Radio.	08
Unit 2	**Cyber Journalism:**Advantages and Disadvantagesof CyberJournalism, Webadvertising,CirculationofWebNewspapers, FutureofWeb Journalism, Analysis of importantIndian News-Based Web-sites.	08
Unit 3	**Cyber Reporting:** Trends in CyberReporting&Editing, Impact of globalizationon WebJournalism, CyberLaws andConceptof e-governance.	08
Unit 4	**WebWriting:** Writing forWebMedia:BasicrulesDo'sandDon'ts, Writing Newsstories,FeaturesandArticleson theWeb,Interviewingon the Web, WhyPrintand Electronic Medianetworks are goingon the Net? Impact ofWebJournalismandRecentTrends.	08
Unit 5	**Digitization of Journalism:** Authorship and what it means in a digital age, Piracy, Copyright, Copyleft and Open Source, Digital archives, New Media and Ethics Linear and Non-linear writing, Contextualized Journalism, Multimedia, Storytelling structures.	07
Course Outcome:		
1	After the completion of this course the students will be able to understand and explain basic concepts and theory of New Media.	
2	They will be able to understand pros and cons and write/use new media for various communication messages and solutions.	
3	Students will develop understanding of Virtual cultures and digital journalism.	
Text Books:		
1	Bharihoke, D. (2009).*FundamentalsofInformationTechnology*.New Delhi:ExcelBooks	
2	D'souza, Y.K.*Electronic Media &the Internet*.	
Reference Books:		
1	Gleick,J.(2011).*TheInformation:AHistory,aTheory,aFlood.* NewYork:HarperCollins Publishers.	
2	Vincent Miller. Understanding digital culture. Sage Publications, 2011.	
3	Lev Manovich. 2001. "What is New Media?" In The Language of New Media. Cambridge: MIT Press. pp. 19-48.	
4	Siapera, Eugenia. Understanding new media. Sage, 2011. Introduction.	

JM20.304	Global Media & Politics	3-0-0-3 Total Lectures: 39
Prerequisite:	Student should have knowledge about world politics and role of media.	
Objective:	To create understanding of the world in historical and contemporary context. To create understanding of the world politics and economics. To inculcate the knowledge of international important developments. To develop the knowledge of India's foreign policy.	
Unit 1	**Media & International Communication:**Communication Debates: NWICO, McBride Commission, UNESCO, UN, NHRC & SAARC, ASEAN, BRICS. International Politics: Ideology and Balance of Power. National Interest and international Politics, Emergence of Super Powers.	09
Unit 2	**Media & Super Power Rivalry:** Unequal development and Third world concern: North-South, Rich-Poor, CNN, Al Jazeera and others. Advent of popular media- a brief overview.	06
Unit 3	**Global Conflict and Global Media:** Basic Principle of India's Foreign Policy. Rise of embedded Journalism. Study of Vietnam, Iraq & Afghanistan war and role of media. Media as a force multiplier. Rise of Communist China and media.	08
Unit 4	**Media & Cultural Globalization:** Cultural homogenization, cultural Imperialism, Media Hegemony and global culture. Discourses of Globalization; Barrier free economy, multinationals technological developments, digital divide, media conglomerates and monopolies in India.	06
Unit 5	**Emerging Challenges and Media:** Terrorism: New Emerging Challenges. Fundamentalism, Ethnic clashes, Satellite Invasion, Information war, Technological Aggression. Dominance, Changing Concept of Sovereignty. India's Media Response to International affairs Coverage of Events, Developments. Editorial by National Dailies, Magazines and Journals and Electronic Medium. Non- English Media's Understanding of International Issues and Challenges (Reference, Hindi and Other Prominent Regional Languages, Newspaper).	10

Course Outcome:	
1	Students will be able to have understanding of the world in historical and contemporary context.
2	Students will be having the understanding of the world politics and economics.
3	Students would have the knowledge of writing on global issues.
4	Students would have the knowledge of international developments.
5	Students will know about India's foreign policy.

Text Books:	
1	DayaKishanThussu. *International Communication: Continuity and Change,* Oxford University Press, 2003.
2	Communication and Society, Today and Tomorrow *" Many Voices One* DayaKishanThussu .*War and the media : Reporting conflict 24x7*, SagePublications, 2003.

Reference Books:	
1	Stuart Allan and Barbie Zelizer. *Reporting war: Journalism in war time,* Routledge Publication, 2004.
2	Yahya R. Kamalipour and Nancy Snow. *War, Media and Propaganda-A Global Perspective,* Rowman and Littlefield Publishing Group, 2004.
3	ZahidaHussain and Vanita Ray. *Media and communications in the third world countries,*Gyan Publications,2007.
4	Lee Artz and Yahya R. Kamalipor. *The Globalization of Corporate Media Hegemony,* New York Press, 2003.

JM20.306	Project	0-0-0-5
Prerequisite:	Student must have all the skills of media and their interest & strength in particular area.	
Objective:	Student will prepare a project on their area of interest like – TV anchoring, Radio Jockeying, short film, documentary, camera, editing, print media, advertising. To develop knowledge and understanding of chosen field and topics. To develop the practical skills of Presentation their skill as per the industry. To understand the technicality of chosen or specialized field.	
Course Outcome:		
1	Students will apply all the learning in their respective or specialized field.	
2	Students will create a show reel for their portfolio.	
3	Student will showcase their work and learning for their job.	

JM20.308	Communication Research & Method	5-1-0-6 Total Lectures: 65
Prerequisite:	Student must have basic understanding and idea of research.	
Objective:	To train young minds for scientific inquiry. To acquainting the students with various methods used for conducting scientific research in media and communication studies. Discuss sampling, scaling techniques and data collection tools.	
Unit 1	**Introduction To Research:**Definition, Role, Function, Types, Scientific Approach, Role of Theory in Research, Steps of Research.	12
Unit 2	**Concept of statistics**: Importance of statistics in research. Role of media metrics in communication and media research. Measures of central tendencies in communication and media research. Measures of dispersion in communication and media research.	10
Unit 3	**Methods of Media Research:** Qualitative, Quantitative techniques, Content Analysis, Survey Methods: Observation Methods, Experimental Studies, Case Studies.	18
Unit 4	**Sampling:** Sampling Methods, Representativeness of the sample, Sampling Error, Tools of data collection: Primary and Secondary data: Questionnaire, Focus Group, Surveys, Online Polls, Published work.	15
Unit 5	**Research Design:** Methods of analysis and report writing, Data Analysis Techniques: Coding and Tabulation, use of SPSS in research, learning SPSS software's, Working with Internet as a source, Writing the Citations, writing the research report, Bibliography. Readership and Audience Surveys.	10
Course Outcome:		
1	Students will be equipped to conduct projects and dissertation studies.	
2	Students will be able to devise a cogent and coherent research plan.	
3	They will be equipped with known techniques of data interpretation and analysis.	
Text Books:		
1	Wimmer, Roger, D and Dominick, Joseph, R. Mass Media Research, Thomson Wadsworth 2006	
2	Berger, A.A. (2000) Media and Communication Research Methods, Sage Publications, N.D	
Reference Books:		
1	Arthur Asa Berger, Media Research Techniques, Sage Publication, 1998	
2	John Fiske, Introduction to Communication Studies, Routledge Publication, 1982	
3	Keyton, J. (2001) Communication Research: Asking Questions, Finding Answers. Mountain View, CA: Mayfield	
4	Merrigan, G. 7 Huston, C.L. (2014) Communication Research Methods. Oxford University Press	

JM20.310	Practical- New Media	0-0-6-3 Total Lectures: 39
Prerequisite:	Student must have fair knowledge of graphics and social media.	
Objective:	To develop an advanced understanding of social media management. To train the students in launching social media campaigns. To teach the students to create and post stories on social media platforms.	
Unit 1	Creation and maintaining accounts on social media platforms.	
Unit 2	Content writing for social media	
Unit 3	Creating attractive infographics for social media.	
Unit 4	Developing a social media campaign. Creating and posting stories on YouTube.	
Unit 5	Report on fake news viral on social media. Case study on citizen journalism.	
Course Outcome:		
1	The students will have ample practical knowledge about citizen journalism.	
2	The students will be able to create effective social media content.	
3	The students will become industry ready to handle social media profiles of various organizations.	
Assignment:		
1	Create the own product and content preperation.	
2	Use infographics and other templets for soial media campaign.	
3	Prepare case study on fake news or news on social media.	

JM20.312	Practical- Media Lab	0-0-6-3 Total Practical Classes: 39
Prerequisite:	Student must have all the skill of their respective specialization area.	
Objective:	Under the guidance of the supervisor to prepare a documentary on any subject chosen which lies in the domain of communication and media. In this paper we have to finally come up with an outcome (documentary) informed by research and methodology and equipped with skills learnt in editing.	
Course Outcome:		
	After conducting guided research and following the methodology discussed, the students will be able to produce a documentary on their chosen subject in the domain of media and communication. This product will have significant social or market value.	

BA Honours English 20-21

EL20.101 **English Poetry-I** **3-0-0-3**

Total Lectures: 39

Objective: To introduce the students' poetry from various cultures, languages and historic periods, letting the students to appreciate poetry as a literary art and its various elements of poetry.

Unit 1	**Literary Terms:** Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	3
Unit 2	**William Shakespeare:** Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree **John Donne:** The Sunne Rising, Batter My Heart, Death Be Not Proud	10
Unit 3	**Christopher Marlowe:** The Passionate Shepherd to His Love **Walter Raleigh:** The Nymph's Reply **Andrew Marvell:** To His Coy Mistress	10
Unit 4	**George Herbert:** Virtue **Ben Jonson:** To Celia	7
Unit 5	**John Milton:** On His Twenty Third Birthday, On His Blindness **Robert Herrick:** To the Virgins to Make Much of Time	9

Course Outcome:

1. Students would be able to identify a variety of forms and genres of poetry from diverse cultures and historic periods, such as sonnets, ballads, dramatic monologues, epic and pastoral, free verse, elegy etc.
2. Identify personal experiences that can be used when writing poems.
3. Analyze the various elements of poetry, such as diction, tone, imagery, figures of speech, symbolism, theme, etc.
4. Develop their critical thinking skills.
5. Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.
6. Examine the rhythms, metrics and other musical aspects of poetry.

Text Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd. (Latest Edition)
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher. (Latest Edition)

Reference Books:

1. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd. (Latest Edition)
2. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
3. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
4. Gardner, Helen: The Metaphysical Poets, London, Penguin. (Latest Edition)
5. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL20.103	English Prose-I	3-0-0-3 Total Lectures: 39
Objective:	To enable the student to understand different ways in which essays and short stories were written in different time period and critically analyze them.	
Unit 1	**Francis Bacon:** Of Studies, Of Revenge **William Hazlitt:** Indian Juggler	8
Unit 2	**Richard Steele:** The Spectator Club **Joseph Addison:** Meditations in Westminster Abbey	8
Unit 3	**Oliver Goldsmith:** Beau Tibbs at Home **Charles Lamb:** Dream Children: A Reverie	8
Unit 4	**Robert Lynd:** The Student **Huxley:** Pleasures	8
Unit 5	**Maxim Gorky:** The Mother of a Traitor **William Somerset Maugham:** The Verger	7

Course Outcome: The student will be able to:	
1	To recognize different types of prose writing.
2	To understand and appreciate the basic concepts of style and literary devices in prose.
3	To apply the basic concepts of style and literary devices to different types of prose writing.
4	To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms in prose.
5	To be able to evaluate and synthesize information from a variety of resources.
6	To write creatively and critically.
Text Books:	
1	Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd. (Latest Edition)
2	Sasikumar, J., Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman. (Latest Edition)
Reference Books:	
1	Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
2	Walker, Hugh: The English Essay and Essayists. London, J. M. Dent & Sons Ltd., 1915
3	Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.2019
4	Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers. (Latest Edition)

EL20.105	History of English Literature: English Literature in the Making	3-1-0-4 Total Lectures: 39
Objective:	To examine the history of English Literature and assist students in the development of intellectual flexibility, creativity, and cultural history and literary knowledge so that they may engage in life-long learning from ancient times to the present.	
Unit 1	**Middle English Period:** Medieval scholarship and the Latin writers	5
Unit 2	**Celtic Literature and Mendicant Friars:** The Goidels, the Brythons, the Religious writers and Legends and lives of the Saints	9
Unit 3	**The Romantic Element (Courtly Poetry):** The Arthurian Cycle, the story of Troy, Oriental Romances	8
Unit 4	**The English Renaissance:** The Dawn of Renaissance, the Height of Renaissance, The Decline of Renaissance	8
Unit 5	**The Restoration Period:** The Court Poets of the Restoration, The Great Essayists , Diarists and Letter Writers	9
Course Outcome:		
1	Students will describe historical events from multiple perspectives.	
2	Students will formulate, sustain, and justify a historical argument using original ideas.	
3	Students will understand and support arguments with historical evidence drawn from primary and secondary sources.	
4	Students will place historical arguments into a larger scholarly literary narrative.	
5	Students will analyze a primary source of language and literature.	
6	Students will relate, compare and contrast different historical viewpoints changing from time to time.	
Text Books:		
1	Crompton- Rickett: A History of English Literature, New Delhi, UBS Publishers, 1996.	
2	Haskins, Katherine: The Art Journal and Fine Art Publishing in Victorian England, London and New York, Routledge Taylor and Francis Group, 2016.	
Reference Books:		
1	Pollard, Arthur: Sphere History of English Literature. London: Sphere, 1971. Rev. ed. 1986. Rpt. as Penguin History of Literature. Harmondsworth: Penguin, 1993.	
2	Baugh, A.C. Ed. A Literary History of England (2nd ed.). London: Routledge & Kegan Paul, 1967.	
3	Ford, Boris Ed. The new Pelican Guide to English Literature Series. Harmondsworth, Middlesex, England, New York, N.Y: Penguin Publications, 1982.	
4	Simon, J. Education and Society in Tudor England. Cambridge: University Press, 1966.	

EL20.107	Modern English Language and Phonetics-I	4-1-0-5 Total Lectures: 52
Objective:	To develop in the student communicative competence by re-aligning the components of grammatical competence already gained back at school. Student will be given basic information about English sounds and phonemic transcriptions in British English. The core components of linguistics like phonology, morphology will also be introduced through this course.	
Unit 1	**Basic Sentence Types** **Coordination and Subordination Clauses**	12
Unit 2	**Different Notions and Concepts** (Request, Order, Purpose, Wish, Suggestion, Obligation, Concession, Condition) **Morphology and Phonology** (Various morphs and phonemes)	10
Unit 3	**Word Substitutions, Idioms and Proverbs** **Synonyms and Antonyms**	8
Unit 4	**Paragraph Writing** **Literary Appreciation**	9
Unit 5	**Reading Skills**: Book reading, Book review and Portrait reading.	13

Course Outcome: The student will be able to:	
1	Learn the essentials of English Grammar and Phonemic symbols.
2	Understand the practical usage of the sounds and grammar of English in our speech and writing.
3	Apply the rules of grammar and phonetics to use flawless English in speech and writing.
4	Analyze, identify and rectify the common errors in speech and writing.
5	Evaluate a piece of writing keeping in mind all the rules of grammar and phonetics studied.
6	Develop Proficiency in English through meaningful use of language that is semantically and grammatically accurate. Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.
Text Books:	
1	Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi.(Latest Edition)
2	Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi, 2018.
3	Raman, M., & Singh, P. Business Communication (2nd edition.). New Delhi: Oxford University Press. 2017.
Reference Books:	
1	Raymond Murphy: Essentials English Grammar, Cambridge University Press.2000.
2	Quirk & Greenbaum: University English Grammar, Longman Publications.1973.
4	CIEFL material on Morphology and Phonology from the Distance Education Department

EL20.109	Foundation Course in English	2-0-0-2 Total Lectures: 26
Objective:	Student will be given knowledge of functional grammar in order to develop effective reading and writing skills.	
Unit 1	**Sentence Structure:** Elements of a sentence (Subject, verb, object, complement and adjunct) **Articles:** Definite and Indefinite & omission of articles	5
Unit 2	**Transformation of Sentence Structure:** Active and Passive Voice (statement, negative, interrogative and imperative), Direct and indirect narration (statement, negative, interrogative and imperative)	5
Unit 3	**Correct Usage of Language:** Tenses (Present, Past and Future), Phrasal verbs, Modals (can, could, will, would, shall, should, may, might, must, ought to, need) **Common Errors in Effective Communication:** How to avoid common sentence – structural errors, vocabulary and pronunciation	6
Unit 4	**Writing Skills:** Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing	6
Unit 5	**Reading Comprehension:** Efficient reading and note taking	4
Course Outcome: The student will be able to:		
1	Learn the essentials of English Grammar.	
2	Apply the rules of grammar to use flawless English in speech and writing.	
3	Analyze, identify and rectify the common errors in speech and writing.	
4	Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.	
5	Evaluate a piece of writing keeping in mind all the rules of grammar studied.	
6	Read and comprehend English	
Text Books:		
1	Wren & Martin: English Grammar & Composition, S.Chand & Co, Delhi (Latest edition)	
2	Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.	
Reference Books:		
1	Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.	
2	Leech Geoffery: English Grammar for today, Longman, Delhi, 1973.	
3	Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.	
4	Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).	

EL20.102	English Poetry-II	3-0-0-3 Total Lectures: 39
Objective:	To introduce the students' poetry from various cultures, languages and historic periods, letting the students to appreciate poetry as a literary art and its various elements of poetry.	
Unit 1	**William Blake:** London **William Wordsworth:** The Solitary Reaper	6
Unit 2	**Percy Byssey Shelley:** Ode to the West Wind, Lines to an Indian Air **John Keats:** Ode to a Nightingale	9
Unit 3	**Lord Alfred Tennyson:** Ulysses **Matthew Arnold:** Dover Beach	9
Unit 4	**Robert Browning:** The Last Ride Together **Gerard Manley Hopkins:** Pied Beauty, God's Grandeur.	8
Unit 5	**William Butler Yeats:** To a Shade **Thomas Stearns Eliot:** Marina	7
Course Outcome:		
1	Recognize poetry from a variety of cultures, languages and historic periods.	
2	Identify personal experiences that can be used when writing poems.	
3	Analyze the various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc.	
4	Develop their critical thinking skills.	
5	Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.	
6	Examine the rhythms, metrics and other musical aspects of poetry.	
Text Books:		
1	Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.(Latest Edition)	
2	Fifteen Poets, Delhi, Oxford University Press, 1974.	
Reference Books:		
1	Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.	
2	Bowra, C M: The Romantic Imagination, London, Oxford University Press.	
3	Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.	
4	Hough Graham: The Romantic Poets, London, Hitchinson University Library.	
5	Eliot, T S: On Poets and Poetry, London, Faber & Faber.	
6	Lucas, F.L: Eight Victorian Poets, Cambridge.	

EL20.104	English Prose-II	3-0-0-3 Total Lectures: 39
Objective:	To enable the student to understand different ways in which essays and short stories were written in different time period and critically analyze them.	
Unit 1	**John Ruskin:** A Gentleman **John Bright:** Peace	8
Unit 2	**Charles Lamb:** Modern Gallantry **Lord Riddel:** The Art of Speaking	8
Unit 3	**Alfred George Gardiner:** All about a Dog **William Cowper:** On Conversation	8
Unit 4	**William Ralph Inge:** Happy People, Ambition.	8
Unit 5	**Thomas Hardy:** The Mayor of Casterbridge (*Non Detailed*)	7
Course Outcome: The student will be able to:		
1	To recognize different types of prose writing	
2	To understand and appreciate the basic concepts of style and literary devices in prose	
3	To apply the basic concepts of style and literary devices to different types of prose writing	
4	To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms in prose	
5	To be able to evaluate and synthesize information from a variety of resources	
6	To write creatively and critically	
Text Books:		
1	Approach to Life, Kolkata, Orient Longman Ltd., 1993.	
2	Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press, 2008.	
Reference Books:		
1	Lascelles, Abercrombie, Thomas Hardy, a Critical Study, Creative Media Partners, LLC, 2018.	
2	Cecil, David. Hardy the Novelist: An Essay in Criticism, London : Constable, 1943.	
3	Walker, Hugh: The English Essay and Essayists. London, J. M. Dent & Sons Ltd., 1915.	

EL20.106	History of English Literature : The Age of Johnson and Fielding	3-1-0-4 Total Lectures: 39
Objective:	To examine the history of English Literature and assist students in the development of intellectual flexibility, creativity, and cultural history and literary knowledge so that they may engage in life-long learning from ancient times to the present.	
Unit 1	Writers of Devotional Verse: William Cowper and George Crabbe	3
Unit 2	The Great Novelists: Samuel Richardson, Henry Fielding, T G Smollett	10
Unit 3	**The Rise of Women Novelists :** Aphra Behn to Jane Austen	10
Unit 4	**Historians from the sixteenth to Eighteenth Century**	7
Unit 5	**Development of Philosophical Thought:** Thomas Hobbes, John Locke	9
Course Outcome:		
1	Students will describe historical events from multiple perspectives.	
2	Students will formulate, sustain, and justify a historical argument using original ideas.	
3	Students will understand and support arguments with historical evidence drawn from primary and secondary sources.	
4	Students will place historical arguments into a larger scholarly literary narrative.	
5	Students will analyze a primary source of language and literature.	
6	Students will relate, compare and contrast different historical viewpoints changing from time to time.	
Text Books:		
1	Crompton- Rickett: A History of English Literature, New Delhi, UBS Publishers, 1996.	
2	Haskins, Katherine: The Art Journal and Fine Art Publishing in Victorian England, London and New York, Routledge Taylor and Francis Group, 2016.	
Reference Books:		
1	Pollard, Arthur: Sphere History of English Literature. London: Sphere, 1971. Rev. ed. 1986. Rpt. as Penguin History of Literature. Harmondsworth: Penguin, 1993.	
2	Baugh, A.C. Ed. A Literary History of England (2nd ed.). London: Routledge & Kegan Paul, 1967.	
3	Ford, Boris Ed. The new Pelican Guide to English Literature Series. Harmondsworth, Middlesex, England, New York, N.Y: Penguin Publications, 1982.	
4	Simon, J. Education and Society in Tudor England. Cambridge: University Press, 1966.	

EL20.108	Modern English Language and Phonetics-II	4-1-0-5 Total Lectures: 52
Objective:	To develop in the student communicative competence by re-aligning the components of grammatical competence already gained back at school. To apply the basic information about English sounds in phonetic transcription.	
Unit 1	**Question Tags** **Punctuations** **Determiners**: a, an, the, little, a little, few, a few, much, more, most	10
Unit 2	**Transformation :** Degrees of adjectives, Active-Passive voice, Direct-Indirect Narration, Assertive into Negatives and Interrogatives **Translations** (English to Hindi, Hindi to English)	14
Unit 3	**Phonemic Symbols for Sounds of English, practice of Phonetic transcription** **Word Structure and word Stress**	10
Unit 4	**Fallacies** (Hasty Generalization, *Petitio Principi*, Non-Sequitur, Composition, Division, *Post Hoc Ergo Propter Hoc*)	10
Unit 5	**Common Errors in English** **Word Power and Vocabulary**	8

Course Outcome: The student will be able to:	
1	Learn the essentials of English Grammar and Phonemic symbols
2	Understand the practical usage of the sounds and grammar of English in our speech and writing
3	Apply the rules of grammar and phonetics to use flawless English in speech and writing
4	Analyze, identify and rectify the common errors in speech and writing
5	Evaluate a piece of writing keeping in mind all the rules of grammar and phonetics studied
6	Develop Proficiency in English through meaningful use of language that is semantically and grammatically accurate. Student can read with ease and fluently, enrich vocabulary and enjoy reading and writing.
Text Books:	
1	Hornby A.S.: A Guide to Patterns and Usage, Oxford University Press, Delhi. (Latest Edition)
2	Wren & Martin: English Grammar & Composition, S. Chand & Co, Delhi, 2018.
3	Leech Geoffery: English Grammar for Today, Longman, Delhi.
Reference Books:	
1	Murphy and Reynold: Essentials of English Grammar, Cambridge University Press, 2000.
2	Quirk & Greenbaum: University English Grammar, Longman Publications, 1973
4	CIEFL material on Morphology and Phonology from the Distance Education Department

EL20.201	English Drama-I	3-0-0-3 Total Lectures: 39
Objective:	To enhance student' writing skills and understanding of different theatrical modes in which dramas were written in different time period and critically analyze them.	
Unit 1	**George Bernard Shaw:** Candida (Act 1-3)	11
Unit 2	**William Shakespeare:** Hamlet (Act 1-3)	7
Unit 3	**William Shakespeare:** Hamlet (Act 4-5)	7
Unit 4	**William Congreve:** The Way of the World (Act 1-3)	7
Unit 5	**William Congreve:** The Way of the World (Act 4-5)	7
Course Outcome: The student will be able to:		
1	Learn the creative usages of English language.	
2	Explain the various themes and forms of drama from Elizabethan to Victorian.	
3	Discuss and explain major theories of performance from Elizabethans to Victorians.	
4	Discuss the impact of different literary theories like Feminism, Psychoanalysis, and Victorianism on drama.	
5	Have knowledge of historical, socio-political, economic and religious trends in the plays.	
6	Explore the entire range of human experience through dramas as a literary form.	
Text Books:		
1	Shakespeare, William: Hamlet, Penguin Classics; Penguin (7 April 2005)	
2	Congreve, William: The Way of the World. Peacock Books; First edition (2020) Shaw, George Bernard: Candida., Peacock Books; Latest edition (2013)	
Reference Books:		
1	M.H. Abrams and Geoffrey Harpham: Glossary of Literary Terms. Cengage Learning; 11 edition (January 1, 2014)	
2	Aristotle. Poetics, Penguin; Revised ed. edition (26 September 1996)	
3	Alexander, N, Poison, Play and Duel: A Study in Hamlet., Routledge and K. Paul; First Edition edition (1971)	
4	Nicoll, Allardyce: British Drama, Chambers; 6th Revised edition (1 September 1978)/ Forgotten Books (9 June 2012)	

EL20.203	English Fiction-I	3-0-0-3 Total Lectures: 39
Objective:	To enable the student to understand different ways in which fiction were written in different time period and critically analyze them.	
Unit 1	**Charles Dickens:** Oliver Twist (Chapter 1-25)	6
Unit 2	**Charles Dickens:** Oliver Twist (Chapter 26- 53)	7
Unit 3	**R. K. Narayan:** The Bachelor of Arts (Chapter 1-8)	8
Unit 4	**R. K. Narayan:** The Bachelor of Arts (Chapter 9-18)	8
Unit 5	**George Orwell :** Animal Farm	10
Course Outcome: The student will be able to:		
1	To recognize different types of fiction writing	
2	To understand and appreciate the basic concepts of style and literary devices in fiction	
3	To apply the basic concepts of style and literary devices to different types of fiction writing	
4	To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms	
5	To be able to evaluate and synthesize information from a variety of resources	
6	To write creatively and critically	
Text Books:		
1	Dickens, Charles: Oliver Twist, Oxford University Press, 2016.	
2	Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir, 2011.	
3	Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications, 2007.	
Reference Books:		
1	Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher, 2002.	
2	Chesterton, G. K.: Charles Dickens: A Critical Study, Trieste Publishing,2018.	
3	Ford, Boris: From Dickens to Hardy, Penguin, 2020.	
4	Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd, 2000.	
5	Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave, 2009.	
6	Crick, Bernard, George Orwell: A Life, Harvill Secker, 2018.	

EL20.205	History of English Literature : The Romantic Revival	3-1-0-3 Total Lectures: 39
Objective:	To examine the history of English Literature and assist students in the development of intellectual flexibility, creativity, and cultural history and literary knowledge so that they may engage in life-long learning from ancient times to the present.	
Unit 1	**Romanticism in English Poetry**: Robert Burns, Lord Byron	3
Unit 2	**Romanticism in English Fiction:** Thomas Love Peacock, Thomas De Quincey, Leigh Hunt	10
Unit 3	**The Development of Journalism:** William Gifford and his Quarterly, Blackwood's Magazine	10
Unit 4	**Social Justice and Politics :** History of Latin Christianity, Jeremy Bentham's life and works	7
Unit 5	**Human Rights:** The rights of women, the rights of men, William Cobbett and his life	9

Course Outcome:	
1	Students will describe historical events from multiple perspectives.
2	Students will formulate, sustain, and justify a historical argument using original ideas.
3	Students will understand and support arguments with historical evidence drawn from primary and secondary sources.
4	Students will place historical arguments into a larger scholarly literary narrative.
5	Students will analyze a primary source of language and literature.
6	Students will relate, compare and contrast different historical viewpoints changing from time to time.
Text Books:	
1	Crompton- Rickett: A History of English Literature, New Delhi, UBS Publishers, 1996.
2	Haskins, Katherine: The Art Journal and Fine Art Publishing in Victorian England, London and New York, Routledge Taylor and Francis Group, 2016.
Reference Books:	
1	Pollard, Arthur: Sphere History of English Literature. London: Sphere, 1971. Rev. ed. 1986. Rpt. as Penguin History of Literature. Harmondsworth: Penguin, 1993.
2	Baugh, A.C. Ed. A Literary History of England (2nd ed.). London: Routledge & Kegan Paul, 1967.
3	Ford, Boris Ed. The new Pelican Guide to English Literature Series. Harmondsworth, Middlesex, England, New York, N.Y: Penguin Publications, 1982.
4	Simon, J. Education and Society in Tudor England. Cambridge: University Press,1966.

EL20.207	English Literature: Pre-romantics & Romantics-I	4-1-0-5 Total Lectures: 52
Objective:	To enable the student to understand romantic era and its literature and critically analyze them.	
Unit 1	**Thomas Gray:** Elegy Written in a Country Churchyard, Progress of Poesy, Ode on Adversity.	10
Unit 2	**William Collins:** Ode to Evening, Ode Occasion'd by the Death of Mr Thomson. **William Wordsworth:** Ode on the Intimation of Immortality, The World is Too Much With Us.	12
Unit 3	**John Keats:** Ode to Grecian Urn, Ode to Autumn, La Belle Dam Sans Merci	10
Unit 4	**William Hazlitt:** On the Ignorance of the Learned, On the Tatler	10
Unit 5	**Jane Austen :** Mansfield Park (Non-detailed)	10
Course Outcome: The student will be able to:		
1	Develop knowledge of and ability to analyse the key texts and concepts of this period of literary history.	
2	Define 'Romanticism'.	
3	List key writers and works of Romanticism.	
4	Compare and contrast characteristics of Romantic poetry to Romantic literature.	
5	Assess the historical and social events of the Romantic Period.	
6	Relate the poem to the real life and compose poetry.	
Text Books:		
1	Hough, Graham, The Romantic Poets, London, Hutchinson's University Library, 1970.	
2	Hazlitt, William: Essays of William Hazlitt: Selected and Edited, with Introduction and Notes, by Frank Carr. Forgotten Books, 2018.	
3	Austen, Jane: Mansfield Park. Penguin Books, 2003.	
Reference Books:		
1	Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.	
2	Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.	
3	Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.	

Spring Semester

EL20.202	**English Drama-II**	**3-0-0-3** **Total Lectures: 39**
Objective:	To enhance student' writing skills and understanding of different theatrical modes in which drama were written in different time period and critically analyze them.	
Unit 1	**Rabindranath Tagore:** Chandalika (Act I & II)	9
Unit 2	**Girish Karnad:** Tughlaq (Scene 1-7)	8
Unit 3	**Girish Karnad:** Tughlaq (Scene 8-13)	7
Unit 4	**Harold Pinter:** The Birthday Party (Act I)	8
Unit 5	**Harold Pinter:** The Birthday Party (Act II)	7
Course Outcome: The student will be able to:		
1	Learn the creative usages of English language.	
2	Explain the various themes and forms of drama at different ages and stages.	
3	Discuss and explain major theories of performance from Aristotle to the present day.	
4	Discuss the impact of modern philosophies like Existentialism, Expressionism, Marxism and Absurdism on drama.	
5	Have knowledge of historical, socio-political, and religious trends in the plays.	
6	Explore the entire range of human experience through dramas as a literary form.	
Text Books:		
1	Karnad, Girish: Tughlaq, Delhi, Oxford University Press, 2 edition (30 May 2012)	
2	Pinter, Harold: The Birthday Party., Publisher: Faber; Main edition (7 May 1991) Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press., 1975	
Reference Books:		
1	Esslin, Martin: Pinter: The Playwright., Publisher: Methuen Publishing Ltd (September 30, 1992)	
2	David Lodge, Nigel Wood: Modern Criticism and Theory: A Reader: Longman; 2 edition (10 August 1999).	
3	Trussler, Simon: The Plays of Harold Pinter: An Assessment, Victor Gollancz; First Edition edition (1973)	
4	J. A. Cuddon: A Dictionary of Literary Terms and Literary Theory, Fifth Edition-Wiley-Blackwell (2013) (1)/ Penguin Books; 5 edition (1 September 2015)	

EL20.204	English Fiction-II	3-0-0-3 Total Lectures: 39
Objective:	To enable the student to understand different ways in which fiction were written in different time period and critically analyze them.	
Unit 1	**D.H. Lawrence:** Sons and Lovers (Part I)	9
Unit 2	**D.H. Lawrence:** Sons and Lovers (Part II)	9
Unit 3	**Khushwant Singh:** A Train to Pakistan	7
Unit 4	**V.S. Naipaul:** A House for Mr. Biswas (Part I)	7
Unit 5	**V.S. Naipaul:** A House for Mr. Biswas (part II)	7
Course Outcome: The student will be able to:		
1	To recognize different types of fiction writing	
2	To understand and appreciate the basic concepts of style and literary devices in fiction	
3	To apply the basic concepts of style and literary devices to different types of fiction writing	
4	To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms	
5	To be able to evaluate and synthesize information from a variety of resources	
6	To write creatively and critically	
Text Books:		
1	Lawrence, D.H: Sons and Lovers, Delhi, Peacock, 2010.	
2	Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd, 2016	
3	Naipaul, V. S.: A House for Mr. Biswas, Picador, 2011.	
Reference Books:		
1	Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher, 2002	
2	Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series, Penguin, 2000.	
3	Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., 2019.	
4	Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher, 2000.	

EL20.206	History of English Literature : The Victorian Era to the Twentieth Century	3-1-0-3 Total Lectures: 39
Objective:	To examine the history of English Literature and assist students in the development of intellectual flexibility, creativity, and cultural history and literary knowledge so that they may engage in life-long learning from ancient times to the present.	
Unit 1	**Introduction to the Major Writers** : Alfred Lord Tennyson and Robert Browning	3
Unit 2	**The Pessimistic Note in Victorian Era**: Matthew Arnold and Edward FitzGerald	10
Unit 3	**Humanitarian Group:** Charles Dickens, Charles Kingsley and Charles Reade	10
Unit 4	**Twentieth Century Tendencies in Literature :** Major theme in poetry, drama, fiction and essays	7
Unit 5	**Major Writers and Their Contribution:** Rudyard Kipling, G B Shaw, H G Wells	9
Course Outcome:		
1	Students will describe historical events from multiple perspectives.	
2	Students will formulate, sustain, and justify a historical argument using original ideas.	
3	Students will understand and support arguments with historical evidence drawn from primary and secondary sources.	
4	Students will place historical arguments into a larger scholarly literary narrative.	
5	Students will analyze a primary source of language and literature.	
6	Students will relate, compare and contrast different historical viewpoints changing from time to time.	
Text Books:		
1	Crompton- Rickett: A History of English Literature, New Delhi, UBS Publishers, 1996.	
2	Haskins, Katherine: The Art Journal and Fine Art Publishing in Victorian England, London and New York, Routledge Taylor and Francis Group, 2016.	
Reference Books:		
1	Pollard, Arthur: Sphere History of English Literature. London: Sphere, 1971. Rev. ed. 1986. Rpt. as Penguin History of Literature. Harmondsworth: Penguin, 1993.	
2	Baugh, A.C. Ed. A Literary History of England (2nd ed.). London: Routledge & Kegan Paul, 1967.	
3	Ford, Boris Ed. The new Pelican Guide to English Literature Series. Harmondsworth, Middlesex, England, New York, N.Y: Penguin Publications, 1982.	
4	Simon, J. Education and Society in Tudor England. Cambridge: University Press,1966.	

EL20.208	English Literature: Pre-romantics & Romantics-II	4-1-0-5 Total Lectures: 52
Objective:	To enhance the student' writing skills and understanding of different ways in poetry were written in the specified time period and critically analyze them.	
Unit 1	**Samuel Taylor Coleridge:** Kubla Khan, **George Byron:** There is Pleasure in Pathless Woods	12
Unit 2	**Percy Bysshe Shelley:** Ode to Skylark, To Night, Death of Hamlet, Death of Cleopatra	12
Unit 3	**Alfred Tennyson:** The Lotus Eaters	8
Unit 4	**Charles Lamb:** Imperfect Sympathies, All Fools' Day	10
Unit 5	**Charles Dickens:** A Tale of Two Cities (non-detailed)	10
Course Outcome: The student will be able to:		
1	Develop knowledge of and ability to analyse the key texts and concepts of this period of literary history.	
2	Define 'Romanticism.	
3	List key writers and works of Romanticism.	
4	Compare and contrast characteristics of Romantic poetry to Romantic literature.	
5	Assess the historical and social events of the Romantic Period.	
6	Relate the poem to the real life and compose poetry.	
Text Books:		
1	Hough, Graham, The Romantic Poets, London, Hutchinson's University Library, 1970.	
2	Lamb, Charles: Essays of Elia. Hesperus Press, 2009.	
3	Dickens, Charles: A Tale of Two Cities. Penguin Books, 2003.	
Reference Books:		
1	Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.	
2	Ridenour, George M, Shelley: A Collection of Critical Essays, New Delhi, Prentice Hall of India Pvt. Ltd.	
3	Perkins, David, Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.	

Third Year
Autumn Semester

EL20.301	**American Literature**	**3-0-0-3** **Total Lectures: 39**
Objective:	Introduces the literature of the land which is now the United States from before European contact through the mid-nineteenth century.	
Unit 1	**Walt Whitman:** When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry	9
Unit 2	**Emily Dickinson:** A Bird came down the Walk, I heard a Fly Buzz, A Light Exists	7
Unit 3	**Robert Frost:** Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening	9
Unit 4	**Sylvia Plath:** Morning Song, Death and Company	5
Unit 5	**R.W. Emerson:** Brahma **Edgar Allan Poe:** The Fall of the House of Usher	9

Course Outcome: The student will be able to:	
1	Describe the major historical and cultural developments of colonial America
2	Appreciate poetry as a literary art and its various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc
3	Demonstrate knowledge of foundational texts of Early American literature through 1860s.
4	Identify and discuss the roles which gender, race, age, class, ethnicity, wealth, poverty, and geography have played in creating American literature.
5	Use literary texts to examine the historical, cultural, and rhetorical contexts in which they were written.
6	Write clear, focused, coherent essays about literature for an academic audience, using standard English conventions of grammar and style.
Text Books:	
1	Allan, Gay W., The Solitary Singer: A Critical Biography Of Walt Whitman, University of Chicago Press, 1985.
2	Anderson, C. R., Emily Dickinson's Poetry, New Yor: Holt, Rinehart and Winston. Heinemann, 1960.
3	Frost, Robert, The Poetry of Robert Frost, Ed. Edward Connery Lathem, Henry Holt and Co., 2002.
Reference Books:	
1	Kaplan, Justin, Walt Whitman: A Life, New York : Simon and Schuster, 1980.
2	Allan, Gay W., Waldo Emerson, Viking Press, 1981.
3	Edgar Allan Poe. Selected Tales. Penguin Books Ltd., 1994.
4	"Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers, 1989.

EL20.303	New Literature in English	3-0-0-3 Total Lectures: 39
Objective:	To enable the student to understand different ways in which poems were written in different time period and critically analyze them.	
Unit 1	**Toru Dutt:** Our Casuarina Tree **Sarojini Naidu:** Indian Weaver, The Song of Radha	8
Unit 2	**Rabindranath Tagore:** Where the Mind is Without Fear **Sri Aurobindo:** Transformation	7
Unit 3	**Kamala Das:** An Introduction as a Writer **Nissim Ezekiel:** A Goodbye Party for Miss Pushpa T.S.	8
Unit 4	**A. K. Ramanujan:** Love Poem for a Wife **Arun Kolatkar**: Chaitanya	8
Unit 5	**Chinua Achebe:** Refugee Mother and Child **John Pepper Clark** : Agbor Dancer	8
Course Outcome: The student will be able to:		
1	To recognize new literature and its significance	
2	To understand and appreciate the basic concepts of style and literary devices in poetry	
3	To apply the basic concepts of style and literary devices to different types of poetry	
4	To analyze and appreciate fiction and enrich their knowledge about diverse poetry forms	
5	To be able to evaluate and synthesize information from a variety of resources	
6	To write creatively and critically	
Text Books:		
1	Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd, 2016.	
2	Narasimhaiah, C. D., Awakened Conscience: Studies in Commonwealth Literature, New Delhi, Sterling Publishers, 1978.	
Reference Books:		
1	Walsh, William, Commonwealth Literature, Macmillan, 1980.	
2	Beier, Ulli (ed.), Introduction to African Literature, Northwestern University Press, 1967.	
3	Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books, 1975.	
4	Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd, 2019.	

RM20.301	Research Methodology	2-0-0-2 Total Lectures: 26
Objective:	To acquire fundamental knowledge of research methodology and apply in sciences and applied sciences.	
Unit 1	Introduction: Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	**05**
Unit 2	Sampling and Data Collection: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques, Data collection: Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	**05**
Unit 3	Measurement and Scaling Techniques: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale.	**05**
Unit 4	Statistical Tools for Data Analysis: Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation -Variance - Coefficient of Variance, Skewness, Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation, Regression: Method of Least Squares. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two- way classification. Non parametric tests - Chi-Square test	**06**
Unit 5	Report writing: Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing (chapterisation), Referencing styles, plagiarism, ethics in research, characteristics of a good research report.	**05**

Course Outcome:	
1	Get basic idea about research and its major components.
2	Understand how to plan research/ write hypothesis.
3	Get to know the how to collect data.
4	Understand how to develop and apply the tools and techniques in research.
5	The students will be able to apply the knowledge of research methodology in sciences, arts and applied sciences to solve curriculum problems.
6	Will be able to write research paper/dissertation in correct format.
Text Books:	
1	Aczel and Sounderpandian (2008). Complete Business Statistics. Tata-McGraw Hill. India.
2	Anderson, Sweeney, William, Cam (2014). Statistics for Business and Economics. Cengage Learning. India
Reference Books:	
1	Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India
2	Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi.
3	Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India
4	Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India.
5	Kothari C. R. (2004). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi

EL20.305	Dissertation	0-0-0-5
Objective:	To enable student acquire skills as a basis for the study of literature and history through English texts and also apply knowledge in solving/analyzing/exploring a real life situation/difficult problem.	
Course Outcome:		
1	Appreciate a work of art critically employing a theory of criticism.	
2	Substantiate their views with apt illustrations and critical support.	
3	The ability to develop a research project, including formulation of a research problem, searching for sources, and engaging in analytic discussion.	
4	Competence in academic writing and oral presentation skills.	
5	Use a working knowledge of research methodology to format the dissertation.	
6	Organize the views and format them into a dissertation of about twenty five to thirty pages.	
Reference Books:		
1	Latest edition of MLA Handbook for Writers of Research Papers	

EL20.307	Contemporary Indian Literature	5-1-0-6 Total Lectures: 65
Objective:	To introduce students to major movements and figures of Indian Literature in English through the study of selected literary texts.	
Unit 1	**Short History of Indian Literature** **Henry Derozio:** To India : My Native Land **Rabindranath Tagore** : Authorship	14
Unit 2	**Agha Shahid Ali :** Postcard from Kashmir **Menka Shivdasani** : The Atheist's Confession	13
Unit 3	**Vijay Tendulkar :** Kamala *(From Five plays by Vijay Tendulkar, OUP)*	13
Unit 4	**R. K. Narayan:** The Martyr's Corner *(from Malgudi Days, India Thought Publication, Madras, 1982, repr. 1998, ISBN 81-85986-17-7)* **S.H. Manto** : The Assignment *(Mottled Dawn, 1997, Penguin Books India, ISBN 0-14-027212-7)*	15
Unit 5	**Amitav Ghosh:** The Glass Palace (Non-detailed) Ref. *(Harper Collins, 2002, ISBN 9780007427468)* **Sudha Murthy:** Dollar Bahu (Non-detailed)	10
Course Outcome: The student will be able to:		
1	Students would be able to identify a variety of forms and genres of Indian poetry and prose from diverse cultures and historic periods, such as sonnets, ballads, dramatic monologues, epic and pastoral, free verse, elegy etc.	
2	Identify personal experiences that can be used when writing Literature and to sensitize towards Indianism through Literature.	
3	Analyze the various elements of poetry, such as diction, tone, imagery, figures of speech, symbolism, theme, etc.	
4	Develop their critical thinking skills. Also to acquaint learners to the pluralistic dimensions of this literature.	
5	Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.	
6	To make learners aware of prominent Indian writers whose works have been translated in English.	
Text Books:		
1	Bassnett, Susan and Harish Trivedi (eds). Postcolonial translation: Theory and Practice. London: Routledge, 2002.	
2	Deshmane, Chetan, ed. Muses India: Essays on English-Language Writers from Mahomet to Rushdie. Jefferson, NC, and London: McFarland & Co., 2013.	
3	Murty Sudha. Dollar Bahu. Penguin Books India, 2007.	
Reference Books:		
1	Bharucha, Nilufer and Vilas Sarang (eds). Indian English Fiction, 1980- 90: An Assessment. Delhi: B R Publishers, 1994.	
2	Devy, G N. Indian Literary Criticsm: Theory and Interpretation. Mumbai: Orient Longman, 2002.	
3	George, K M.. Modern Indian Literature: An Anthology – Plays and Prose. New Delhi: Sahitya Academy, 1995.	
4	Nemade,,Bhalchandra. Nativism. Shimla: Indian Institute of Advanced Studies, 2009.	
5	Mehrotra, Arvind Krishna (ed). 2003. A History of Indian Literature in English. New York: Columbia University Press. Distributed in India by Doaba Books Shanti Mohan House 16,Ansari Road, New Delhi.	

EL20.309	Twentieth Century English Literature-I	5-1-0-6 Total Lectures: 65
Objective:	To enhance student' LSRW skills and understanding of different ways in poetry, dramas and fiction were written during the twentieth century to critically analyze them.	
Unit 1	**W B Yeats :**The Second Coming, Byzantium, Lapis Lazuli, When you are Old	13
Unit 2	**W B Yeats :** A Prayer for my Daughter **W H Auden :** In Memory of W B Yeats, September 1, 1939	13
Unit 3	**T S Eliot :** The Wasteland	13
Unit 4	**Samuel Backett :** Waiting for Godot	13
Unit 5	**E. M. Forster:** A Passage to India	13
Course Outcome: The student will be able to:		
1	Learn to read, analyze and appreciate poetry, drama and fictional critically.	
2	Discuss the significant figures and events of the period.	
3	Have an understanding of the major Literary and Cultural Trends in poetry, drama & fiction.	
4	Recognize the rhythms, metrics and other literary aspects of poetry, drama & fiction.	
5	Have an understanding of the circumstances that shape the processes of literary production during the twentieth century.	
6	Know about the diverse poetic devices and strategies employed by the literary writers.	
Text Books:		
1	Eliot, T S : The Wasteland, Wisehouse Classics; 1 edition (22 November 2016) Sold by: Amazon Asia-Pacific Holdings Private Limited	
2	Beckett, Samuel: Waiting for Godot., Faber; Main edition (27 July 2010)/ Atlantic Books (18 January 1994)	
Reference Books:		
1	Literary Movement for the Students, Cengage Gale (18 September 2002)	
2	Cox, R. C.: "The Poetry of W. H. Auden" (in the Modern Age, Vol. VII of The Pelican Guide to English Literature)., R.G. Cox, "The Poetry of W.H. Auden" in The Modern Age voL 1. 7, of The Pe1ican Guide to English Literature ed. Boris Ford' (Penguins 1964) p.387.	
3	W.H. Long: English Literature: Its History and Its Significance for the Life of the English Speaking World, Rupa Publications India; First edition (4 October 2015)	
4	Titus, T. K.: A Critical Study of T. S. Eliot's Works, New Delhi, Atlantic Publishers. , Atlantic (1 December 1999)	

EL20.302	Literary Trends and Movements	3-3-0-3 Total Lectures: 39
Objective:	To provide a great amount of information and knowledge about the structure and history of English Literature, and it's social and geographical variations that prepare them for a various career paths.	
Unit 1	The Renaissance The Metaphysical School of Poets	8
Unit 2	The Classical Movements The Romantic Revival	8
Unit 3	The Fin De Siecle Movement The Georgian Poets	7
Unit 4	Poets of the First World War The High Modernist Mode	8
Unit 5	Poetry of the Thirties Poets of the Second World War	8
Course Outcome: The student will be able to:		
1	Describe major writers and their works in chronological order	
2	Understand how literature also influences the social and political history of each period	
3	Compare literary trends of one period with that of another	
4	Analyze how literary trends/movements emerge, function and dissolve, only to be reborn again	
5	Evaluate and classify all major literary trends and movements	
6	Explore issues, controversies & themes rather than chronological periods and write a well-organized paragraph in order to answer a question	
Text Books:		
1	Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.	
2	Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.	
Reference Books:		
1	Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.	
2	Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.	
3	Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.	
4	Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.	
5	Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.	

EL20.304	Literary Criticism	3-0-0-3 Total Lectures: 39
Objective:	To enable the student to understand different theories and its implications in the world of literature.	
Unit 1	Aristotle's Concept of Tragedy	5
Unit 2	Arnold's Touchstone Method Eliot's Concept of Tradition	9
Unit 3	Post Modernism The New Critics and Chicago Critics	10
Unit 4	Psychoanalytic Criticism Marxist Criticism	10
Unit 5	Post-Colonial Criticism	5
Course Outcome: The student will be able to:		
1	Understanding of the major schools of theory	
2	To imply the theories in the world of literature	
3	Interpret the literary texts critically	
4	Perform research, analysis, and criticism of the literary and cultural texts	
5	Write analytically in a variety of formats, including research, essays, etc.	
6	Examine the historical developments of the theories	
Text Books:		
1	Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press, 2018	
2	Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan, 2016.	
Reference Books:		
1	Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press, 1997.	
2	Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Columbia University Press, 2019.	
3	Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press,2001.	
4	Aristotle, Poetics, translated by S. H. Butcher, 2018.	

EL20.306	Dissertation	0-0-0-5
Objective:	To enable student acquire skills as a basis for the study of literature and history through English texts and also apply knowledge in solving/analyzing/exploring a real life situation/difficult problem.	
Course Outcome:		
1	Appreciate a work of art critically employing a theory of criticism	
2	Substantiate their views with apt illustrations and critical support	
3	The ability to develop a research project, including formulation of a research problem, searching for sources, and engaging in analytic discussion.	
4	Competence in academic writing and oral presentation skills.	
5	Use a working knowledge of research methodology to format the dissertation.	
6	Organize the views and format them into a dissertation of about twenty five to thirty pages.	
Reference Books:		
1	Latest edition of MLA Handbook for Writers of Research Papers	

EL20.308	Victorian Literature	5-1-0-6 Total Lectures: 65
Prerequisite:	Student should have the basic understanding of the era.	
Objective:	To enhance the student' writing skills and understanding of different types of poetry and texts written in Victorian era and critically analyze them.	
Unit 1	**Robert Browning:** My Last Duchess, Porphyria's Lover, Andrea Del Sarto, Prospice.	15
Unit 2	**Gerard Manley Hopkins:** Spring and Fall, Windhover, Felix Randal, The Sea and the Skylark.	15
Unit 3	**Emily Bronte:** Wuthering Heights (Ch. 1-17)	12
Unit 4	**Emily Bronte:** Wuthering Heights (Ch. 18-34)	12
Unit 5	**Thomas Hardy:** Far From the Madding Crowd (non- detailed)	11
Course Outcome: The student will be able to:		
1	Analyse, discuss and write critically about the use of supernatural and gothic tropes and their significance in a range of Victorian texts.	
2	Understand a range of Victorian literature in relation to a range of contexts including Victorian anxieties about modernity, madness, sexual transgression and disease.	
3	Identify and discuss theoretical discourses concerning class, sexuality, gender and colonialism as these illuminate a range of Victorian texts.	
4	Read carefully with attention to detail and to the ways in which texts are constructed, and demonstrate this skill in their writing.	
5	Evaluate a range of terms and concepts integral to literary studies.	
6	Generate a viewpoint to a range of genres including the novel, short story and poetry.	
Text Books:		
1	Pick, John: Gerard Manley Hopkins: Priest and Poet, Delhi, Oxford University Press	
2	Rhys, E.: Robert Browning and His Poetry.	
3	Bronte, Emily: Wuthering Heights	
Reference Books:		
1	Leavis, F. R., Essays on G M in New Bearing's Poetry, Penguins Books	
2	De Vane, W. C.: A Browning Handbook.	
3	Hardy, Thomas. Far From the Madding Crowd.	

EL20.310	Twentieth Century English Literature-II	5-1-0-6 Total Lectures: 65
Objective:	To enhance student' LSRW skills and understanding of different ways in poetry, dramas and fiction were written during the twentieth century to critically analyze them.	
Unit 1	**Philip Larkin :** Toad, Coming, At Grass, **Ted Hughes :** Pike, View of a Pig, Thought Fox	13
Unit 2	**Arthur Miller**: The Crucible	13
Unit 3	**Sudha Murty:** Dollar Bahu	13
Unit 4	**Virginia Woolf :** To the Lighthouse (non- detailed)	13
Unit 5	**James Joyce :** A Portrait of the Artist as a Youngman(non- detailed)	13
Course Outcome: The student will be able to:		
1	Learn to read, analyze and appreciate poetry, drama and fiction critically.	
2	Discuss the significant figures and events of the period.	
3	Have an understanding of the major Literary and Cultural Trends in poetry.	
4	Recognize the rhythms, metrics and other musical aspects of poetry.	
5	Have an understanding of the circumstances that shape the processes of literary production during the twentieth century.	
6	Know about the diverse poetic devices and strategies employed by the writers.	
Text Books:		
1	Joyce, James: A Portrait of the Artist as a Youngman. Wordsworth Editions Ltd; New edition edition (5 May 1992) / Peacock; First edition (1 January 2012)	
2	Woolf, Virginia: To the Lighthouse. UBS Publishers' Distributors Pvt. Ltd. (2004)/ Fingerprint! Publishing; Latest Edition edition (1 March 2016)	
Reference Books:		
1	Routledge History of Literature, Routledge; 1 edition (29 May 1997)	
2	Lois Tyson: Critical Theory Today A User-Friendly Guide, Routledge; 2 edition (27 September 2006)	
3	Leavis, F. R.: Essays on G M in New Bearing's Poetry, Penguins Books.	
4	M.H. Abrams and Geoffrey Harpham: Glossary of Literary Terms. Cengage Learning; 11 edition (January 1, 2014)	

BA Honours Political Science 2020-21

PS20.101 Fundamentals of Political Science 3-0-0-3 Total Lectures: 39

Objective: State and Government are the Institutions which are regulating the behaviour of the individual in the society by its laws; Political science is the subject which is dealing with these Institutions. The objective of the course is to create awareness among the student about the basic concepts of Political Science and to make them acquaint of the various dimensions
of the subject by introducing them to underline principles of state & Governance.

Unit 1	Introduction: Nature and scope of Political Science-conceptual analysis, Relationship of Political Science with other disciplines – History, Economics, Sociology	8
Unit 2	State, Government and Sovereignty: Concept and theories of origin of State: Divine Theory, Force Theory, Theory of Social Contract and Evolutionary Theory; Government & State; Forms of Government: unitary, Federal, Quasi – Federal, Parliamentary Presidential;	9
Unit 3	Sovereignty: Concept and types of Sovereignty and challenges to Sovereignty, Theories of Sovereignty: Pluralist, Legal, Monistic Theory.	7
Unit 4	Political Concepts : Power, Authority & Legitimacy : Inter-Relationship; Law, Citizenship, Property	12
Unit 5	Political Obligation : Political obligation: Concept and its basis	3

PS20.103 Indian Political Thought-I 3-0-0-3 Total Lectures: 39

Objective: This course introduces the specific elements of Indian Political Thought spanning over two millennia. The basic focus of study is on individual thinkers whose ideas are however framed by specific themes. The course as a whole is meant to provide a sense of the broad streams of Indian thought while encouraging a specific knowledge of individual thinkers and texts.

Unit 1	Traditions of Pre-colonial Indian Political Thought: Brahmanic and Shramanic	8
Unit 2	Ved Vyasa (Shantiparva): Rajadharma	5
Unit 3	Manu: Origin of state, Saptang theory, Inter-state relations, Functions of state	9
Unit 4	Kautilya: Origin of state, Saptang theory, Inter-state relations, Functions of state	9
Unit 5	Barani: Ideal Polity; AbulFazal: Monarchy	8

PS20.105 Perspectives on Public Administration-I 3-1-0-4

Total Lectures: 39

Objective: The course provides an introduction to the discipline of public administration. This paper encompasses public administration in its historical context with an emphasis on the various classical and contemporary administrative theories. The course also explores some of the recent trends, including feminism and ecological conservation and how the call for greater democratization is restructuring public administration. The course will also attempt to provide the students a comprehensive understanding on contemporary administrative developments.

Unit 1	Public Administration as a discipline: Meaning, Dimensions and Significance of the Discipline	6
Unit 2	Growth of discipline: Evolution of Public Administration, Public and Private Administration	5
Unit 3	Classical Theories: Scientific management (F.W.Taylor), Administrative Management (Gullick, Urwick and Fayol), Ideal-type bureaucracy (Max Weber)	10
Unit 4	Neo-Classical Theories: Human relations theory (Elton Mayo), Rational decision-making (Herbert Simon)	10
Unit 5	Contemporary Theories: Ecological approach (Fred Riggs), Innovation and Entrepreneurship (Peter Drucker)	8

PS20.107 Feminism: Theory & Practice

4-1-0-5 Total Lectures: 52

Objective: The aim of the course is to explain contemporary debates on feminism and the history of feminist struggles. The course begins with a discussion on construction of gender and an understanding of complexity of patriarchy and goes on to analyze theoretical debates within feminism. Further, the paper covers history of feminism in the west, socialist societies and in anti-colonial struggles.

Unit 1	Approaches to Study Patriarchy Understanding Sex/ Gender Distinction: Biologism versus Social Constructivism, Patriarchy; Private, Public and Power relations within the Family	12
Unit 2	History of Feminism Origins of Feminism in the West & Socialist Countries: Britain and France, China, Cuba and USSR	6
Unit 3	Waves of Feminism : Liberal, Socialist, Marxist, Radical feminism, New Feminist Schools/Traditions	12
Unit 4	The Status of Women in India The Position of Women in Indian Society, Gender relations in the Family, Legal Provisions for the protection of Women in India	12
Unit 5	Contemporary Position of Women in Indian Society: Understanding Woman's Work and Labour , Representation of women in the Indian Parliament, Debates on the Reservation of Women in Legislature	10

PS20.102 Understanding Political Theory

3-0-0-3 Total Lectures: 39

Objective: This course introduces the students to the idea of political theory, its history and approaches, and an assessment of its critical and contemporary trends. Further it is designed to reconcile political theory and practice through reflections on the ideas and practices related to democracy.

Unit 1	What is Politics: Theorizing the 'Political'; Traditions of Political Theory: Liberal, Marxist, Anarchist and Conservative	10
Unit 2	Approaches to Political Theory: traditional, Behaviouralism, Post-behaviouralism, System approach	6
Unit 3	Critical and Contemporary Perspectives in Political Theory: Feminist and Postmodern	7
Unit 4	Democracy: The history of an idea, Procedural Democracy and its critique	8
Unit 5	Deliberative Democracy, Participation and Representation	8

PS20.104 Indian Political Thought-II

3-0-0-3
Total Lectures: 39

Objective: Based on the study of individual thinkers, the course introduces a wide span of thinkers and themes that defines the modernity of Indian political thought. The objective is to study general themes that have been produced by thinkers from varied social and temporal contexts. Selected extracts from original texts are also given to discuss in the class.

Unit 1	Introduction to Modern Indian Political Thought; Rammohan Roy: Rights; DayanandSaraswati: Swarajya	7
Unit 2	Pandita Rama Bai: Gender; Gopal Krishna Gokhale: Political Testament; Bal GangadharTilak: Swarajya	9
Unit 3	Gandhi: Ideal State; B. R. Ambedkar: Social Justice	9
Unit 4	Muhammad Iqbal: Community; V. D. Savarkar: Hindutva	6
Unit 5	J. L.Nehru: Democratic Socialism; J .P. Narayan: Socialism	8

PS20.106 Perspectives on Public Administration-II

3-1-0-4
Total Lectures: 39

Objective: The course provides an introduction to the major approaches to Public Administration. The course also explores some of the recent trends, including feminism and ecological conservation and how the call for greater democratization is restructuring public administration. The course will also attempt to provide the students a comprehensive understanding on contemporary administrative developments as well as an introduction to the concept of Public Policy.

Unit 1	Major Approaches in Public Administration: New Public Administration, New Public Management, Public Service Approach, Good Governance	12
Unit 2	Basic concepts:: Hierarchy, Delegation, Coordination, Supervision, Line Staff relationship	8
Unit 3	Control over Public Administration: Legislative, Judicial and Popular Nature, Limits and role of these controls.	6
Unit 4	Public Policy: Concept, relevance and approaches, Formulation, Implementation and Evaluation of public policy	8
Unit 5	Forces in Policy making approach: Electorate power, Policy agenda, Influence of media, Pressure groups, Political parties	5

PS20.108 Political Ideologies

4-1-0-5
Total Lectures: 52

Objective: The study of political ideologies gives the student a window through which to view complex political phenomena. This course examines the origins and impact of ideologies on the development of societies. Major ideologies such as liberalism, conservatism, anarchism, Marxist theory, socialism, applied Marxism, fascism, nazism and other Modern ideologies are covered.

Unit 1	Introduction : The historical development of ideology, The goals and purpose of ideologies	6
Unit 2	Classical Ideologies : Evolution & Development, Principle Characteristics and evaluation of Liberalism, Idealism and Socialism	12
Unit 3	Varieties of Socialism : Fabian, Guild, Revisionism, Syndicalism & Democratic Socialism	14
Unit 4	Totalitarianism : Fascism & Nazism	8
Unit 5	Contemporary Ideologies : Neo- Marxism, Neo- Liberalism, Environmentalism, Multiculturalism	12

PS20.201 **National Movement & Constitutional Development in India** **3-0-0-3**

Total Lectures: 39

Objective: The purpose of this course is to help students understand the struggle of Indian people against colonialism. The course begins with the nineteenth century Indian responses to colonial dominance in the form of reformism and its criticism and continues through various phases up to the events leading to the Partition and Independence. In the process, the course tries to highlight its various conflicts and contradictions by focusing on its different dimensions: communalism, class struggle, caste and gender questions.

Unit 1	Phases of Nationalist Movement: Liberal, Extremists and the Revolutionaries	9
Unit 2	Gandhi and Mass Mobilization: Non-Cooperation Movement, Civil DisobedienceMovement and Quit India Movement	7
Unit 3	Social Movements: a. The Women's Question: Participation in the National Movement and its Impact b. Peasant, Tribals and Workers Movements	8
Unit 4	Partition and Independence: a. Communalism in Indian Politics b. The Two-Nation Theory, Negotiations over Partition	6
Unit 5	Major Acts, Indian Council Act 1909, Mont-Chelmsford Reform Act 1919, Government of India Act 1935, Indian independence Act 1947	9

3-0-0-3 Total Lectures: 39

PS20.203 Comparative Government & Politics-I

Objective: This is a foundational course in comparative politics. The purpose is to familiarize students with the basic concepts and approaches to the study of comparative politics. More specifically the course will focus on examining politics in a historical framework while engaging with various themes of comparative analysis in developed and developing countries.

Unit 1	Understanding Comparative Politics : Nature and scope	3
Unit 2	Historical context of modern government: a. Capitalism: meaning and development; globalization b. Socialism: meaning, growth and development	8
Unit 3	Approaches to Studying Comparative Politics: Constitutionalism; Culture; Political Development; Political Modernization; Political Socialization	10
Unit 4	Electoral System: Definition and procedures: Types of election system (First Pastthe Post, Proportional Representation, Mixed Representation); Political parties and pressure groups	6
Unit 5	Salient Features of Major Constitutions: United States, England, France, Switzerland and China	12

PS20.205 Political Theory-Concepts and Debates 3-1-0-4 Total Lectures: 39

Objective: This course helps the student familiarize with the basic normative concepts of political theory. Each concept is related to a crucial political issue that requires analysis with the aid of our conceptual understanding. This exercise is designed to encourage critical and reflective analysis and interpretation of social practices through the relevant conceptual toolkit. Further, the course introduces the students to the important debates in the subject. These debates prompt us to consider that there is no settled way of understanding concepts and that in the light of new insights and challenges, besides newer ways of perceiving and interpreting the world around us, we inaugurate new modes of political debates.

Unit 1	Importance of Freedom: Negative Freedom, Positive Freedom	7
Unit 2	Significance of Equality: Political equality, Egalitarianism: Backgroundinequalities and differential treatment	7
Unit 3	Indispensability of Justice: Procedural Justice, Distributive Justice	7
Unit 4	The Universality of Rights: Natural Rights, Moral and Legal Rights	7
Unit 5	Major Debates: I. Why should we obey the state? Issues of political obligation and civildisobedience. II. How do we accommodate diversity in plural society? Issues of multiculturalism and toleration.	11

PS20.205 Political Theory-Concepts and Debates 3-1-0-4 Total Lectures: 39

Objective: This course helps the student familiarize with the basic normative concepts of political theory. Each concept is related to a crucial political issue that requires analysis with the aid of our conceptual understanding. This exercise is designed to encourage critical and reflective analysis and interpretation of social practices through the relevant conceptual toolkit. Further, the course introduces the students to the important debates in the subject. These debates prompt us to consider that there is no settled way of understanding concepts and that in the light of new insights and challenges, besides newer ways of perceiving and interpreting the world around us, we inaugurate new modes of political debates.

Unit 1	Importance of Freedom: Negative Freedom, Positive Freedom	7
Unit 2	Significance of Equality: Political equality, Egalitarianism: Background inequalities and differential treatment	7
Unit 3	Indispensability of Justice: Procedural Justice, Distributive Justice	7
Unit 4	The Universality of Rights: Natural Rights, Moral and Legal Rights	7
Unit 5	Major Debates: III. Why should we obey the state? Issues of political obligation and civildisobedience. IV. How do we accommodate diversity in plural society? Issues of multiculturalism and toleration.	11

PS20.202 **Constitutional Government & Democracy in India** **3-0-0-3**

Total Lectures: 39

Objective: This course acquaints students with the constitutional design of state structures and institutions, and their actual working overtime. The Indian Constitution accommodates conflicting impulses (of liberty and justice, territorial decentralization and a strong union, for instance) within itself. It further encourages a study of state institutions in their mutual interaction, and in interaction with the larger extra-constitutional environment.

Unit 1	The Constituent Assembly, Preamble, Features of the Constitution and Federalism	8
Unit 2	Fundamental Rights, Directive Principles and Fundamental Duties	8
Unit 3	The Legislature: Parliament and State Legislatures	8
Unit 4	The Executive: President, Prime Minister, Governor, Council of Ministers	8
Unit 5	The Judiciary: Supreme Court and High courts	7

PS20.204 Comparative Government & Politics-II 3-0-0-3 Total Lectures: 39

Objective: This paper studies some model constitutions of the world. The historical background of individual constitutions is to be emphasized to gain an understanding of its evolution. Furthermore the political institutions are to be studied in the light of the political process to gain an understanding of the dynamics of actual politics and policy making

Unit 1	Britain: British Parliament, Monarchy and Prime Minster in Britain, British Judicial System	7
Unit 2	USA: US Congress, President of US, Supreme Court of America	7
Unit 3	Switzerland: Swiss Federal Assembly, Federal Council of Switzerland, Federal Tribunal of Switzerland	8
Unit 4	France: French Parliament, President and Prime Minister of France, French Judicial Structure	9
Unit 5	China: Chinese National People's Congress, President and Premier of China, Supreme People's Court in China	8

PS20.208 Modern Political Analysis 4-1-0-5 Total Lectures: 52

Objective: This paper seeks to provide an in-depth understanding of the nature of the discipline and its major concepts useful for analyzing political process and phenomena.

Unit 1	Political Analysis: meaning, need and nature; Methods of Political Analysis: Philosophical and Scientific	9
Unit 2	Decline of Political Theory- Historicism; Moral Relativism; Hyper factualism; Positivism and Neo-Positivism	10
Unit 3	Group Theory, Distributive Approach, Communications Theory, Decision-Making Theory	14
Unit 4	Political process and change; Theories of Alienation	9
Unit 5	Theories of Political Development and under-development	10

PS20.301	Ancient and Medieval Political Thought	3-0-0-3 Total Lectures: 39
Objective:	This course goes back to Greek antiquity and familiarizes students with the manner in which the political questions were first posed. Further the course deals with medieval political thought. This is a basic foundation course for students.	
Unit 1	Greek Political Thought: the Sophists, Plato and Aristotle.	9
Unit 2	Roman Political Ideas and their concept of Law, the Roman contribution to Political thought with special reference to Cicero.	8
Unit 3	The Growth of the Christian Church and Political ideas of early Christianity; St. Augustine.	8
Unit 4	Beginning of Medieval Era: Chief features of its Growth of the Papal Power-Church State Controversy.	8
Unit 5	St. Thomas Aquinas; Close of the Middle Ages and the Councillor Movement.	6

PS20.303	**Perspectives on International Relations and World History**	**3-0-0-3 Total Lectures: 39**
Objective:	This paper seeks to equip students with the basic intellectual tools for understanding International Relations. It introduces students to some of the most important theoretical approaches for studying international relations. The course begins by historically contextualizing the evolution of the international state system before discussing the agency-structure problem through the levels-of-analysis approach. After having set the parameters of the debate, students are introduced to different theories in International Relations. It provides a fairly comprehensive overview of the major political developments and events starting from the twentieth century.	
Unit 1	Studying International Relations: How do you understand International Relations: Levels of Analysis	6
Unit 2	Theoretical Perspectives: Classical Realism & Neo-Realism; Liberalism & Neoliberalism, Marxist Approaches	10
Unit 3	Theoretical Perspectives: Feminist Perspectives; Euro-centricism and Perspectives from the Global South	7
Unit 4	An Overview of Twentieth Century IR History: World War I: Causes and Consequences; World War II: Causes and Consequences	8
Unit 5	Cold War: Different Phases; Collapse of the USSR and the End of the Cold War	8

PS20.307 **Foreign Policy of Indian in Globalizing World** **5-1-0-6 Total Lectures: 65**

Objective: This course's objective is to teach students the domestic sources and the structural constraints on the genesis, evolution and practice of India's foreign policy. The endeavour isto highlight integral linkages between the 'domestic' and the 'international' aspects of India's foreign policy by stressing on the shifts in its domestic identity and the corresponding changes at the international level. Students will be instructed on India's
shifting identity as a postcolonial state to the contemporary dynamics of India attempting to carve its identity as an 'aspiring power'.

Unit 1	Determinants and Principles of India's Foreign Policy: a. Domestic and International sources of Indian's Foreign Policy b. Objectives and principles	12
Unit 2	India and the Global Economic and Political Regimes – Main Issues:India and World Trade Organization**;** India at the United Nations: Security CouncilReforms	12
Unit 3	India and South Asian States: a) Pakistan: Challenges and Prospects b) Afghanistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives: MainIssues	20
Unit 4	Changing Relations with the US and Russia from Cold War to Post-ColdWar; India- China Relations: Challenges and Prospects	11
Unit 5	Security Challenges of India: An Appraisal: Terrorism , Energy Security; India in contemporary multi-polar world	10

PS20.309 **Indian Administration** **5-1-0-6 Total Lectures: 65**

Objective: Modern Indian administration initiates its journey through legacy of British colonialism. In fact there has been a wider acknowledgement that the practices of Indian administration date back to Kautilya's era. Hence the paper seeks to introduce to students the historical roots of Indian administration and its relationship with accountability, welfare and well-being of the society. Secondly it deals with how the commencement of modern bureaucracy and its intersection with political structure has to be analyzed.

Unit 1	Evolution of Administration in India: The British legacies, the constitutional and Political system in Indian and its implications.
Unit 2	Central Administration: Secretariat, Prime Minister Office, Organization andworking of Union Ministers of Home, Finance and External Affairs.
Unit 3	State Administration: role of Chief Secretary, Police administration in the state.
Unit 4	District Administration: Divisional Commissioner, Role of Collector and its changing patterns.
Unit 5	Institutional Arrangement : National Development Council, Administrative Reform Commissions, Niti Aayog, Zonal Councils, Central Vigilance Commission

PS20.309 **Indian Administration** **5-1-0-6 Total**

Lectures: 65

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Unit 1	Evolution of Administration in India: The British legacies, the constitutional and Political system in Indian and its implications.	15
Unit 2	Central Administration: Secretariat, Prime Minister Office, Organization andworking of Union Ministers of Home, Finance and External Affairs.	12
Unit 3	State Administration: role of Chief Secretary, Police administration in the state.	12
Unit 4	District Administration: Divisional Commissioner, Role of Collector and its changing patterns.	12
Unit 5	Institutional Arrangement : National Development Council, Administrative Reform Commissions, NitiAayog, Zonal Councils, Central VigilanceCommission	14

PS20.311 Development Process and Social Movements in Contemporary India

5-1-0-6

Total Lectures: 65

Objective: Under the influence of globalization, development processes in India have undergone transformation to produce spaces of advantage and disadvantage and new geographies of power. The high social reproduction costs and dispossession of vulnerable social groups involved in such a development strategy condition new theatres of contestation and struggles. A variety of protest movements emerged to interrogate and challenge this development paradigm that evidently also weakens the democratic space so very vital to the formulation of critical consensus. This course proposes to introduce students to the conditions, contexts and forms of political contestation over development paradigms and their bearing on the retrieval of democratic voice of citizens.

Unit 1	Development Process since Independence a. State and planning b. Liberalization and reforms	13
Unit 2	Industrial Development Strategy and its Impact on the Social Structure	10
Unit 3	Mixed economy, privatization, the impact on organized and unorganized labour; Emergence of the new middle class	13
Unit 4	Agrarian Development: Strategy and its Impact on the Social Structure a. Land Reforms, Green Revolution b. Agrarian crisis since the 1990s and its impact on farmers	14
Unit 5	Social Movements a. Tribal, Peasant, Dalit and Women's movements b. Maoist challenge c. Civil rights movements	15

PS20.302 Modern Western Political Thought(From Machiavelli to Marx) **3-0-0-3 Total Lectures: 39**

Objective: With the help of this paper the student will develop an understanding about the development of political thought in western world.

Unit 1	Transition from the Middle Ages to the Modern Period: Political Thought of the Renaissance and Reformation: Machiavelli and Jean Bodin.	8
Unit 2	The Contractualists: Hobbes, Locke and Rousseau,	10
Unit 3	Utilitarianism: Bentham and J.S. Mill	7
Unit 4	The Idealist Tradition in Political Thought – Hegel & Green.	6
Unit 5	Scientific Socialism and Karl Marx.	8

PS20.304 Understanding Global Politics **3-0-0-3 Total Lectures: 39**

Objective: This course is about the international political affairs and the various ways to define global politics, which is a subject to enhance the world system

Unit 1	United Nations: Structure, Reforms and Significance in Contemporary era.	10
Unit 2	Nuclear Issues and disarmament: NPT, CTBT, other efforts for disarmamentation and India's nuclear policy.	6
Unit 3	Foreign policy of major countries:United States, United Kingdom,Russia and China	8
Unit 4	New International Economic Order: North- South Dialogue, South-South Cooperation	6
Unit 5	Regional organizations and Issues: SAARC, ASEAN, NAM and BRICS; Major contemporary trends and issues in the world.	9

PS20.308 Contemporary Political Thought **5-1-0-6 Total Lectures: 65**

Objective: To introduce students to the divergent traditions of political philosophy in contemporary times. It will equip students to engage with nuanced debate in contemporary political philosophy. Further will enable students to comprehend the different arguments about organising state, society and politics.

Unit 1	Lenin and Mao Zedong: Theories of Social Change	12
Unit 2	Hannah Ardent : Civic Republicanism Herbert Marcuse &JurgenHabermass : Critical Theory	15
Unit 3	Michael Walzer : Complex Equality Jean Paul Sartre : Existentialist view of Freedom	15
Unit 4	Third World Political Thought: Frantz Fanon, Che Guevara	11
Unit 5	Francis Fukuyama : End of History Samuel P. Huntington: Clash of civilizations	12

PS20.310 Local Self Administration in India **5-1-0-6 Total Lectures: 65**

Objective: This paper deals with the wider debate on compatibility of democracy and development. It intends to initiate discussion among students about the mechanisms and methods on how the benefit of development to be shared by the local structure of our society, as there has been a general concern that democracy is subject to elite capture.

Unit 1	Local Self Government: meaning and importance; Evolution of Local Self Government in India; Committees on Democratic Decentralization: Balwant Rai Mehta Committee, Ashok Mehta Committee, G. V. K. Rao Committee, L. M. Singhavi Committee, Thungon Committee	15
Unit 2	73rd and 74th Amendment: features, structural facets	12
Unit 3	Election and Finance: Composition and Functions of State Election Commission and State Finance Commission	10
Unit 4	Planning and Control: Rural and Urban Poverty Alleviation Programmes, State control over Rural and Urban Local Bodies	13
Unit 5	Critical Evaluation: SWOT (Strengths, Weaknesses, Opportunities & Threats) Analysis of Rural and Urban Local Institutions.	15

PS20.312 Contemporary Political Economy **5-1-0-6 Total Lectures: 65**

Prerequisite: The student should have the understanding of relationship between political science and economics.

Objective: Given the growing recognition worldwide of the importance of the political economy approach to the study of global order, this course has the following objectives:

1. To familiarize the students with the different theoretical approaches;
2. To give a brief overview of the history of the evolution of the modern capitalist world.
3. To highlight the important contemporary problems, issues and debates on how these should be addressed

Unit 1	Approaches to Political Economy: Classical Liberalism, Marxism, Welfarism, Neo-liberalism and Gandhian approach	5
Unit 2	Capitalist Transformation: European Feudalism and Transition to Capitalism	(
Unit 3	Globalization: Transnational Corporations, World Trade Organization, Non-governmental Organizations (their role in development)	(
Unit 4	Issues in Development (i) Culture: Media and Television (ii)Big Dams and Environmental Concerns (iii) Military: Global Arms Industry and Arms Trade (iv) Knowledge Systems	5
Unit 5	Globalization and Development Dilemmas (i) IT revolution and Debates on Sovereignty (ii)Gender (iii) Racial and Ethnic Problems (iv) Migration	5

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PL20.101 **Basic Psychological Processes-I** **3-0-0-3**

Total Lectures: 39

Objective: To introduce students to the basic concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Unit 1	**Introduction:** Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology.	8
Unit 2	**Methods of Psychology:** Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment.	7
Unit 3	**Biological Bases of Behavior:** Structure and Organization of the nervous system, function of the brain; Autonomic Nervous system.	8
Unit 4	**Learning:** Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.	7
Unit 5	**Personality:** Meaning and Nature, Determinants of Personality, Personality Traits, Development of Personality, Trait and type approaches, Freudian's Psycho-Sexual Theory and Erikson's Psycho-Social Theory, Assessment of personality.	9

PL20.103	Statistical Methods for Psychological Research-I	2-0-0-2 Total Lectures: 26
Objective:	To familiarize students with the use of statistical methods in psychological research and the techniques of descriptive statistics for quantitative research.	
Unit 1	**Scientific Foundations of Research:** Nature of Science and Scientific Method, Meaning and Purpose of Research, Techniques of data collection: Questionnaire, Interview, Observation, Survey, Experimental Method.	5
Unit 2	**Problem, Variable and Hypothesis:** Nature, Type and Sources. Control of variables	5
Unit 3	**Meaning and Purpose of Statistics in Psychology:** Discrete and Continuous Scores. Nature and Levels of Measurement.	5
Unit 4	**Frequency Distribution and Their Graphical Presentation:** Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks.	6
Unit 5	**Measures of Central Tendency:** Mean, Median and Mode	5

PL20.107	Child Psychology	3-1-0-4 Total Lectures: 39
Objective:	This course is an introduction to child development from conception through adolescence with emphasis on physical, cognitive and psychosocial growth. The effect of environmental and cultural influences on development will be investigated. Developmental theories will be analyzed and tested through practical applications such as child observations and interviews	
Unit 1	**Concept of Development:** Principles of growth. Maturation and development, Havighurtst's Developmental stages, Theories of Development: Piaget, Vygotsky, Chomsky, Erikson, Kohlberg	10
Unit 2	**Determinants of Development:** Biological and socio - cultural determinants of development, Methodological approaches: Longitudinal and cross-sectional; Sequential strategies and cohorts. Methods of study: Observation, experimentation, field study, interview and testing.	8
Unit 3	**Prenatal and Neonatal Development:** Stages and factors affecting it, Developmental Hazards The neonate: Physical characteristics, reflexes, sensory and motor capacities, Hazards of development in neonates.	8
Unit 4	**Development during Infancy:** Physical growth and motor development; Sensory and perceptual development; Language, emotional and social development, Developmental hazards.	6
Unit 5	**Development during Childhood**: Cognitive. Social, emotional and moral. Development of self - identity, Hazards of development in childhood.	7

PL20.109	Social Psychology	4-1-0-5 Total Lectures: 52
Objective:	• Develop an understanding of the individual in relation to the social world • Introduce students to the realm of social influence, as to how individuals think, feel and behave in social situations.	
Unit 1	**Introduction:** Nature and Scope of Social Psychology Social Psychology	8
Unit 2	**Person Perception**: Impression Formation; Impression Management; Attribution with Special References to Self Biases	12
Unit 3	**Attitude**: Nature, Formation and Change; Measurement, Attitudes as an effective social process.	8
Unit 4	**Group Behavior**: Structural and functional Properties; Formation; Process, Types, Effectiveness, Group ideology.	12
Unit 5	**Other Issues:** Terrorism, Poverty, Female infanticide and feticide.	12

PL20.102	Basic Psychological Processes -II	3-0-0-3 Total Lectures: 39
Objective:	To introduce students to the basic concepts of the field of psychology with an emphasis on applications of psychology in everyday life.	
Unit 1	**Sensory and Perceptual Processes:** Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception.	8
Unit 2	**Thinking:** The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation.	7
Unit 3	**Intelligence:** Nature, Theories of Intelligence: Factor, Process and Gardener's Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests.	7
Unit 4	**Memory and Forgetting:** Sensory, Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory.	7
Unit 5	**Motivation and Emotion:** Meaning and Nature, Types of Motives: Primary and Secondary, Biogenic and Sociogenic Motives, Intrinsic and Extrinsic Frame Work, Theories of Motivation – Drive Reduction, Arousal, Incentive, Opponent Process, Cognitive and Need Hierarchy; Techniques of Assessment of Motivations; Frustration and Conflict . Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.	10

PL20.104	Statistical Methods for Psychological Research-II	2-0-0-2 Total Lectures: 26
Objective:	To familiarize students with the use of statistical methods in psychological research and the techniques of descriptive statistics for quantitative research.	
Unit 1	**Sampling Methods:** Probability and Non-Probability Sampling Methods.	5
Unit 2	**Experimental Design:** Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs	5
Unit 3	**Measures of Variability:** Range, Quartile Deviation and Standard Deviation.	5
Unit 4	**Normal Probability Curve:** Properties and Applications. Skewness and Kurtosis.	5
Unit 5	**Reliability of Statistics:** Product Moment Method and Rank Order Method, Chi-Square, t-test: Mean for large and small independent samples,ANOVA.	6

PL20.108	Psychology of Adolescence and Adulthood	3-1-0-4 Total Lectures: 39
Objective:	To understand the transition from adolescence to adulthood.	
Unit 1	**Puberty:** Characteristics, Criteria and causes of puberty, Body changes at puberty, Effects of puberty changes, Effects of deviant Maturing, Sources of Concern, Hazards of Puberty.	8
Unit 2	**Adolescence:** Characteristics, Developmental tasks, Physical and psychological changes, Emotionality, Social changes and morality in adolescents, Family relationships in adolescence, Hazards of adolescence.	8
Unit 3	**Early Adulthood:** Characteristics, Developmental tasks, Changes in interests, Social mobility and sex role adjustments in early adulthood, Vocational and marital adjustments, Adjustment to parenthood, Hazards during early adulthood.	8
Unit 4	**Middle Adulthood:** Characteristics, Developmental tasks, Adjustment to physical and mental changes, adjustment to changed interests, Social and vocational Adjustments, Adjustments to loss of a spouse, approaching old age and retirement. Hazards of Middle adulthood.	8
Unit 5	**Old Age:** Characteristics, Developmental tasks, adjustment to physical changes, motor abilities , mental abilities and interests in Old age. Hazards of old age.	7

PL20.110	Psychology of Relationships	4-1-0-5 Total Lectures: 52
Objective:	To make student aware of different social relationships and how to work effectively with people.	
Unit 1	**Social Relationships**: Nature, Types, Theories (reinforcement, social exchange and cognitive), Social Learning, SituationalLearning.	10
Unit 2	**Interpersonal Communication:** Communication Process; Verbaland Non-verbal Communication; Factors Affecting Communication.	11
Unit 3	**Interpersonal Attraction:** Nature, theories, affective basis of attraction.	10
Unit 4	**Intergroup Relations:** Nature, Strategies, Intergroup conflict,Stereotypes and Prejudices – Formation. Maintenance and Change.	10
Unit 5	**Prosocial Behaviour:** Altruism: diffusion of responsibility, pluristic ignorance, confusion of responsibility, empathy,attribution, emotion and mood, norms and helping.	11

PL20.201	Understanding Psychological Disorders-I	3-0-0-3 Total Lectures: 39
Objective:	The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information on psychopathology and dispel myths regarding it.	
Unit 1	**Concept of normality and abnormality:** Criteria for determining abnormality, Historical perspectives on abnormal behavior, Research methods in abnormal psychology: Scientific Method, Naturalistic Observation, Correlational Method, Experimental Method, Epidemiological studies, Kinship studies and Case studies	8
Unit 2	**Contemporary perspectives Methods of Assessment and Treatment:** Biological, Psychodynamic, Behavioristic, Humanistic, Socio-Cultural and Bio-psychosocial perspective; Types of helping professionals, Methods of Treatment by therapies.	7
Unit 3	**Stress related Disorders:** Stress And Health; Endocrine System, Immune System, General Adaptation Syndrome, Stress and Life Changes, Psychological factors that moderate stress, Adjustment Disorder; Traumatic Stress Disorders; Theoretical perspective and treatment approaches.	8
Unit 4	**Anxiety Disorders**: Overview, Panic disorder, Phobic disorder, Generalized Anxiety Disorder, Obsessive Compulsive and related disorders, theoretical perspective and treatment approaches.	8
Unit 5	**Mood Disorders:** Types: Major Depressive Disorder, Persistent Depressive Disorder, Premenstrual Dysphoric Disorder, Bipolar disorder, Cyclothymic disorder; Causal factors and treatment.	8

PL20.203	Introduction to Indian Psychological Thought	2-0-0-2 Total Lectures: 26
Objective:	To introduce students to the basic psychology with reference to Indian context.	
Unit 1	**Introduction to Indian psychological thought –** what is psychology and what could it be: alternative perspectives; what the Indian tradition can contribute: a psychology friendly philosophy; rigorous methods of enquiry in the subjective domain; effective methods for therapy and the harmonious development of the individual and the society; Sri Aurobindo's 4 types of knowledge; stages in experiential learning; self-knowledge for its own sake, for healing, and for developing one's potential.	5
Unit 2	**Self and personality**: Who am I? – different Indian traditions on the self and the structure of personality; the character and location of the border between self and world; personality types; emotion and attitudes; states of consciousness and their effect on perception and quality of life. **Individual development** – various determinants of who and how we are; prenatal influences; past impressions and formations during childhood, adolescence and adulthood; Ashramas then and now .	5
Unit 3	**Self in action**: Self in the social context – relationships with family, friends and partners, social groups, work and the world; relationship with oneself and one's Self; group membership by birth and by choice; roles and hierarchies; shifting identities; positive and negative group-derived values and judgments.	5
Unit 4	**Application of Indian Psychology in Counselling and therapy** – Vipassana and mindfulness; Hathayoga-based therapies; The Gita as guide.	5
Unit 5	**Application of Indian Psychology in Education, Organizational behaviour& community work** – Gandhi's NaiTalim; Tagore's system of education; Sri Aurobindo's integral education; Gita-based approaches to OB.	6

PL20.207	Biopsychology-I	3-1-0-4 Total Lectures: 39
Objective:	To explore the biological basis of experience and behaviour and bodily system.	
Unit 1	**Introduction to Physiological Psychology:** Definition, Historical Background, Methods, Approaches.	7
Unit 2	**Cell Biology:** Structure and Function of Cells	8
Unit 3	**Nerve Physiology**: Structure and Function of Neuron, Nerve Impulse Transmission (Electrical and Chemical).	9
Unit 4	**Central Nervous System**: Brain and Spinal Cord; Brain disorders	8
Unit 5	**Peripheral Nervous System**: Somatic, Autonomic.	7

PL20.209	Schools of Psychology-I	4-1-0-5 Total Lectures: 52
Objective:	To develop the understanding of various schools of psychology.	
Unit 1	**The study of the history of Psychology:** Why study the history of psychology, The data of history: Reconstructing the Psychology's past, Contextual forces in Psychology, Philosophical influences and physiological influences on Psychology.	11
Unit 2	**Beginning of Scientific Psychology** – Wundt, Weber, Fechner, Helmholtz.	11
Unit 3	**Associationism**: Associationism of S-R, Pavlov, Thorndike, Associationism as a system; criticism.	11
Unit 4	**Structuralism** : Wundt and Titchener: As a System; criticism.	9
Unit 5	**Functionalism** : James, Dewey: Functionalism as a system, criticism.	10

PL20.202	Understanding Psychological Disorders-II	3-0-0-3 Total Lectures: 39
Objective:	The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information on psychopathology and dispel myths regarding it.	
Unit 1	**Dissociative Disorders & Psychological Factors Affecting Physical Health:** Dissociative Identity Disorder, Dissociative Amnesia, Depersonalization Disorder; Theoretical perspective and treatments. Psychological factors affecting physical health: Headaches, Cardiovascular Disease, Asthma, Cancer and AIDS.	7
Unit 2	**Schizophrenia Spectrum Disorder**:Course of development, Diagnostic features,Theoretical perspectives,Treatment approaches;Other Schizophrenia Spectrum disorders:Brief Psychotic disorder,Schizophreniform disorder, Delusional disorder, Schizoaffective disorder.	8
Unit 3	**Personality Disorders & Impulse Control Disorders:** Types: Personality Disorders characterized by odd or eccentric behavior, Schizotypal disorder, Personality disorders characterized by dramatic, emotional or erratic behavior, Antisocial behavior, Personality disorders characterized by Anxious or Fearful behavior; Theoretical perspectives and Treatment. Impulse Control Disorders: Kleptomania, Intermittent Explosive Disorders, Pyromania.	9
Unit 4	**Substance related and Addictive Disorders:** Substance use and Abuse, Clarifying terms, Pathwaysto addiction, Drugs of abuse: Depressants, Stimulants, Hallucinogens. Theoretical perspectives and treatment.	8
Unit 5	**Therapeutic Approaches:**Psychodynamic therapies ; Behaviour therapies; Client centered therapy; Cognitive therapies; Indigenous therapies (Yoga, Meditation); Bio-feedback therapy; Prevention and rehabilitation of the mentally ill; Fostering mental health.	7

PL20.204	Psychometrics	2-0-0-2 Total Lectures: 26
Objective:	To provide an advanced understanding of psychometrics and its research applications.	
Unit 1	**Psychological Tests:** Historical antecedents. Characteristics, types and applications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.	5
Unit 2	**Psychometric properties of tests: Reliability:** Meaning, sources of error, methods of estimate, and special problems. **Validity:** meaning, validation procedures, and special problems.	5
Unit 3	**Construction and Standardization of Psychological Tests** General steps of test construction: Preparation for Item writing, item analysis, reliability, validity. Development of norms, Item analysis for speed test; cross validation.	6
Unit 4	**Personality Tests:** Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors. Projective- Rorschach and TAT.	5
Unit 5	**Intelligence Tests:** WAIS, Raven's Standard and Color progressive Matrices, Bhatia battery.	5

PL20.208	Biopsychology-II	3-1-0-4 Total Lectures: 39
Objective:	To explore the biological basis of experience and behaviour. bodily system.	
Unit 1	**States of Consciousness :**Overview, Physiological and psychological states, Sleep and activation, sleep theories, Sleep Cycle, Dreaming and Circadian Rhythm.	7
Unit 2	**Motivation and Emotion**: Overview, Specific motives, Characteristics of drives and motives, Regulation of thirst , hunger and sex drive; Approaches to emotion, Theories, Neural mechanism in emotion.	8
Unit 3	**Learning and Language:** Overview, Locus of the memory trace; Language and brain, Learning and memory; Biofeedback, Types of conditioning and time course of brain activity in learning, Hologram model.	8
Unit 4	**Audition and Vision:** Anatomy of auditory and visual mechanism, Auditory defects, Complex auditory phenomena: aural harmonics, masking, after sensations, speech and localizations; Nervous connection of the eye, color vision theory, duplicity theory, electroretinogram, Response of cerebral cortex to visual information.	8
Unit 5	**Science of Genetics** : Mitosis; Meiosis; Mendel's Law, Linkage and Cross Over. Introduction to the theory of evolution by Darwin, Human Behavior, Genetic Analysis (Family and Twin Methods). Inheritance of Intelligence and Psychopathology (mood disorder) in Humans.	8

PL20.210	Schools of Psychology-II	4-1-0-5 Total Lectures: 52
Objective:	To develop the understanding of various schools of psychology.	
Unit 1	**Behaviorism** : Watson, Skinner, Behaviorism as a System, criticism	10
Unit 2	**Gestalt Psychology** : Antecedents of Gestalt Movement, Berlin and Leipzig School, Gestalt Psychology as a system. Criticism.	12
Unit 3	**Psychoanalysis :** Freud, Adler, Jung	10
Unit 4	**Neo Freudians :** Horney, Fromm, Sullivan	10
Unit 5	**Dynamic Psychology :** Woodworth and McDougall	10

PL20.301	Educational Psychology	3-0-0-3 Total Lectures: 39
Objective:	To understand the applications of psychology in the area of education.	
Unit 1	**Introduction to Educational Psychology:** Nature, scope & relevance of Educational Psychology, professional knowledge and skills of effective teaching	6
Unit 2	**Conceptual and Theoretical Perspectives in Educational Psychology:** Information-Processing approach, Behavioral and Social Cognitive approaches, Social Constructivist approach.	9
Unit 3	**Human Diversity and Education:** Intelligence & Creativity, Learning & thinking styles, Personality and Temperament; Socio-Cultural diversity- culture & ethnicity, multicultural education and gender.	10
Unit 4	**Classroom Management:** Classroom management issues, designing physical environment of classroom, creating positive environment for learning, being a good communicator, dealing with problem behaviours, technology and education.	8
Unit 5	**Exceptionality and Special Education:** Conceptualizing Exceptionality: Categorization, Labelling and its educational implications; Responsibilities of Teachers towards learners with Special Needs.	6

PL20.303	Industrial and Organizational Psychology-I	2-0-0-2 Total Lectures: 26
Objective:	To develop an awareness of the concepts related to organizational behavior.	
Unit 1	**Industrial/Organizational Psychology:** Nature, historical development and scope.	5
Unit 2	**Personnel selection and development:** Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.	6
Unit 3	**Training of Personnel:** Nature, Principles and Methods: On the job and of the job training methods. Evaluation of training programme.	5
Unit 4	**Performance Appraisal:** Necessity. Performance criteria, Techniques of performance appraisal	5
Unit 5	**Work environment:** Noise, atmospheric conditions. Illumination and performance.	5

PL20.309	Perspectives in Psychology- I	5-1-0-6 Total Lectures: 65
Objective:	To understand different applications of psychology.	
Unit 1	**Introduction:** Nature, Fields of applied psychology, Role of applied psychologist; Trends of Psychology in the 21st century	12
Unit 2	**Psycho-oncology:** Understanding cancer, emergence of psycho-oncology, role of psycho-oncologists, psychosocial issues, psychosocial screening, communication and interpersonal skills in psycho-oncology, psychological interventions used in cancer care.	13
Unit 3	**Community Psychology**: Definition of community psychology; types of communities; models; core values (Individual and family wellness; sense of community; respect for human diversity; social justice; empowerment and citizen participation; collaboration and community strengths); process of community organization for health promotion; Community program for: child and maternal health, physical challenged and old age in the Indian context.	14
Unit 4	**Health & Wellbeing**- Components of health, characteristics, barriers and theories of health behavior, health enhancing behaviors (exercise, nutrition, safety, pain, stress management), happiness, life satisfaction, resilience, hope and optimism.	13
Unit 5	**Youth, Gender and Identity:** Transition to Adulthood , Sexual Orientation, Gender Roles; youth and identity (family, peer group, workplace identity and relationships); Gender and Identity (issues of sexuality in youth, gender discrimination); issues related to youth, gender & violence, women empowerment, encouraging non-gender stereotyped attitudes in youth.	13

PL20.311	Counseling and Guidance	5-1-0-6 Total Lectures: 65
Objective:	To develop an understanding of basic concepts, processes, and techniques of Counseling.	
Unit 1	**Guidance:** Historical Perspective, Objectives and Principles of guidance. Types of Guidance: Personal, Educational and Vocational.	12
Unit 2	**Counseling:** Definition, Nature, Goals; Necessary personal characteristics/qualities of effective counselors; Counseling as a profession: professional ethics (Latest version of American Counseling Association – ACA); status of counseling psychology in India.	13
Unit 3	**Counseling approaches**: Psychoanalytic techniques; Humanistic techniques; Behavioral techniques; Cognitive techniques; Indian techniques: Yoga and Meditation.	14
Unit 4	**Counseling process:** External conditions and preparation; Structuring the counseling relationship; Counseling interview and degrees of lead by the counselor, nonverbal behavior; Group counseling approaches.	13
Unit 5	**Areas of Counseling:** Child, career, family and marital gerontological and weaker sections; Stress management oriented counseling; Crisis Intervention: suicide, grief, and sexual abuse.	13

PL20.302	Cognitive Psychology	3-0-0-3 Total Lectures: 39
Objective:	To give students knowledge of the most important concepts, themes, problems and empirical research in modern cognitive theory as it concerns how we receive, interpret, edit, use and save information.	
Unit 1	**Introduction to Cognitive Psychology:** Definition, philosophical and psychological antecedents, Research methods, Fundamental ideas in cognitive psychology.	7
Unit 2	**Memory:** Models of memory, Exceptional memory and neuropsychology; Memory processes: Encoding and transfer of information, Retrieval, Process of Forgetting and memory distortion; Mental images, maps and propositions.	8
Unit 3	**Language:** Properties of language: basic components of words and sentences; Language comprehension: Understanding words, semantics and syntax; Language and thought; Neuropsychology of language	8
Unit 4	**Problem Solving and Creativity:** Problem solving cycle, types of problems, Obstacles and aids to problem solving; Creativity: characteristics of creative people, neuroscience and creativity.	9
Unit 5	**Decision Making and Reasoning:** Judgment and Decision making, Neuroscience of Decision Making, Deductive Reasoning, Inductive Reasoning, Neuroscience of Reasoning.	7

PL20.304	Industrial and Organizational Psychology-II	2-0-0-2 Total Lectures: 26
Objective:	To develop an awareness of the concepts related to organizational behavior.	
Unit 1	**Work motivation:** Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacy theory.	6
Unit 2	**Job Satisfaction, Supervision and leadership:** Concept, determinants and measurement; Functions and approaches. Trait, behavioral and contingency models.	5
Unit 3	**Accident and safety:** Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.	5
Unit 4	**Human engineering:** Man-machine system. Designs, displays, controls and action.	5
Unit 5	**Occupational stress:** Counterproductive behavior, role conflicts, absenteeism and burnouts, their causes and interventions.	5

PL20.310	Perspectives in Psychology-II	5-1-0-6 Total Lectures: 65
Objective:	To understand various applications of psychology.	
Unit 1	**Consumer Psychology:** Testing advertising effectiveness, consumer opinion surveys, assessment of consumer attitude, psychological marketing segmentation, product testing, observing consumer behavior; perceptual, cognitive, emotional and motivational factors of consumer behavior, decision making process, safeguarding consumer rights and wellbeing.	14
Unit 2	**Peace Psychology:** Meaning, psychology of peace; management to transformation - key concepts: peacekeeping, peacemaking, peace-building, reconciliation, conflict management, conflict resolution, conflict prevention, and conflict transformation; building peace (structure, Process, Integrated framework for peace building, peace education).	12
Unit 3	**Media Psychology**: Understanding the interface between media & psychology, Portrayal of Social Groups in Media: Gender, Minority Groups; Effect of Media Violence**;** Use & Abuse of Media: Internet Addiction**;** Role of Media in Social Change.	13
Unit 4	**Military Psychology:** Origin, concept, utility, scope; individual factors in armed forces (personnel selection, intelligence, personality); group dynamics in military life (structure, types, function, leadership, morale); psychological welfare (propaganda, rumor, coercive persuasion, brain washing	13
Unit 5	**Para Psychology:** Introduction of the field and concepts, History of Para Psychology, Subject variables affecting Psi test performance (Gender, Personality and attitudes), Implications and Applications of Psi, Out of Body Experiences and Near Death Experiences, Emotional problems and adjustment during war and peace.	13

PL20.312	Environmental Psychology	5-1-0-6 Total Lectures: 65
Objective:	To understand the concept of environmental psychology.	
Unit 1	**Emergence of environmental psychology and its growth:** Definition and scope. Human-environment relationship: different worldviews to understand human-environment relationship; Salient features of environmental psychology; Recent trends and future directions in environmental psychology.	12
Unit 2	**Human-environment transaction:** Personal space, territoriality, crowding; Indian research on crowding and personal space. Theoretical models: stimulus overload, behavioral constraint,ecological and adaptation.	14
Unit 3	**Environmental stress**: Concept and type of stress. Sources of stressors: Cataclysmic, ambient stressors, daily hassles.	13
Unit 4	**Pollutions:** noise, air, water, chemical and their consequences.	13
Unit 5	**Pro-environmental behaviour**: Changing the environmental destructive mindset; Environmental education, environmental prompts and cues; Reinforcement strategies, Environmental movements	13

BA Pass Course 2020-21

EL20.101 **English Poetry-I** **3-0-0-3**

Total Lectures: 39

Objective: To introduce the students' poetry from various cultures, languages and historic periods, letting the students to appreciate poetry as a literary art and its various elements of poetry.

Unit 1	**Literary Terms:** Simile, Metaphor, Alliteration, Ode, Sonnet, Pun, Heroic Couplet	3
Unit 2	**William Shakespeare:** Shall I Compare thee to a Summer's Day, Not Marble, nor the Gilded Monuments, Under the Greenwood Tree **John Donne:** The Sunne Rising, Batter My Heart, Death Be Not Proud	10
Unit 3	**Christopher Marlowe:** The Passionate Shepherd to His Love **Walter Raleigh:** The Nymph's Reply **Andrew Marvell:** To His Coy Mistress	10
Unit 4	**George Herbert:** Virtue **Ben Jonson:** To Celia	7
Unit 5	**John Milton:** On His Twenty Third Birthday, On His Blindness **Robert Herrick:** To the Virgins to Make Much of Time	9

Course Outcome:

1. Students would be able to identify a variety of forms and genres of poetry from diverse cultures and historic periods, such as sonnets, ballads, dramatic monologues, epic and pastoral, free verse, elegy etc.
2. Identify personal experiences that can be used when writing poems.
3. Analyze the various elements of poetry, such as diction, tone, imagery, figures of speech, symbolism, theme, etc.
4. Develop their critical thinking skills.
5. Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.
6. Examine the rhythms, metrics and other musical aspects of poetry.

Text Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd. (Latest Edition)
2. Dwivedi, A N (ed): A Garland of Flower, Allahabad, Narayan Publisher. (Latest Edition)

Reference Books:

1. Abrams, M H: A Glossary of Literary Terms, Delhi, Macmillan Ltd. (Latest Edition)
2. Margoleouth, H M: The Poems and Letters of Andrew Marvell, Delhi, Oxford University Press.
3. Gardner, Helen: John Donne: A Collection of Critical Essays, New Delhi, Prentice Hall.
4. Gardner, Helen: The Metaphysical Poets, London, Penguin. (Latest Edition)
5. Ford, Boris (ed): Pelican Guide to English Literature, Delhi, Penguin.

EL20.103 **English Prose-I** **3-0-0-3**

Total Lectures: 39

Objective: To enable the student to understand different ways in which essays and short stories were written in different time period and critically analyze them.

Unit 1	**Francis Bacon:** Of Studies, Of Revenge **William Hazlitt:** Indian Juggler	8
Unit 2	**Richard Steele:** The Spectator Club **Joseph Addison:** Meditations in Westminster Abbey	8
Unit 3	**Oliver Goldsmith:** Beau Tibbs at Home **Charles Lamb:** Dream Children: A Reverie	8
Unit 4	**Robert Lynd:** The Student **Huxley:** Pleasures	8
Unit 5	**Maxim Gorky:** The Mother of a Traitor **William Somerset Maugham:** The Verger	7

Course Outcome: The student will be able to:

1 To recognize different types of prose writing.
2 To understand and appreciate the basic concepts of style and literary devices in prose.
3 To apply the basic concepts of style and literary devices to different types of prose writing.
4 To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms in prose.
5 To be able to evaluate and synthesize information from a variety of resources.
6 To write creatively and critically.

Text Books:

1 Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd. (Latest Edition)
2 Sasikumar, J., Gunashekhar, Paul (eds): Spectrum, Chennai, Orient Longman. (Latest Edition)

Reference Books:

1 Hudson, William Henry: An Outline History of English Literature, Delhi, Atlantic Publishers.
2 Walker, Hugh: The English Essay and Essayists. London, J. M. Dent & Sons Ltd., 1915
3 Lall, Ramji: Essays of Elia, Delhi, Rama Brothers.2019
4 Daiches, David: A Critical History of English Literature, Delhi, Allied Publishers. (Latest Edition)

EL20.102 **English Poetry-II** **3-0-0-3**

Total Lectures: 39

Objective: To introduce the students' poetry from various cultures, languages and historic periods, letting the students to appreciate poetry as a literary art and its various elements of poetry.

Unit 1	**William Blake:** London **William Wordsworth:** The Solitary Reaper	6
Unit 2	**Percy Byssey Shelley:** Ode to the West Wind, Lines to an Indian Air **John Keats:** Ode to a Nightingale	9
Unit 3	**Lord Alfred Tennyson:** Ulysses **Matthew Arnold:** Dover Beach	9
Unit 4	**Robert Browning:** The Last Ride Together **Gerard Manley Hopkins:** Pied Beauty, God's Grandeur.	8
Unit 5	**William Butler Yeats:** To a Shade **Thomas Stearns Eliot:** Marina	7

Course Outcome:

1. Recognize poetry from a variety of cultures, languages and historic periods.
2. Identify personal experiences that can be used when writing poems.
3. Analyze the various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc.
4. Develop their critical thinking skills.
5. Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.
6. Examine the rhythms, metrics and other musical aspects of poetry.

Text Books:

1. Jain, Jasbir (ed): Strings of Gold-II, Delhi, Macmillan India Ltd.(Latest Edition)
2. Fifteen Poets, Delhi, Oxford University Press, 1974.

Reference Books:

1. Dwivedi, A. N. (ed): A Garland of Flower, Allahabad, Narayan Publishers.
2. Bowra, C M: The Romantic Imagination, London, Oxford University Press.
3. Brooks, Cleanth and Warren, Robert Penn: Understanding Poetry, New York, R Linehart & Wincton.
4. Hough Graham: The Romantic Poets, London, Hitchinson University Library.
5. Eliot, T S: On Poets and Poetry, London, Faber & Faber.
6. Lucas, F.L: Eight Victorian Poets, Cambridge.

EL20.104	**English Prose-II**	**3-0-0-3**
		Total Lectures: 39

Objective: To enable the student to understand different ways in which essays and short stories were written in different time period and critically analyze them.

Unit 1	**John Ruskin:** A Gentleman **John Bright:** Peace	8
Unit 2	**Charles Lamb:** Modern Gallantry **Lord Riddel:** The Art of Speaking	8
Unit 3	**Alfred George Gardiner:** All about a Dog **William Cowper:** On Conversation	8
Unit 4	**William Ralph Inge:** Happy People, Ambition.	8
Unit 5	**Thomas Hardy:** The Mayor of Casterbridge (*Non Detailed*)	7

Course Outcome: The student will be able to:

1 To recognize different types of prose writing
2 To understand and appreciate the basic concepts of style and literary devices in prose
3 To apply the basic concepts of style and literary devices to different types of prose writing
4 To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms in prose
5 To be able to evaluate and synthesize information from a variety of resources
6 To write creatively and critically

Text Books:

1 Approach to Life, Kolkata, Orient Longman Ltd., 1993.
2 Hardy, Thomas: The Mayor of Casterbridge, Oxford University Press, 2008.

Reference Books:

1 Lascelles, Abercrombie, Thomas Hardy, a Critical Study, Creative Media Partners, LLC, 2018.
2 Cecil, David. Hardy the Novelist: An Essay in Criticism, London : Constable, 1943.
3 Walker, Hugh: The English Essay and Essayists. London, J. M. Dent & Sons Ltd., 1915.

EL20.201 **English Drama-I** **3-0-0-3**

Total Lectures: 39

Objective: To enhance student' writing skills and understanding of different theatrical modes in which dramas were written in different time period and critically analyze them.

Unit 1	**George Bernard Shaw:** Candida (Act 1-3)	11
Unit 2	**William Shakespeare:** Hamlet (Act 1-3)	7
Unit 3	**William Shakespeare:** Hamlet (Act 4-5)	7
Unit 4	**William Congreve:** The Way of the World (Act 1-3)	7
Unit 5	**William Congreve:** The Way of the World (Act 4-5)	7

Course Outcome: The student will be able to:

1. Learn the creative usages of English language.
2. Explain the various themes and forms of drama from Elizabethan to Victorian.
3. Discuss and explain major theories of performance from Elizabethans to Victorians.
4. Discuss the impact of different literary theories like Feminism, Psychoanalysis, and Victorianism on drama.
5. Have knowledge of historical, socio-political, economic and religious trends in the plays.
6. Explore the entire range of human experience through dramas as a literary form.

Text Books:

1. Shakespeare, William: Hamlet, Penguin Classics; Penguin (7 April 2005)
2. Congreve, William: The Way of the World. Peacock Books; First edition (2020)
Shaw, George Bernard: Candida., Peacock Books; Latest edition (2013)

Reference Books:

1. M.H. Abrams and Geoffrey Harpham: Glossary of Literary Terms. Cengage Learning; 11 edition (January 1, 2014)
2. Aristotle. Poetics, Penguin; Revised ed. edition (26 September 1996)
3. Alexander, N, Poison, Play and Duel: A Study in Hamlet., Routledge and K. Paul; First Edition edition (1971)
4. Nicoll, Allardyce: British Drama, Chambers; 6th Revised edition (1 September 1978)/ Forgotten Books (9 June 2012)

EL20.203 **English Fiction-I** **3-0-0-3**

Total Lectures: 39

Objective: To enable the student to understand different ways in which fiction were written in different time period and critically analyze them.

Unit 1	**Charles Dickens:** Oliver Twist (Chapter 1-25)	6
Unit 2	**Charles Dickens:** Oliver Twist (Chapter 26- 53)	7
Unit 3	**R. K. Narayan:** The Bachelor of Arts (Chapter 1-8)	8
Unit 4	**R. K. Narayan:** The Bachelor of Arts (Chapter 9-18)	8
Unit 5	**George Orwell :** Animal Farm	10

Course Outcome: The student will be able to:

1 To recognize different types of fiction writing
2 To understand and appreciate the basic concepts of style and literary devices in fiction
3 To apply the basic concepts of style and literary devices to different types of fiction writing
4 To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms
5 To be able to evaluate and synthesize information from a variety of resources
6 To write creatively and critically

Text Books:

1 Dickens, Charles: Oliver Twist, Oxford University Press, 2016.
2 Orwell, George: Animal Farm, Jaipur, Jain Pustak Mandir, 2011.
3 Narayan, R. K.: The Bachelor of Art, Chennai, Indian Thought Publications, 2007.

Reference Books:

1 Daiches, David: A Critical History of English Literature, vol. IV, Delhi, Allied Publisher, 2002.
2 Chesterton, G. K.: Charles Dickens: A Critical Study, Trieste Publishing,2018.
3 Ford, Boris: From Dickens to Hardy, Penguin, 2020.
4 Iyengar, K. R. Srinivasa: Indian Writing in English, Sterling Publishers Pvt. Ltd, 2000.
5 Singh, Promod Kumar: Five Contemporary Indian Novelists, Jaipur, Book Enclave, 2009.
6 Crick, Bernard, George Orwell: A Life, Harvill Secker, 2018.

EL20.202 **English Drama-II** **3-0-0-3**

Total Lectures: 39

Objective: To enhance student' writing skills and understanding of different theatrical modes in which drama were written in different time period and critically analyze them.

Unit 1	**Rabindranath Tagore:** Chandalika (Act I & II)	9
Unit 2	**Girish Karnad:** Tughlaq (Scene 1-7)	8
Unit 3	**Girish Karnad:** Tughlaq (Scene 8-13)	7
Unit 4	**Harold Pinter:** The Birthday Party (Act I)	8
Unit 5	**Harold Pinter:** The Birthday Party (Act II)	7

Course Outcome: The student will be able to:

1. Learn the creative usages of English language.
2. Explain the various themes and forms of drama at different ages and stages.
3. Discuss and explain major theories of performance from Aristotle to the present day.
4. Discuss the impact of modern philosophies like Existentialism, Expressionism, Marxism and Absurdism on drama.
5. Have knowledge of historical, socio-political, and religious trends in the plays.
6. Explore the entire range of human experience through dramas as a literary form.

Text Books:

1. Karnad, Girish: Tughlaq, Delhi, Oxford University Press, 2 edition (30 May 2012)
2. Pinter, Harold: The Birthday Party., Publisher: Faber; Main edition (7 May 1991)
Tagore, R. N.: Chandalika, translated by Marjorie Sykes, Delhi, Oxford University Press., 1975

Reference Books:

1. Esslin, Martin: Pinter: The Playwright., Publisher: Methuen Publishing Ltd (September 30, 1992)
2. David Lodge, Nigel Wood: Modern Criticism and Theory: A Reader: Longman; 2 edition (10 August 1999).
3. Trussler, Simon: The Plays of Harold Pinter: An Assessment, Victor Gollancz; First Edition edition (1973)
4. J. A. Cuddon: A Dictionary of Literary Terms and Literary Theory, Fifth Edition-Wiley-Blackwell (2013) (1)/ Penguin Books; 5 edition (1 September 2015)

EL20.204 **English Fiction-II** **3-0-0-3**

Total Lectures: 39

Objective: To enable the student to understand different ways in which fiction were written in different time period and critically analyze them.

Unit 1	**D.H. Lawrence:** Sons and Lovers (Part I)	9
Unit 2	**D.H. Lawrence:** Sons and Lovers (Part II)	9
Unit 3	**Khushwant Singh:** A Train to Pakistan	7
Unit 4	**V.S. Naipaul:** A House for Mr. Biswas (Part I)	7
Unit 5	**V.S. Naipaul:** A House for Mr. Biswas (part II)	7

Course Outcome: The student will be able to:

1. To recognize different types of fiction writing
2. To understand and appreciate the basic concepts of style and literary devices in fiction
3. To apply the basic concepts of style and literary devices to different types of fiction writing
4. To analyze and appreciate fiction and enrich their knowledge about diverse fictional forms
5. To be able to evaluate and synthesize information from a variety of resources
6. To write creatively and critically

Text Books:

1. Lawrence, D.H: Sons and Lovers, Delhi, Peacock, 2010.
2. Singh, Khuswant: A Train to Pakistan, Delhi, Penguin Books India Ltd, 2016
3. Naipaul, V. S.: A House for Mr. Biswas, Picador, 2011.

Reference Books:

1. Daiches, David: A Critical History of English Literature, vol.IV, Delhi, Allied Publisher, 2002
2. Ford, Boris,The Modern Age: The Pelican Guide to Eng. Literature Series, Penguin, 2000.
3. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publishers Pvt. Ltd., 2019.
4. Singh, Pramod Kumar, Indian Fiction in English, Delhi, Atlantic Publisher, 2000.

EL20.301 **American Literature** **3-0-0-3**

Total Lectures: 39

Objective: Introduces the literature of the land which is now the United States from before European contact through the mid-nineteenth century.

Unit 1	**Walt Whitman:** When the Lilacs in the Last Dooryard Bloomed, Crossing Brooklyn Ferry	9
Unit 2	**Emily Dickinson:** A Bird came down the Walk, I heard a Fly Buzz, A Light Exists	7
Unit 3	**Robert Frost:** Mending Wall, After Apple Picking, Birches, Stopping by Woods on a Snowy Evening	9
Unit 4	**Sylvia Plath:** Morning Song, Death and Company	5
Unit 5	**R.W. Emerson:** Brahma **Edgar Allan Poe:** The Fall of the House of Usher	9

Course Outcome: The student will be able to:

1. Describe the major historical and cultural developments of colonial America
2. Appreciate poetry as a literary art and its various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc
3. Demonstrate knowledge of foundational texts of Early American literature through 1860s.
4. Identify and discuss the roles which gender, race, age, class, ethnicity, wealth, poverty, and geography have played in creating American literature.
5. Use literary texts to examine the historical, cultural, and rhetorical contexts in which they were written.
6. Write clear, focused, coherent essays about literature for an academic audience, using standard English conventions of grammar and style.

Text Books:

1. Allan, Gay W., The Solitary Singer: A Critical Biography Of Walt Whitman, University of Chicago Press, 1985.
2. Anderson, C. R., Emily Dickinson's Poetry, New Yor: Holt, Rinehart and Winston. Heinemann, 1960.
3. Frost, Robert, The Poetry of Robert Frost, Ed. Edward Connery Lathem, Henry Holt and Co., 2002.

Reference Books:

1. Kaplan, Justin, Walt Whitman: A Life, New York : Simon and Schuster, 1980.
2. Allan, Gay W., Waldo Emerson, Viking Press, 1981.
3. Edgar Allan Poe. Selected Tales. Penguin Books Ltd., 1994.
4. "Adventures in American Literature", Pegasus Edition, Orlando: Harcort Brace Jovanovic Publishers, 1989.

EL20.303	**New Literature in English**	**3-0-0-3**
		Total Lectures: 39

Objective: To enable the student to understand different ways in which poems were written in different time period and critically analyze them.

Unit 1	**Toru Dutt:** Our Casuarina Tree **Sarojini Naidu:** Indian Weaver, The Song of Radha	8
Unit 2	**Rabindranath Tagore:** Where the Mind is Without Fear **Sri Aurobindo:** Transformation	7
Unit 3	**Kamala Das:** An Introduction as a Writer **Nissim Ezekiel:** A Goodbye Party for Miss Pushpa T.S.	8
Unit 4	**A. K. Ramanujan:** Love Poem for a Wife **Arun Kolatkar**: Chaitanya	8
Unit 5	**Chinua Achebe:** Refugee Mother and Child **John Pepper Clark** : Agbor Dancer	8

Course Outcome: The student will be able to:

1. To recognize new literature and its significance
2. To understand and appreciate the basic concepts of style and literary devices in poetry
3. To apply the basic concepts of style and literary devices to different types of poetry
4. To analyze and appreciate fiction and enrich their knowledge about diverse poetry forms
5. To be able to evaluate and synthesize information from a variety of resources
6. To write creatively and critically

Text Books:

1. Narasimhaiah, C. D. (ed.), An Anthology of Commonwealth Poetry, Macmillan India Ltd, 2016.
2. Narasimhaiah, C. D., Awakened Conscience: Studies in Commonwealth Literature, New Delhi, Sterling Publishers, 1978.

Reference Books:

1. Walsh, William, Commonwealth Literature, Macmillan, 1980.
2. Beier, Ulli (ed.), Introduction to African Literature, Northwestern University Press, 1967.
3. Soyinka, Wole (ed.), Poems of Black Africa, African writers series, London, Heinemann Educational Books, 1975.
4. Iyengar, K. R. S., Indian Writing in English, Delhi, Sterling Publisher Pvt. Ltd, 2019.

EL20.302 **Literary Trends and Movements** **3-3-0-3**

Total Lectures: 39

Objective: To provide a great amount of information and knowledge about the structure and history of English Literature, and it's social and geographical variations that prepare them for a various career paths.

Unit 1	The Renaissance The Metaphysical School of Poets	8
Unit 2	The Classical Movements The Romantic Revival	8
Unit 3	The Fin De Siecle Movement The Georgian Poets	7
Unit 4	Poets of the First World War The High Modernist Mode	8
Unit 5	Poetry of the Thirties Poets of the Second World War	8

Course Outcome: The student will be able to:

1. Describe major writers and their works in chronological order
2. Understand how literature also influences the social and political history of each period
3. Compare literary trends of one period with that of another
4. Analyze how literary trends/movements emerge, function and dissolve, only to be reborn again
5. Evaluate and classify all major literary trends and movements
6. Explore issues, controversies & themes rather than chronological periods and write a well-organized paragraph in order to answer a question

Text Books:

1. Beers, H., History of English Romanticism in the Nineteenth Century, London, Dover Publications.
2. Prasad, B., A Background to the Study of English Literature, Delhi, Macmillan India Ltd.

Reference Books:

1. Abrams, M. H., A Glossary of Literary Terms, Bangalore, Prism Books Pvt. Ltd.
2. Childs, Peter, The Twentieth Century in Poetry: A Critical Survey, London, Rutledge.
3. Legouis, E. & L. Cazamian, History of English Literature, London, J. M. Dent & Sons.
4. Upham, A. H., The Typical Forms of English Literature, Oxford, Oxford University Press.
5. Pillai, Dravyam, Post- Modernism, Tiruchirapalli, Theresa.

EL20.304	**Literary Criticism**	**3-0-0-3**
		Total Lectures: 39

Objective: To enable the student to understand different theories and its implications in the world of literature.

Unit 1	Aristotle's Concept of Tragedy	5
Unit 2	Arnold's Touchstone Method Eliot's Concept of Tradition	9
Unit 3	Post Modernism The New Critics and Chicago Critics	10
Unit 4	Psychoanalytic Criticism Marxist Criticism	10
Unit 5	Post-Colonial Criticism	5

Course Outcome: The student will be able to:

1. Understanding of the major schools of theory
2. To imply the theories in the world of literature
3. Interpret the literary texts critically
4. Perform research, analysis, and criticism of the literary and cultural texts
5. Write analytically in a variety of formats, including research, essays, etc.
6. Examine the historical developments of the theories

Text Books:

1. Barry, Peter, Beginning Theory: An Introduction to Literary and Cultural Theory, Manchester University Press, 2018
2. Seturaman, V. S., Contemporary Criticism: An Anthology, Macmillan, 2016.

Reference Books:

1. Enright, D. J. & Ernst De Chikera, English Critical Texts, Delhi,Oxford University Press, 1997.
2. Gandhi, Leela, Post-Colonial Theory: A Critical Introduction, Columbia University Press, 2019.
3. Rice, Phillip & Patricia Waugh (ed.), Modern Literary Theory, Delhi, Replica Press,2001.
4. Aristotle, Poetics, translated by S. H. Butcher, 2018.

HY 20.101. Ancient Indian History-I

Objectives: The course intends to provide an extensive survey of early Indian history to the students of the history honors course. It also familiarizes them with the tools of studying ancient Indian history. It further aims empowers the students not only with the significance of sources in history writing but make them aware with the importance of environmental factors in the study of history

Unit 1. Sources: Literary written sources-Vedic/Hindu canonical literature, Jain canonical literature, secular literary sources-Sangam literature. Foreign accounts-The Greeks and Romans, Chinese. Material /Archaeological sources-Inscription, epigraphy, coins, and monuments

Unit2. The Pre-Historic Period: Paleolithic culture-Sequence and geographical distribution, evolution and uses of stone industries. Mesolithic culture-regional and chronological distribution. Neolithic Age and Chalcolithic Age

Unit 3. The Harappan Civilization: Origin, distribution, morphology of major sites (Mohanjodaro, Harappa, Kalibangan, Lothal, Dholavira). Society, economy, polity and religion as reflected in the Vedic literature. Religious beliefs and practices and art and architecture.

Unit 4.Vedic Age to 6th Century B.C: The origin of Aryans, geographical background, Political, social, economic and religious conditions of the Aryans in the Rig Vedic and Later Vedic period

Unit 5. Rise of territorial States in Northern India: Urbanization of the Ganga Valley, Sixteen Mahajanpadas, and ascendency of Magadha.Iranian and Macedonian invasion: Significance, religious movements in 6th century B.C, Buddhism and Jainism: Rise, growth and contribution to Indian History.

HY20.103 Ancient River Civilisation-I

Objectives: To offer a historical survey of human evolution. It details the features of material culture of early humankind by tracing the transitions from the hunting-gathering subsistence pattern to more advanced human subsistence patterns involving domestication of animals and food production. The paper highlights how such changes were gradual and did not unfold uniformly in all parts of the world; thereby allowing for coexistence of different subsistence forms.

Unit.1 Introduction to the idea of river and civilization.

Unit 2. Cradle of civilization Mesopotamia: Origin of Fertile Crescent, Geography, Early civilization of Sumerian, Akkadian, Babylonian and Assyrians, Religious Beliefs, Rituals and practices, Social Levels, Classification, Priest, King, Upper class, Nobles, Lower Class, Slavery, Medicines, Astronomy, Astrology, Time, Inventions, Mummification, Tools and Methods, Script on Tablets, Seals , Mode of warfare, Strategies, Government, Polity, Administrative units Law Code, Justice, Causes of Decline of Civilization

Unit 3. The Nile Valley civilization Egypt: Geography, Early civilization, extent and Empire, Government, Polity, Administrative units, Social stratification in society, food, Dress, Social Classes, Making of Pyramids, techniques, Material, Script of Egypt Civilization Legacy and causes of decline

Unit 4. The Yellow river civilization China: Xia Dynasty and Shang Dynasty, Zhou Dynasty and Qin Dynasty, Early Han Dynasty and Later Han Dynasty, Society and Culture of Civilization, Contribution of Civilization.

Unit 5. Inter-civilizations comparison: similarities and dissimilarities.

HY20.102Ancient Indian History-II

Objectives: To offer a historical survey of human evolution. It details the features of material culture of early humankind by tracing the transitions from the hunting-gathering subsistence pattern to more advanced human subsistence patterns involving domestication of animals and food production. The paper highlights how such changes were gradual and did not unfold uniformly in all parts of the world; thereby allowing for coexistence of different subsistence forms.

Unit 1. The Age of Maurya: Sources of Mauryan History: Kautilyas Arthasastras and Meghsthenes Indica and Ashokan Inscriptions. Chandragupta Maurya, Bindusara and Asoka- Foundation and Consolidation of Empire, Administrative system. Ashoka's policy and reforms, Dhamma, Art and architecture: Decline of Mauryan Empire.

Unit 2. Post Mauryan Polity: Post Mouryan Polity in India: Ruling dynasties in Northern and Southern India: Sungas, Satavahanas and Kushanas. Rise of Kharavela in Kalinga.

Unit 3. Age of the Guptas and Post-Gupta period (to c. 750): Political history of northern and southern India. Samanta system and Changes in political structure. Economy and Social structure. Culture and Religion.

Unit 4. Sangam age: Literature, Polity, Economy and Society

Unit 5. Themes in early Indian cultural history: Languages and texts, Major stages in the evolution of art and architecture, Major philosophical thinkers and schools.

HY20.104 Ancient River Civilisation-II

Objectives: This paper traces the changing political formations, economic and social structures in the ancient Greek and Roman empires because ancient history of these two regions explain in great detail about Europe owes to the development of civilization to these particular regions in large measure**.**

Unit 1. The civilization of Ancient Greece: Minoan, Mycenaean and Archaic Greece.

Unit 2. Classical Greece: Athenian Slavery and Democracy

Unit 3. Culture: Art, Architecture and Religion

Unit 4. Roman Empire: Roman Republic, Transition from Republic to Empire, Julius Caesar and Augustus Caesar, Pax Romana.

Unit 5. Fall of Roman Empire, slavery and slave mode of production, Fall and division of Empire into the Eastern and Western part**.**

HY20.201 History of Medieval India (750-1526 A.D) –I

Objectives: The purpose of this paper is to introduce to students the idea of major transition in early medieval India in the wake of disintegrating power at the Centre. It aims to guide students as to how the corresponding rise and rapid spread of Islam marks the advent of Islam in India through various channels**.**

Unit 1 Early Medieval India, 750-1200: Polity: Major political developments in Northern India and the Peninsula, Origin and the rise of Rajputs, The Cholas: administration, village economy and society -—Indian Feudalism‖ Agrarian economy and urban settlements, Trade and commerce, Society, Science and technology

Unit 2 Cultural Traditions in India, 750- 1200: Philosophy: Skankaracharya and Vedanta, Ramanuja and Vishishtadvaita, Madhva and Brahma Mimansa, Religion, Tamil devotional cult, Growth of Bhakti, Islam and its arrival in India Sufism, Literature, Growth of Tamil literature, Kalhan‘s Rajtarangini, Alberuni‘s, Art and Architecture: Temple architecture, Sculpture, Painting.

Unit 3 Establishment of the Delhi Sultanate: The Ghurian invasions, Factors behind Ghurian success, Economic, Social and Cultural consequences, Foundation of Delhi Sultanate and early Turkish Sultans - Consolidation: The rule of Iltutmish and Balban.

Unit 4 "The Khalji Revolution": Alauddin Khalji, Muhammad Tughluq, Firuz Tughluq, Decline of the Sultanate, Foreign contacts and Ibn Battuta‘s account

Unit 5 Sayyid Dynasty: Khizr Khan, Mubarak Shah, Lodhi Dynasty: Bahlol Lodhi, Sikander Lodhi, Ibrahim Lodhi, Sultanate administration.

HY20.203 Main Outline of World History-I

Objectives: Through discussion of a period in Europe marked by Renaissance, Protestantism, Thirty-Years-War Counter-Reformation, rise of absolutism, this paper seeks to familiarize students with phenomenal movements in Europe in the fields of culture, religion and politics which laid the future roadmap for largerdevelopment in Europe and the world. It covers discussion on famous monarchs and friction between the state and the Church over the issue of power share.

Unit 1 Renaissance: Meaning and Definition, Nature & Impact, The Reformation, Causes, Nature of Reformation, Results, counter reformation.

Unit 2 Rise of National States: Causes, Main monarchies and their growth -Ferdinand, Isabella of Spain, and Louis XI of France.

Unit 3 England - Henry VII, and Holy Roman Empire. Rise and Decline of Spain - Foreign Policy of Charles V, Philip II, Revolt of Netherland, Thirty Years War, Causes of downfall of Spain.

Unit 4 France under Henry IV: Growth of Royal absolutism.

Unit 5 Cardinal Richelieu, Cardinal Mazarin, Louis-XIII, The Thirty Years War, Treaty of Westphalia, Louis XIV, Foreign Policy, Religious Policy , Policy of Colbert's.

HY20.202 History of Medieval India (1526-1740 A.D) –II

Objectives: Teaching of this paper plans to demonstrate political transition with the establishment and consolidation of the Mughal Empire. It introduces students to a new rounds of social-political-cultural-religious and economic developments under the Mughal regime. By covering about a period of over two centuries, this paper covers the arrival of Europeans and takes into account a larger sort of development as a result of industrial development in Europe and its cascading impact all over places including India where it coincides with the downfall of a mighty Mughal empire. Other issues also get covered under this paper like

Unit 1 Foundation and Expansion of the Mughal Empire: struggle for empire in North India; Babur's invasion; Mughal-Afghan conflict. Shershah Suri and his administrative reforms.

Unit 2 Consolidation of the Empire: Akbar's imperialist agenda—administration, Mansabdari system, Zabt system; Religion and state—Akbar to Aurangzeb; evolution of the nobility under the Mughals.

Unit 3 Mughal Economy, Society and Culture: rural society and agrarian relations; crafts and industries; monetary system; inland and oceanic trade; literature; technology; architecture and painting.

Unit 4 Disintegration of the Mughal Empire: problems of succession and court politics in the reign of Aurangzeb; popular revolts within the Mughal empire—the Jats, Satnamis, Afghans, and the Sikhs.

Unit 5 Crisis in the Jagirdari system; peasant uprising and agrarian crisis; Bhakti Movement & Prominent saints, Sufism meaning and Sects.

HY20.204 Main Outline of World History-II

Objectives: The paper aims to acquaint the students with a brief history of Russia, Prussia and Austria from thematic standpoint of political and economic changes. Moreover, effort is to familiarize students with the development in the field of art and architecture along with the French revolution and further rise and fall of Napoleonic phase.

Unit 1 Rise of Modern Russia: Peter the great, Catherine II their foreign policies.

Unit 2 Austrian Empire - War of Austrian succession - Treaty of Aix-La-Chapple, Causes of seven years' war, Foreign policy of Joseph II

Unit 3 The Rise of Prussia: Domestic, foreign and religious policy of Frederick the great.

Unit 4 The Baroque Age: Science and Technology in 17th and 18th Centuries, The Anglo-French Rivalry for overseas Colony, French Revolution, Causes and results

Unit 5 Napoleon Bonaparte: Continental System, Battle of Waterloo-Fall of Napoleon-Vienna Congress-Concert of Europe.

HY20.301 History of Modern India (1740-1857 A.D) –I

Objectives: This paper on modern India familiarizes with the strategies of Europeans especially British traders who soon took over entire India under the initial garb of trading. Herein, the discussion encompasses the establishment, consolidation and ultimately dissolution of East India company and transfer of power to the British Queen in 1857-58. All sorts of developments during the stated period are discussed and debated in great detail. The ideas of modernity and modern ideas are also discussed in brief.

Unit 1 Political Condition of India in the 18th Century: Decline of Mughal emperor and its impact, Advent of Europeans in India – Establishment of bases and trading centers of East India Company and other European companies, Rise of Maratha power, Third battle of Panipat, Cause of defeat of Maratha's and impact of Maratha defeat, Early Anglo – French conflict.

Unit 2 Establishment of British rule in India: Causes of Anglo-French rivalry, Conflict in Bengal, Clive as Governor of Bengal, Battle of Plassey and Buxer, Administrative and Judicial Reforms.

Unit 3 Consolidation of English Rule in India: Lord Cornwallis and his reforms, Judicial And Commercial reforms, Lord Wellesley, Lord William Bentinck, Lord Dalhousie and the policy ofannexation (1848-56).

Unit 4 Relations of Leading Indian States with English powers: Anglo- Mysore relations – Anglo Mysore wars, Haidar Ali and Tipu Sultan, Anglo- Sikh Relations – Anglo-Sikh wars, Raja Ranjit Singh, Anglo- Maratha Relations-Anglo- Maratha wars.

Unit 5 Revolt of 1857: Causes, Nature and Impact, British Policy towards Burma, The British Afghan Policy –Afghan Wars, Policy Towards Sindh and Nepal, The British Social and Economic Policies.

HY20.303 History of China and Japan (1840-1949 A.D) –I

Objectives. In this paper, focus is on gradual downfall of Chinese political system and gradual transition of power into the hands of Western powers especially Britain with the first and second Opium wars. The rise of regional powers and anti-manchus sentiments, anti-foreign sentiments, rise of Christianity, and occurrence of several rebellions and movements, the Chinese effort to modernize and militarize are planned to be cover under this paper.

Unit 1 Chinese Feudalism: Gentry, Bureaucracy and peasantry; The Confucian value system; Sino centrism

Unit 2 The Canton commercial system, The transformation of China into an _informal' colony; the Opium Wars; The Unequal Treaties; The _scramble' for concessions; Finance Imperialism; The Open Door' policy.

Unit 3 The Unequal Treaties; The scramble' for concessions; Finance Imperialism; The Open Door' policy.

Unit 4 Agrarian and Popular Movements: Taiping and Yi Ho Tuan, Attempts at _Self- Strengthening (Tzu-Chiang): Reforms of 1860-95; 1898; and 1901-08.

Unit 5 The Revolution of 1911: Causes, Nature and significance; The social composition of the Revolution; Sun-Yet-Sen and his contribution; The formation of the Republic; Yuan Shih Kai; Warlordism. May Fourth Movement of 1919: Nature and significance.

HY20.302 History of Modern India (1857-1947 A.D) –II

Objectives: This paper provides a thematically arranged overview of the history of India from the first major revolt of 1857 to the making of the republic in 1950. The paper tries to bring up discussion about changing nature of leadership and forms of resistance over period of time.

Unit 1 Impact of the rule of British Rule in India: Destruction of village economy and handicrafts, Impact on agriculture and Industries, Social Impact- Social and Religious reform movements. Economy and social classes (a) Economic critique of colonial rule (b) Rise of modern industry: emergence of capitalist and working class (c) Famines and their impact

Unit 2 Stages of Emergence of Nationalism: Peasant and tribal revolts, rise of middle class, Formation of Associations and Pressure groups, Birth of the Indian national Congress, Rise of the Extremism in the Indian National Congress, Programs and objectives of moderate and extremist functions, partition of Bengal and Surat split, Swadeshi Movement, Leaders of Extremist and Moderate factors.

Unit 3 Rise of Revolutionary Nationalism: Impact of Bengal partition, Growth of revolutionary ideas and organization in India and abroad, Home Rule movement, Lucknow Pact, Rise of Communal organizations, Gandhian movements, Rowlett Act, Khilafat Movement, Round table conference, Poona Pact, British Response to Indian Demand – Simon Commission, Rise of communal Politics – Policies and Act of Muslim League and other communal bodies, the Jinnah Factor, Partition of India and attainment of freedom, August offer, Cripps mission, cabinet mission, Wavell Plan, Mountbatten Plan, Leaders of Indian National Movement.

Unit 4 Other Currents in Nationalism (a) Ambedkar and the Dalit Movement (b) Singh Sabha and the Akali Movement (c) Left movements: peasants and workers (d)Tribal movements . Communalism: ideologies and practices (a) Trends in Communalism (b)World War II and the post-War crisis

Unit 5 I. Independence and the emergence of a new State (a) Negotiations for Independence (b) The Making of the Constitution (c) Integration of Princely States (d) Land Reforms and the beginning of Planning.

HY20.304 History of China and Japan (1840-1949) –II

Objectives: The purpose of this paper is to discuss the end of dynastic rule in China, beginning of new era altogether with contestation between nationalists and communists for Centre stage of politics along with unsuccessful attempt to revive the dynastic and traditional pattern. There is also an effort to situate China in a new global order which was underway. There is particular reference to the rise communism under the leadership of Mao Zedong. In this paper, the rise of Japan as a new force to reckon with in East Asia under the restored Meiji government has been discussed along with the Japanese antagonism with USA and its consequences.

Unit 1 China: 1900-1949-: End of dynastic rule, rise of new form of government, rise of nationalism (Kuomintang Party, viz., Nationalist Party)

Unit 2 The Communist Movement 1921-1949:The Jiangxi Period and the rise of Mao Tse-Tung, The Second United Front, Rise in China‘s power under the Leadership of Mao Zedong.

Unit 3 Japan: Crisis of Tokugawa,Transition from feudalism to capitalism,

Unit 4 Bakuhan system, Meiji Restoration, Political Reorganization, Military Reforms, Social, Cultural and Educational reforms (Bunmeikaika)

Unit 5 Financial reforms and Economic development in the _Meiji‘ era, Meiji Constitution. Japanese Imperialism: China, Korea and Manchuria. Democracy and Militarism/Fascism: Popular/People‘s Rights Movement, Nature of political parties, Rise of Militarism, Second World War

SN20.101 संस्कृतस्योद्भवःविकासश्च**(Origin and Development of Sanskrit)** **3-0-0-3**
Total Lectures: 39

Objective: This course aims to get students acquainted with the journey of Sanskrit literature from Vedic literature to Purana. It also intends to give an outline of different shastric traditions, through which students will be able to know the different genres of Sanskrit Literature and Shastras.

Unit 1	संस्कृत स्योद्भवः (**Evolution of Sanskrit):**संस्कृत नामकरणम् (Nomenclature of Sanskrit), वैदिकसंस्कृत लौकिकसंस्कृत च(Vedic Sanskrit and Classical Sanskrit), प्राकृत म्(Prakrita), पालः(Pali), पभ्रंशः(Apabhransha),अधुनिकभारतीयभाषाः(Modern Indian Languages)	09
Unit 2	वैदिकसंस्कृत साहित्यम्**(Vedic Sanskrit):**वेद शब्दस्योत्पत्तिः(Origin of the word Veda), वैदिकमन्त्राः(Vedic Hymns), वैदिकमन्त्राणांविभागः(Division of Vedic Hymns),शाखाः(Branches), संहितायाः नुक्रमणिका(Content of the Samhitas), वैदिकऋषिकाः(Women Vedic Seers)	09
Unit 3	उत्तरवैदिकसाहित्यसाहित्यम्**(PostVedic Literature):**ब्राह्मणसाहित्यम्(Brahmana), अरण्यकसाहित्यम्(Aranyaka), उपनिषद्साहित्यम्(Upanishad)	07
Unit 4	लौकिकसंस्कृत साहित्यम्**(Classical Sanskrit):** महाकाव्यम्(Epics), महाभारतम्(Mahabharata), रामायणम्(Ramayana), गीता(Gita), पुराणम्(Purana), पद्यकाव्यम्(Poetry), गद्यकाव्यम्(Prose), चम्पूकाव्यम्(Champoo).	09
Unit 5	अधुनिकसंस्कृत साहित्यम्(Modern Sanskrit Literature): सामान्यसर्वेक्षणम् (General Survey)	05

Course Outcome:

1 Show the Vedic Sanskrit and classical Sanskrit.
2 Illustrate modern Indian languages.
3 Classify the Vedic hymns.
4 Describe Brahman and Saranyak sahity.
5 Discuss the poetic beauty of epics- Ramayan, Mahabharat.
6 List the poets name of modern Sanskrit literature.

Text Books:

1 History of Sanskrit Literature (2010) Keith A.B., MLBD, Delhi
2 History of Classical Sanskrit Literature (2009) Krishnamachariar, MLBD, Delhi

Reference Books:

1 Macdonel A.A. (1988) History of Sanskrit Literature, MLBD, Delhi
2 Shastri Gaurinath (1960) A Concise History of Sanskrit Literature, MLBD, Delhi
3 Maurice Winternitz (2009) History of Indian Literature (Vol. I & II), MLBD, Delhi

SN20.103 भगवद्गीतायामात्मप्रबन्धनम् **3-0-0-3**

(Self Management in the Bhagavad Gita) **Total Lectures: 39**

Objective: The objective of this course is to study the philosophy of self-management in the Bhagavad-Gita.The course seeks to help students negotiate the text independently without referring to the traditional commentaries so as to enable them to experience the richness of the text.

Unit 1	मनःतत्कार्यकारणंच**(Mind and its Functions)**- मनसःप्रकृतेः**(**Nature of Mind)-7.4- 6,15.7,15.9,3.42,10.20,10.22,मानवसकव्वप्रवृत्तेपवतः**(**Mental Conflict)-1.1,2.60,67,3.36-38,40,16.21,मानवसकव्वप्रवृत्तेपतेःकारकतत्त्वानि(Factors responsible for Mental Conflict)-16.21, 2.62-63, कमयस्वभावाभ्याम्कारकतत्त्वानि (Factors responsible for Karma & Swabhava)-18.13-16	09
Unit 2	मनसःबुद्धेश्च दौर्बल्यम्**Infirmity of Mind and Quandary of Intelligence)**- आवन्ियाणांवनयमनंबुद्धेःमहत्त्वञ्च(Sense control and Importance of Intellect)- 2.3,2.49,52,55,62,65,67, 4.38,39,42, 18.63,18.3.-32, मनसःचाञ्चल्यंवनग्रहणञ्च(Versatility of Mind and restraint)- 6.11-14, 25-26,34,36 योगवसद्धत्त्वेकारकतत्त्वानि (Factors for Perfection in Yoga)- 3.8, 6.3, 16-17, 17.8-10, 3.12-13, 17.14-19, 6.36	10
Unit 3	कमणःमहत्त्वम्**Importance of Karma)-**आत्मनःप्रकृतेःतस्यजगतःवभन्नत्वञ्च(Nature of soul and its difference from the material world)- 2.19-26 , ज्ञानेकमययोगस्यावदानम्(Karma-yoga :as a means to attain the knowledge) – 2.40-44, 47-50.	08
Unit 4	वनष्कामकमययोगेभवि-न्ययोगस्यावदानम्Bhakti-yoga: as a means to facilitate Nishkaamkarmayoga)- 12.19-20, लोकसङ्ग्रहः(Concept of Lokasangraha)- 3.18-25	07
Unit 5	दैवत्वंचैतन्यञ्च**(Relationship between consciousness anddivinity)-**श्लोक-13.31- 32, 10.41, 7.12, 10.4,18.51-66,78	05

Course Outcome:

1 Understand the nature of Mana.
2 Solve the infirmity of Mind.
3 Discuss the factors for perfection in yoga.
4 Clarify the importance of Karma.
5 Illustrate Bhakti Yoga.
6 Recommend the divinity.

Text Books:

1 Srimad Bhagavadgita(with English Translation and Transliteration) (2015), Gita Press, Gorakhpur
2 Srimad Bhagavadgita(with English Translation)Th Divine Life Society ,Rishikesh, Uttarakhand

Reference Books:

1 Ramsukhdas (2006) Shrimad Bhagavadgītā-Sadhaka-Sanjivani (with Appendix in two Volumes), Gita Press, Gorakhpur
2 Chinmayananda (2015) The Holy Geeta, Chinmay Prakashan, Mumbai
3 Chinmayananda (2013) The Art of Man Making (in two Volumes, 114 short talks on the Bhagavadgita), First Edition 2010, Reprint 2013, Central Chinmay Mission Trust, Mumbai

SN20.102 व्याकरणRचनाच (प्रथमभाग) **3-0-0-3**

(Grammar and Composition-I) **Total Lectures: 39**

Objective: This paper aims at teaching Sanskrit grammer, composition and other related informations based on Laghusiddhantakaumudi.

Unit 1	सम्भाषणमाध्यमेनसस्ं कृताभ्यास्(**Inititialising Sanskrit Language through conversation)**-शब्दरूऩाणि(Diclension), धातरुू ऩाण ि(Conjugation), अव्ययऩदाननतत्रयोगञ्च(Avayay with their applications in simple sentences)	09
Unit 2	रघु सद्धन्तकौमदु ी(**Laghusiddhanta Kaumudi)**-महेश्वरसू ाण ि रत्यायहारवमश्श (Maheshvara Sutra and concept of Pratyahara),	09
Unit 3	सञ्ज्ञा, सनन्ध्(**Sanjna and Sandhi**) Only essential rules based on application in the texts to be taught)	09
Unit 4	प्रारम्भककारकप्रकरणम्(**Elementary Knowledge of Case)**-अ भराय्, सङ्ख्या(Meaning, Numbers), व वक्त्(Vibhakti)	07
Unit 5	अनवु ाद्(**Translation**): अनवु ादस्यसामान्यऩनयम्(General rules of Translation)आङ्ग्र ि षात्सस्ं कृत(े From English into Sanskrit),सस्ं कृतद्आङ्ग्र ि षाय्याम्(From Sanskrit into English)	05

Course Outcome:

1 Describe Diclension and Conjugation.
2 Define Pratyahara.
3 Explain Maheshvara Sutra.
4 Discuss Sanjna and Sandhi.
5 Analyse Case.
6 Apply rules of Translation.

Text Books:

1 The Students' Guide to Sanskrit Composition (2009) Apte V S, Chowkhamba Sanskrit Series, Varanasi
2 Rachananuvad Kaumudi(1999) Kapildev Dvivedi, Vishwavidyalay Prakashan, Varanasi

Reference Books:

1 शास्त्रीि ीमसेन(2005)रघु सद्धन्तकौमदु ी, ि मीव्य्या-रथमि ाग, ि मीरकाशन, ददल्ली
2 नौदिया़चक्रधर(2005)अनवु ादचन्ि का, मोतीऱाऱबनारसीदास, ददल्ली
3 Kale M.R.(2011) Higher Sanskrit Grammar, MLBD, Delhi
4 Macdonell A.A. (1988) A Sanskrit Grammar for Students, MLBD, Delhi
5 Mahesh Singh Kushwaha, Laghusiddhant Kaumudi, Chaukhambha, New Delhi

SN20.104 | सस्ं कृ | **3-0-0-3**

तनीततसाहह्त्यम्

(Sanskrit Niti Litrature) | **Total Lectures: 39**

Objective: This course aims are to get the students acquainted with the outline of Sanskrit Niti literature including the text readings of the Nitishatakam and Chanakya Niti with the General Introduction to Sanskrit Niti Literature.

Unit 1	भतहृ रणावरचचतबं ीततशतकम(्मङ्गगराचर िन्मं मर्ू श्रा द्धनत्) (**NitiShatakam of Bhartrihari** (selected verses only)- Mangalacharan, Moorkhapaddhati	07
Unit 2	भतहृ रणावरचचतबं ीततशतकम(्ववद्वत्प्नद्धनत्) **NitiShatakam of Bhartrihari** Vidwatpaddhati	07
Unit 3	भतहृ रणावरचचतबं ीततशतकम(्मानशौयन्द्धनत्) **NitiShatakam of Bhartrihari** Manshauryapaddhati)	07
Unit 4	चाणक्यनीततश्रोकस्ं या101त्20 न्यङ्क्तम्**Chanakyaniti – Sloka 01-20**	09
Unit 5	चाणक्यनीततश्रोकस्ं या121त्40 न्यङ्क्तम्**Chanakyaniti – Sloka 21-40**	09

Course Outcome:

1. Show the Mangalacharan.
2. Ilustrate Murkhpaddhati.
3. Apply vidwatpaddhati.
4. Describe Manashaury.
5. Discuss the chanakyaniti.
6. List the poets name of nitishashtras.

Text Books:

1. The Nitishatakam of Bhartrihari(2009) (Ed.) M.R. KaleMLBD, Delhi
2. Chanakya Neeti (1996) BK Chaturvedi, MLBD, Delhi

Reference Books:

1. Gunjeshwar Chaudhury(Ed) Chanakya Niti Darpan,Chaukhambha Sanskrit Pratishthan, Varanasi
2. Gopinath P. & Singh N.S. (1989) Shatakatrayam, Nag Publishers, Delhi
3. Radhakrishna Pillai, Chankya in you, Jaico Books
4. Warder A.K. (2004) Indian Kavya Literature, MLBD, Delhi
5. Kosambi D.D. (1975) Bhartrihari's Shatakatrayam (with the Oldest Commentary of Jain Scholar Dhanasaragani) , Bharatiya Vidya Bhavan, Mumbai

SN 20.201 व्याकरणंरचनाच (द्ववतीय:भाग)**(Grammar and Composition-II)** **3-0-0-3**
Total Lectures: 39

Objective: This course aims to get the students to know the Sanskrit Grammar, including rules of karakas, Samasa and Vachya pratyaya based on siddhantakaumudi. The students will also learn the techniques of the Paragraph Writing and Translation.

Unit 1	सद्धान्तकौमदु यानसु ारंकारकम(् **Case)-** Based on Siddhantakaumudi)	08
Unit 2	सद्धान्तकौमदु यानसु ारंकारकम(् **Case)-** Based on Siddhantakaumudi)	08
Unit 3	रघसु द्धान्तकौमदु यानसु ारंसमासस् **(Compound)-** Based on Laghusiddhantakaumudi)	08
Unit 4	रघसु द्धान्तकौमदु यानसु ारंसमासस् **(Compound)-**Based on Laghusiddhantakaumudi)	08
Unit 5	वाच्यम् **(Voice)-** कतथृ ाच्यम(् Kartri-Vachy), कमथ ाच्यम(् Kam-vachya), ि◌ावव ाच्यम(् Bhav-Vachya)	07

Course Outcome:

1 Discuss the work of Bhattoji Dikshit.
2 Expalin the rules of Translation in Sanskrit.
3 Ilustrate Smasa.
4 Define Karakas.
5 Identyfy Vibhakti.
6 Describe Vachya.

Text Books:

1 Kanshiram(2009). Laghusiddhantakaumudi (Vol. 1-2). Delhi: MLBD. (2011).

2 Gopaldutt Pandey(2010)Siddhant Kaumudi,Chaukhmbha Surbharatu Publication, Varanasi

Reference Books:

1 Kale, M.R. Higher Sanskrit Grammar. Delhi: MLBD.
2 Apte, V.S.(1996). The Students‘ Guide to Sanskrit Composition. Varanasi Chowkhambha Sanskrit Series.
3 Shastri, Dharanand.(2008). Laghusiddhantakaumudi- Bhaimivyakhya (Vol. 3-6). Delhi: Bhaimi Prakashan.
4 Shastri, C.(1960).Vyakaranchandrodaya (Vol. 1-3). Delhi: MLBD
5 Macdonell A.A. (1988) A Sanskrit Grammar for Students, MLBD, Delhi

SN 20.203 भारतीय-वैज्ञानिक-तनचध् **(Indian Scientific Heritage)** **3-0-0-3**
Total Lectures: 39

Objective: The National Culture of every country depends on its environment, climatic conditions and human behavior with natural resources. The aim of this course is to make the students acquainted with the basic concept of Indian Science of Environment and salient features of environmental awareness as reflected in Vedic and Classical Sanskrit literature.

Unit 1	सस्ं कृतसाहहत्येप्रततबिम्बित-वैज्ञानिक-सभ्यता **(Scientific Awareness reflected in Sanskrit Literature)**,वदै दकसादहत्येऋतुवज्ञानम(् Rituvigyana in Vedic Literature), सवं त्सरचक्रम(् Samvatsarchakra), वृष्टिवज्ञानम(् Vristhivigyana),	08
Unit 2	वराहमहहरमतप्रे ाचीनभारतजे ऱवायुवज्ञानस्यावधारणा**(Concept of Climatology in Ancient India- according to Varahmihira)**, बहृ त्सदहता21.1-2,28.1-5 (Brihatsamhita-21.1-2,28.1-5), बिृहद्बाहुसदं हता-9.1-15 (Bhadrabahusamhita-9.1-15)	07
Unit 3	प्राचीनभारतजऱससाधन प्रन्धस्यइततहास् **(History of Water Resource Management in Ancient India)**- ऋग्वेद-10.9 **(** Rigveda-10.9**)**, अथशा स्त्रम(् Arthashastra(2.1.20-24,3.9.29-38,7.12.4-5), बहृ त्सदं हता(Brihatsamhita-54.1-10),महाभारत-आददऩव:श **(**Mahabharata -Adi Parva-96)	07
Unit 4	ऩातञ्जऱयोगसू सदं भेतनाव-प्रबिन्धनम(् **Stress Management**:In context of PatanjaliYogasutra)समाधधऩाद:(Samadhipada1.1,1.2,1.5,1.12,1.13,1.15,1.23, 1.30,1.30-37), साधनऩाद:(Sadhanapada **(**2.1, 2.3 ,2.11, 2.16, 2.27, 2.29)	10
Unit 5	वहदकजीवनचयाृआसनप्राणायाम्च –ससद्धान्तमात्र(ं **Vedic Life Style-** Aasana and Pranayama (theory only), यौधगक-षट्कमश् (Yogic Satkarma),ऋतचु याश (Ritucharya), आहार: ववहार:(Ahaara-Vihaara), आयवु ेदत्राकृ नतकधचककत्सा(Naturopathy from Ayurveda)	07

Course Outcome:

1 Explain Rituvigyan.
2 Describe the concept of climatology of varah.
3 Discuss water resource management.
4 Define the word stress.
5 Analyse chittvritti.
6 Apply Asnas, Pranayam & Ritucharya.

Text Books

1 Yogasutra with Maniprabha (2006), Mohanchand, Eastern Book Linkers Delhi.
2 Brihat Samhita of Varahmihira (1960) Mishra B. P., Khemraj Shrikrishnadas Prakashan, Mumbai.

Reference Books

1 Dwivedi, R.(1990).Prachin Bharat Me Mausam Vigyan, Meerut: Maruti Prakashan.

2 Swami and Vinekar, S.L.(2001).Kuvalayanand Yogic Theraphy, Central Health Education Bureau. Delhi: Ministry of Health.

SN 20.202 काव्यशास्त्रसाहहनत्यकसमी□ाच **(Poetics and Literary Criticism)** **3-0-0-3**

Total Lectures: 39

Unit 1	सस्ं कृतकाव्यशास्त्राणाऺनररचय् (**Introduction to Sanskrit poetics):**काव्यशास्त्र<>ि<>ाऺनररचय्(**Introduction to poetics):** सस्ं कृतकाव्यशास्त्रा<>ि<>ाऺउत्पऺनक्त्वकास्चOrigin and development of Sanskrit poetics, वव भन्ननामानन- its various names- कक्रयाकल्प(kriyākalpa)**,**अरङ्काारशास्त्रम(् alaṅkāraśāstra)**,**सादहत्यशास्त्रम(् sāhityaśāstra)**,**सौन्दयशा स्त्रम(् saundryaśāstra)**,**र□<>ि<>म(् Definition-lakṣaṇa), रयोजनम(् objectives (prayojana) andकाव्यस्यहेत(ु causes (hetu) of poetry. काव्यरकाशसन्द<>ि<>े according to kāvyaprakāśa)	10
Unit 2	काव्य-भेद् (**Forms of Kāvya-Literature):** Forms of Kāvya-Literature, महाकाव्यम(् Mahākāvya)**,**ख्ण्डकाव्यम(् khaṇḍakāvya)**,**गद्यकाव्यम(् gadya-kāvya): कथा(kathā)**,**आ्यानयका(ākhyāyikā), सादहत्यदऩश न्द<>ि<>े accordingto Sāhityadarpaṇa)	04
Unit 3	शब्दशनक्त्(**Śabda-śakti and rasa-sūtra):** काव्यरकशो्त: शब्दशक्त्अथ्च(Power/Function of word and meaning (according to kāvyaprakāśa).अ भधा(abhidhā -expression/ denotative meaning)**,**र□<>ि<>ा(lakṣaṇā-indication/ indicative meaning) andव्यञ्जनाच(vyañjanā - suggestion/ suggestive meaning),	07
Unit 4	रस:**(Rasa):**<>ि<>रतर<>ि<>ीतरं ससू म्रमर्ु रऩतऩाद्यवषय्च, (rasa-sūtra ofBharata and its prominent expositions):उत्पऺनक्त्वाद(् utpattivāda)**,**अनमु नतवाद(् anumitivāda)**,**<>ि<>ु ्तवाद(् bhuktivāda)अ भव्य ्तवाद्च(andabhivyaktivāda)**,**काव्यरकाशसन्द<>ि<>ेरसस्यअर्ोककक्तता alaukikatā (transcendental nature) of rasa (as discussed in Kāvyaprakāśa)	09
Unit 5	अरङ्कारा्**(Figures of speech):**अनमु ास(् anuprāsa)**,**यमकम(् yamaka)**,**श्रेष:(śleṣa)**,**उऩमा(upamā), रूऩक(rūpaka), सन्देह:(sandeha)**,**उत्रे□ा(utprekṣā), अनतशयोक्त:(atiśayokti), समासोक्त:(samāsokti), स्िवावोक्त:(svabhāvokti), अरस्तमु रशसं ा(aprastutapraśaṁsā), अथाशन्तरन्यास:(arthāntaranyāsa)**,**काव्यर्ङ्गम(् kāvyaliṅga)**,**व वावना(vibhāvanā)	09

SN 20.204 राष्ट्रवाद: भारतीयराजशास्त्रम्च**(Nationalism and Indian Polity)** **3-0-0-3**
Total Lectures: 39

Objective: Nationalism and Indian Polity have been highlighted in Dharma-shastra literature The aim of this course is to make the students acquainted with various aspects of Nationalism and Indian polity as propounded in the ancient Sanskrit texts such as Sanhitas, Mahabharata, Purana, Kauṭilya's Arthashastra and other Sanskrit works.

Unit 1	भारतीयराजशास्त्रम्- स्वरूपम्,महत्त्वम्,सद्यै ानन्तकववकास्चच**Indian Polity: Nature, Importance and Development** कौदिल्य्(Kautilya),ि ीटम्(Bhishma),मन:(Manu), शक्रु ाचाय्श (Shukracharya),सोमदेवसरू ी(Somdev Suri),कमदक्(Kamandaka)	09
Unit 2	सस्ं कृतसाहत्यP ाएरवादच् (**Sanskrit Literature and Nationalism**)- श्ु रयजुवेद: 22.22(Shuklayajurveda (22.22), अथववेद:-12.1.1-2(Atharvaveda (12.1.1-2), ववट ुनरु ा म2.3 (Vishnupurana (2.3), रामाय कृ.कक. काण्डम्.46-48 (Ramayana (KK 46-48)	07
Unit 3	सस्ं कृतसाहत्यP ाएरवादच् (**Sanskrit Literature and Nationalism**अकम्बकादत्य्तव्य्यास:, Ambikadutt Vyas,न.मारावः Pt. Kshama Rao,मथरुारसादद ीत: (Mathura Prasad Dixit), चारुदेवशास्त्री (Charudev Shashtri)	07
Unit 4	भारतीयराजशास्त्रस्यएमख्ु ग्रन्थातन (**Important Texts on Indian Polity**)- ऋ्वेद:- 10.173,10.174 (Rigveda -10.173,10.174), अथववेद:-6.87,7.13 (Atharvaveda 6.87,7.13), शतऩथब्राह्म 5.1.1.8-13,9.4.1.1-5(Shatapath Brahmana -5.1.1.8-13, 9.4.1.1-5).	08
Unit 5	भारतीयराजशास्त्रस्यएमख्ु ग्रन्थातन (**Important Texts on Indian Polity**)-अथश ास्त्रम्- 1.4.1-19 (Arthashastra 1.4.1-19), महा ारत-शाकन्तऩव्श -120.1-35(Mahabharata-Shantiparva 120.1-35),मनस्ु मृ त:-7.1-35(Manusmriti 7.1-35),गान्धीगीता-सत्याग्रहनरुऩ म्5.1-25 (Gandhigita- Satyagraha Nirupana - 5.1-25)	08

Course Outcome:

1 Describe thr nature of Indian polity.
2 Analyze the importance of Kautily, Bhishma, Shukrachary.
3 Explain Nationalism.
4 Show the important texta of Indian polity.
5 Illustrate Rigvrda, Shatapath Brahman.
6 Discuss Manusmriti and Gandhigita.

Text Books:

1 Altekar, A.S.(2001).State and Government in Ancient India. Delhi: Motilal Banarsidas.
2 Tiwari, S.(2007). Rashtriyata Evam Bharatiya Sahitya. Delhi:Vidhyanidhi Prakashan.

Reference Books:

1 Dutt, M.N.(2008).Mahabharat. Delhi: Parimal Publication.
2 Goyanka, J.(2001) Valmiki Ramayan.Gorakhpur: Gita Press i
3 Shashtri, U. (2001).Arthashastra- Kautilya. Delhi: Meharchanda Lachchmandas
4 Singh, G.P. and Singh, S. (2004). *Kingship in Ancient India: Genesis and Growth*. Delhi: Premananda Akanksha Publishing House.

SN 20.301	सौन्दयशास्त्रम्भारतीयनाट्यशाराच **(Aesthetics and Indian Theatre)**	3-0-0-3 Total Lectures: 39

Objective: The objectives of this curriculum are to give its brief overview with reference to major trends of Indian Aesthetics and identify the beauty of drama and to introduce classical aspects of development of Indian theatre among the students**.**

Unit 1	सौन्दयशृ ास्त्रम(् **Aesthetics**)-काव्यरकाश्-4.27-28 (Kavyaprakasha-4.27-28),	08
Unit 2	सहृत्यदृणृ : (**Sahityadarpana)** -दशमृनररच्छेद्(Dashamparichcheda)	08
Unit 3	छन्दशास्त्रम-(**Chhandashastr**a)- अनटु ि्रुभ्:(Anushtupa), आय(Arya),इन्द्रवज्रा(Indravajra), उपेन्द्रवज्रा(Upendravajra), उपजानत:(Upajati),वन्शस्थ:(Vanshastha), द्रुतविलम्बितं बत:(Drutavilambita)	07
Unit 4	छन्दशास्त्रम् (**Chhandashastr**a)नमु टृनतागृ्रा(Pushpitagra),वसन्ततनतरका(Vasantatilaka),मालभरनी(Malini), मन्दाक्रान्ता(Mandakranta),भशरररिी(Shikharini),शादशलू वविक्रडीतं (Shardulavikridita), स्धरा(Sragdhara)	07
Unit 5	नाट्यशास्त्रम् द्ववतीयअध्यायृ(Natyashastra2nd Chapter)नरमृनरागत ि्रारतीयआधुननकना ट्यशारृच (Traditional Indian and Modern Theatre),नाट्यमण्डृनम् (Natyamandapa), रङ्खगशीषश Rangashirsha), रङ्गपृीठम(् Rangapeetha),रङ्खगमञ्च: (Rangamancha) स्वरूृनकम्प्वकासश्च (Features and Developments)	09

Course Outcome:

1 Describe The word meaning of Asthetics.
2 Define the objectives of Dashamparikshed.
3 Discuss Varnik Chandas.
4 Illustrate Matric Chandas.
5 Analyse Traditional Indian and Modern Theater.
6 Explain Features and Developments of Rangamanch.

Text Books:

1 Nagendra (1996). *Kavyaprakash of Mammata with Vishveshwar Vyakhya*. Varanasi: Gyanmandal Ltd.
2 Nagar, R. (1994). Natyashashtra of Bharata. Delhi: Parimal Publication.

Reference Books:

1 Bakshi, M.C. (1971). The Concept of Ancient Theatre. Delhi: Munsiram Manoharlal.
2 Ghosh, M.M. (2007). Natyashastra of Bharat, Delhi: Chaukhambha Publication.
3 Gupta, C.B. (1987). Indian Theatre. Delhi: Munshiram Manoharlal.
4 Shastri, S. (1978). Sahityadarpana. Delhi: MLBD.
5 Mankad, D.R.(1996). Ancient Indian Theatre. Delhi: MLBD

SN 20.303 संस्कृतनाटकसाहित्यम् (**Sanskrit Drama**) **3-0-0-3**
Total Lectures: 39

Objective: This course aims to acquaint students with three most famous dramas of Sanskrit literature which represent three stages in the growth of Sanskrit drama.

Unit 1	कालिदासविरचितमभिज्ञानशाकुन्तलमङ्के (**Abhigyana-Shakuntalam of Kalidasa**- 1st Act)	09
Unit 2	कालिदासविरचितमभिज्ञानशाकुन्तलमङ्के तथा चतुर्थोऽङ्कः (**Abhigyana-Shakuntalam of Kalidasa**- 4th Act)	09
Unit 3	कालिदासविरचितमभिज्ञानशाकुन्तलमङ्के पञ्चमोऽङ्कः (**Abhigyana-Shakuntalam of Kalidasa**- 5th Act)	09
Unit 4	भासविरचितं दूतवाक्यमङ्कः (**Doot-Vakyam of Bhasa**- 1st Act)	08
Unit 5	नाट्यशास्त्रीय-नारभावषक-शब्दावली - रूपकम्, नाटिका, नायक, नान्दी, सूत्रधार, प्रस्तावना, विदूषक, प्रतिवाक्यम्, विष्कम्भक, नाटक, नेपथ्य, पताका, विदूषक, आकाशभाषित	05

Course Outcome:

1. Explain Abhigyanshakuntalamfirs act.
2. Describe the character of Dushyant and shakuntala.
3. Discuss forth and fifth act.
4. Illustrate shlokas.
5. Analyse dootvakyam.
6. Define Natyashashtriya shabdas.

Text Books:

1. Kale, M.R. (2010). Abhigyana-Shakuntalam *of Kalidasa*. Delhi:MLBD.
2. Kumar, P.(1974).Shukanasopadesha (Kadambari). Delhi:Meharchand Lachchmandas.

Reference Books:

1. Dwivedi, K. (1989). Abhigyana-Shakuntalam. Allahabad: Ramnarayan Lal Benimadhav Press.
2. Tiwari, R. (2005). Natakakar Kalidasa aur Kavyakar Kalidas.Delhi: Parimal Publication.
3. Macdonell, A.A.(1970).History of Sanskrit Literature. Delhi: MLBD.
4. Pant, S.C. (1992). Abhigyana-Shakuntalam. Delhi: MLBD.
5. Dwivedi, H. (1976).Kalidas ki Lalitya Yojana. Delhi: Rajkamal Prakashan

SN20.302	सस्ं कृतव्याकरणंभारतीयतकृ नद्धतत्च**(Sanskrit Grammar and Indian System of Reasoning)**	**3-0-0-3 Total Lectures: 39**

Objective: This course aims to get the students acquainted with grammer and the Indian principles of debate and its applications, not just in philosophical dialogue, but in every walk of knowledge. It also wants to enable students to develop logical faculty of their mind and to perceive the world in a more rational way in their day to day life.

Unit 1	वरदराजाचायृ वरचचतरघु सद्धान्तकौमदु ी- अच्सकन्धसू बोधसदहत्, सू - 6.1.47,1.1.65,1.149,6.1.75,1.3.10,1.1.2,1.1.69 (**Laghusiddhantakaumudi ofVaradaraja** (Achsandhi with sutrabodha)Sutra-6.1.47,1.1.65,1.149,6.1.75,1.3.10,1.1.2,1.1.69)	07
Unit 2	वरदराजाचायृ वरचचतरघु सद्धान्तकौमदु ी- अच् सकन्धसू बोधसदहत्, सू - 6.1.84,1.3.2,1.1.50,1.1.1,6.1.85,6.1.91,6.1.97 (**Laghusiddhantakaumudi ofVaradaraja** (Achsandhi with sutrabodha)- Sutr-6.1.84,1.3.2,1.1.50,1.1.1,6.1.85,6.1.91,6.1.97)	07
Unit 3	वरदराजाचायृ वरचचतरघु सद्धान्तकौमदु ी-प्रत्यय-शतृ शानच, ल्यप्,् ्तवतु ननटठा**Laghusiddhantakaumudi of Varadaraja- Pratyay-** Shatri, Shanach, Lyapa, Ktavatu, Nishtha	06
Unit 4	अन्नम्भ प्रणीत्तकृ सग्रह्(**Tarkasangraha of Annambhatta**)-न्दाथश नरूनि्र्म(् Padartha Nirupan)	10
Unit 5	अन्नम्भ प्रणीत्तकृ सग्रह्(**Tarkasangraha of Annambhatta**)-रमाि्र्ननरूनि्र्म(् Praman Nirupan)	09

Course Outcome:

1 Describe Acha-Sandhi.
2 Define Akah Savrnedeerghah.
3 Explain Vriddhiradaich.
4 Discuss Nyaay-Shastra.
5 Analyse Pramana.
6 Evaluate Tarkasangrah.

Text Books:

1 Kushwaha, M.S.(1998).Laghusiddhantakaumudi(Vol. 1&2).Delhi: Choukhambha Prakashan.
2 Athalye, B. (1990). Tarkasangraha of Annambhatta with Dipika & Nyayabodhini. Mumbai: Khemraj Prakashan

Reference Books:

1 Kanshiram and Rathore, S. (2007). Tarkasangraha of Annambhatta. Delhi: MLBD.
2 Kumar, S. (1992).Vaisheshik Darshan me Padarth Nirupan. Delhi: University of Delhi.
3 Chaterjee, S.C. (1988). Nyay Theory of Knowledg. Kolkata: Progressive Publisher.
4 Shastri, B.(2007).Laghusiddhantakaumudi-Vol-1-Bhaimaivyakhya. Delhi: Bhaimi Prakashan.
5 Radhakrishnan,S.(1962). Indian Philosophy. Delhi: MLBD.

SN 20.304 वह्दकगणणतखगोऱववद्याच **(Vedic Mathematics and Astronomy)** **3-0-0-3**
Total Lectures: 39

Objective: This course aims to get the students acquainted with Vedic Mathematics & Astronomy. This course will also introduce students to the theory of vedic mathemetics and deep knowledge of astronomical calculation.

Unit 1	भारतीयगणणतस्यखगोऱववद्यायाःचसंक्षप्त-इततहासः(**A Brief History of Vedic Mathematics & Astronomy**-वेदाङ्खग-ज्योनतषम्(Vedanga Jyotisha),शल्ु बसत्रू ं (Shulbasutra), नत्रःचभसद्धाकन्तका(Panchasiddhantika), सयू श सद्धान्तःSuryasiddhanta, आयभिश ट्ट:-I (Aryabhatta-I), गभिणेशदैवज्ञ(Ganesh Daivagya), कमराकर Kamalakara,जयभसहं Jay Singh,सधु ाकरद्ववदेी(Sudhakar Dwivedi	08
Unit 2	वदै कगणणतमV् **edic Mathematics-**रीरावती(21श्लोका), Selected section of Lilawati (21Verses),श्रीभिारतीकृष्णभिततीथ:(5सत्रू णभिा), Shri Bharati Krishna Teertha (5 Aphorism)	10
Unit 3	खगोऱववद्या **(Astronomy)** (ऋगधज्योनतषं -1- 10)) - Selected section of Lagadh Jyotisha (1-10)	06
Unit 4	खगोऱववद्या**(Astronomy) -** सयू श सद्धान्त:(थमोऽध्यायः)Suryasiddhanta (1st Chapter)	09
Unit 5	वेधशाऱाअथचखगोऱीयगणनाथ्ं मख्ु यचीनयन्त्राणा(**Observatories and ImportantAncient Instruments for Astronomical Calculations**)- Samrat yantra, Mishra Yantra, Ram Yantra, Jaipraksh Yantra, Nadivalay yantra, Shanku Yantra.	06

Course Outcome:

1 Describe the brief history of Vedic mathematics.
2 Define Vedic mathematics Sutras.
3 Discuss Astronomy.
4 Classify the different modes of reckoning time.
5 Recite the various eminent Indian Astronomers & mathematicians.
6 Illustrate the Observatories and important Ancient Instruments for Astronomical calculations.

Text Books:

1 Burgess, E. (1977). Suryasiddhanta: A Text Book of Hindu Astronomy. Delhi: Indological Book House.
2 Tirtha, S. B. K. (1992).Vedic Mathematics. Delhi: MLBD

Reference Books:

1 Sharma, K. (1994).Vedhashala Parichaya Pustika. Delhi: S.L.B.S.Rastriya Sanskrit Vidyapeeth.
2 Sharma, P. (2008). Lagadhajyotisha of Lagadhacharya. Delhi: Nag Publishers.
3 Bag, A.K.(1979). Mathematics in Ancient and Medieval India. Varanasi: Chowkhambha Orientalia.
4 Bhardwaj, S.(1991). SuryaSiddhanta: An Astrolinguistic Study. Delhi: Parimal Publications.
5 Shukla, K.S. and Sharma, K.V. (1976). Aryabhatiya of Aryabhata-With the commentary of Bhaskara-I and Somesvara. Delhi: Indian National Science Academy.

SO20.101 **Introduction to Sociology-I** **3-0-0-3**

Total Classes: 39

Objective: The objective of the course is to create awareness among the student on the basics of Sociology.

Unit 1	**Sociology:** Concept, emergence**,** nature and scope of sociology-Formalistic and Synthetic School. Alex Inkel_s approach to the subject matter of sociology.	7
Unit 2	**Relation of Sociology with other Social Sciences:** Sociology and Psychology, Sociology and History, Sociology and Economics, Sociology and Political Science	6
Unit 3	**Basic Concepts:** Society- Concept and characteristics; Community- Concept and characteristics; difference between society and community; Status- Concept and characteristics, types and related concepts; Role- Concept, characteristics and related concepts.	10
Unit 4	**Individual and Society:** Individual and society interrelationships, feral cases, man as a social animal, Socialization-Concept, Stages andagents**.**	8
Unit 5	**Culture:** Concept, characteristics; sub-culture, contra-culture, the theory of cultural lag; Civilization- Concept and characteristics; convergence and divergence between culture and civilization.	8

Course Outcome: The student will:

1 Develop an understanding of the subject.
2 Making a sense of the relation of Sociology with other social sciences.
3 Understanding the concepts basic to Sociology
4 To make out the interdependence between man and society
5 Analyzing culture as the identity of any society

Text Books:

1 Vidyabhushanand Sachdeva: 2005, An Introduction to Sociology, Allahabad, KitabMahal.
2 Rao,C.N.S. : 2005, Sociology, New Delhi,S.Chand.

Reference Books:

1 Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.
2 MacIver, R. M. and C. H. Page, 1965, Society: An Introductory Analysis, Macmillan.
3 Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.
4 Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.

SO20.103	Classical Thought -I	3-0-0-3 Total Lectures: 39

Objective: The objective of the course is to create awareness about the intellectual contributions to Sociology as a science.

Unit 1	**Auguste Comte:** Intellectual background, law of three stages and positivism	7
Unit 2	**Auguste Comte: H**ierarchy of sciences, social statics and dynamics.	7
Unit 3	**Herbert Spencer:** Intellectual background, the evolutionary doctrine, the theory of organic analogy and social Darwinism.	10
Unit 4	**Vilfredo Pareto :**Intellectual background, residues and derivations,.	8
Unit 5	**Vilfredo Pareto : L**ogical and non- logical actions and the circulation of élites.	7

Course Outcome: The student will:

1 Develop an understanding of the evolutionary progression of the social life and human thought.
2 Getting an idea about the origin and development of social sciences and the basic components of society.
3 Understanding the evolution of society and comparison of society with organism.
4 To make out the constant and variable elements of society.
5 Analyzing human action and movement of people in social hierarchy.

Text Books:

1 Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, RawatPublication.
2 Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.

Reference Books:

1 Aron, R.: 1967, Main CurrentsinSociologicalThought, London,Weidenfieldand Nicholson.
2 Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.
3 Tucker, Jr. and Kenneth, H. (1992). ―Althusser, Louis.‖ in George Ritzer (ed.), The Blackwell Encyclopaedia of Sociology. Oxford:Blackwell: 3612:3613
4 Wortmann, S. (2007). ―Praxis‖ in George Ritzer (ed.), The Blackwell Encyclopaedia of Sociology. Oxford: Blackwell: 3612:3613

SO20.102
Introduction to Sociology -II

3-0-0-3
Total Lectures: 39

Objective:
The objective of the course is to create awareness among the student on the socialinstitutions and processes.

Unit 1

Family: Concept, characteristics, functions, types.
6

Unit 2

Marriage: Concept, causes, characteristics, types-monogamy and polygamy.
7

Unit 3

Recent Changes: Recent changes in the family system and marriage.
9

Unit 4

Social Stratification: Concept, attributes, bases and theories-Marxian, Weberian and Functionalistic; M.M.Tumins criticism, Social Mobility-concept and types.
9

Unit 5

Social Control: Concept, nature, purposes, agencies of social control-Formal and informal.
8

Course Outcome: The student will:

1 Develop an understanding of family as a fundamental social institution.

2 Understand marriage as an essential social institution.

3 Understanding the current changes in marriage and family.

4 Analyze the divisive nature of society

5 Analyzing the restrictions in social life

Text Books:

1 Vidyabhushan and Sachdeva: 2005, AnIntroduction to Sociology, Allahabad, KitabMahal.

2 Rao,C.N.S. : 2005, Sociology, New Delhi,S.Chand.

Reference Books:

1 Johnson, H. M.: 1995, Sociology: A Systematic Introduction, New Delhi, Allied Publishers.

2 MacIver, R. M. and C. H. Page, 1965, Society: An Introductory Analysis, Macmillan.

3 Inkeles, Alex: 1987, What is Sociology? New Delhi, Prentice-Hall of India.

4 Harlambos, M.: 1998, Sociology: Themes and perspectives, New Delhi, Oxford University Press.

SO20.104 **Classical Thought -II**

3-0-0-3

Total Lectures: 39

Objective:

The objective of the course is to create awareness about the intellectual contributions to Sociology as a science.

Unit 1

Karl Marx: Intellectual background, the theory of class struggle, dialectical materialism, historical materialism and the theory of alienation.

10

Unit 2

Max Weber: Intellectual background, the verstehen, social action, bureaucracy.

7

Unit 3

Max Weber: Iideal type, protestant ethics and spirit of capitalism.

6

Unit 4

Emile Durkheim: Intellectual background, division of labour insociety, rules of sociological methods.

9

Unit 5

Emile Durkheim: The theory of suicide and the elementary forms ofreligious life.

7

Course Outcome: The student will:

1 Develop an understanding of the economy as the base of society.

2 Getting an idea about the interpretative understanding of human action and state administration.

3 Understanding the relation between religion and economy.

4 To make out the divisive nature of society and social norms.

5 Analyzing suicide and religion as social phenomena.

Text Books:

1 Fletcher, Ronald: 1994, The Making of Sociology, Jaipur, Rawat Publication.

2 Ritzer, G.: 1996, Sociological Theory, New York, McGraw-Hill.

Reference Books:

1 Aron, R.: 1967, Main CurrentsinSociologicalThought, London,Weidenfield and Nicholson.

2 Coser, Lewis: 1979, Masters of Sociological Thought, New York, Harcourt Brace Jovanovich.

3 Tucker, Jr. and Kenneth, H. (1992). ―Althusser, Louis.‖ in George Ritzer (ed.), The Blackwell Encyclopaedia of Sociology. Oxford:Blackwell: 3612:3613

4 Wortmann, S. (2007). ―Praxis‖ in George Ritzer (ed.), The Blackwell Encyclopaedia of Sociology. Oxford: Blackwell: 3612:3613

SO20.201

Sociology of Gender-I
3-0-0-3
Total Lectures: 39

Objective:
The objective of the course is to provide a complete understanding of gender, its feminist sociological perspectives and society‘s support to women.

Unit 1

Gender: Meaning and definitions of gender; key concepts- Gender stereotypes, patriarchy, gender equity and equality, gender mainstreaming, gender socialization, difference between gender and sex, gender mainstreaming.

9

Unit 2

Branches of Feminism-Liberal, socialist, radical, multicultural and global feminism, eco-feminism.

8

Unit 3

Sociological Perspectives on Gender Roles: Functionalist, conflict,symbolic interactionist and the feminist Sociological theory.

9

Unit 4

Women in Family: Gender role division, household work, dual role, role conflictand coping mechanism.

8

Unit 5

Support System for Women: Network and support for working women, gender and health, gender and education.

5

Course Outcome: The student will:

1 Understanding gender and its aspects in its actual sense.

2 Gathering idea about the different approaches to gender.

3 Understanding gender from sociological point of view.

4 Analysing gender in practical sense.

5 Understanding the implementation of different policies to address gender differences.

Text Books:

1 Misra, R.:2014, Rethinking Gender, Jaipur, Rawat Publications.

2 Lindsey, L.L., 2011, Gender Roles: A Sociological Perspective, New Delhi, PHI Learning Pvt. Ltd.

Reference Books:

1 Abbot, P. and C. Wallace. 1990, An Introduction to Sociology: Feminist Perspectives, London: Routledge & Kegan Paul.

2 Oakley, Ann. 1972, Sex, Gender and Society, London, Temple Smith.

3 Butler, Judith. 1993. Bodies that matter: Routledge.

SO20.203 **Sociology of Indian Society-I**

3-0-0-3

Total Lectures: 39

Objective:

The objective of the course is to provide a complete understanding of the structure and themajor facets of Indian society.

Unit 1

Understanding Indian Society: A brief history of Indian Society,Characteristics of Indian Society and culture.

7

Unit 2

Indian Social Pluralism: Religious, linguistic, regional andracial; unity in diversity-factors of unity and factors of diversity.

7

Unit 3

Hindu Social Organisation: Bases of Hindu social organization, varna and ashram systems, purushartha.

9

Unit 4

Doctrine of Karma: The theory of karma, contemporary relevance of the theory, Indian theory of karma vs. western theory of action.

9

Unit 5

Inequality and Social Mobility: Poverty & Income Inequality, Educational Inequality, Caste and Class Mobility

7

Course Outcome: The student will:

1

Understanding the basic exclusivity of Indian society.

2

Gathering idea about the pluralistic nature of Indian social life.

3

Understanding the organizational dimensions of the Hindus in India because Hunduism isthe major religion in India.

4

Analysing the concept of kama as prevalent in Indian social belief.

5

Understanding the social inequality and movement in social life.

Text Books:

1

Rao, C.N.S, 2009, Sociology of Indian Society, S. Chand and Company Ltd., New Delhi.

2

Kar, P.K., 2004, Indian Society, Kalyani Publishers, New Delhi.

Reference Books:

1

Mandelbaum, D.G. 1955, Society in India, Popular Prakasan, Bombay

2

Madan, T.N. 1994, Pathways: Approaches to Study of Society in India, Delhi: Oxford University Press.

3

Mukerji, D. P. 1958, Diversities, Delhi: Peoples PublishingHouse.

4

SO20.202

Sociology of Gender-II
3-0-0-3
Total Lectures: 39

Objective:
The objective of the course is to provide knowledge about the disadvantages encountered by women, developmental initiatives concerning them and their fight for right.

Unit 1

Gender Based Violence: Meaning and definitions of GBV, forms of GBV, laws to control violence against women.

8

Unit 2

Women Empowerment: Concept, indicators, importance and the key aspects-Social, economic and political; constraining factors of empowerment, the recent global and Indian initiatives for the empowerment
of women, role of educationin the empowerment of women.

10

Unit 3

Women and Development: National Commission for Women, women_s work and technology, Impact of development policies, liberalization and globalization on women.

8

Unit 4

The role of women in development: Sustainable development and women, reservation for women.

6

Unit 5

Various Feminist Movements: History of feminism, feminist movement in India

7

Course Outcome: The student will:

1

Understanding gender based violence faced by women in society.

2

Analyzing the empowerment policies and praxis for women.

3

Understanding the developmental initiatives for women.

4

Getting a picture of women‘s contribution to the developmental process.

5

Understanding women‘s fight for their rights across the world.

Text Books:

1

Desai, Neera and M. Krishnaraj. 1987, Women and Society in India. Delhi: Ajanta.

2

Forbes, G. 1998, Women in Modern India. New Delhi, Cambridge University Press.

Reference Books:

1

Dube, Leela et.al. (eds.) 1986, Visibility and Power: Essays on Women in Society and Development. New Delhi: OUP.

2

Oakley, Ann. 1972, Sex, Gender and Society, London, Temple Smith.

3

Ram, F., S. Unisa and T.V.Sekhar: 2011, Population, Gender and Reproductive Health,

SO20.204 **Sociology of Indian Society-II**

3-0-0-3

Total Lectures: 39

Objective:

The objective of the course is to provide a complete understanding of the structure and the major social institutions of Indian society.

Unit 1

Indian Social Hierarchy: Caste- origin, concept, characteristics, theories,dynamics and continuity; class System in India–Emergence and characteristics, Interrelationship between caste and class.

8

Unit 2

Hindu marriage: A religious sacrament, traditional forms of Hindu marriage, divorce among the Hindus, Hindu Marriage Act-1955, recent changes in Hindu marriage, compulsory registration of marriage and live-in relationship.

10

Unit 3

Muslim marriage -A contract, types and changing patterns, divorce among Muslims, differences between Hindu and Muslim marriages.

7

Unit 4

Kinship System in India: Concept and types of kinship, kinship usages, kinship terminology-classificatory and descriptive.

7

Unit 5

Theories and Systems of Kinship: Descent and alliance theories, kinship systems of North and South India.

7

Course Outcome: The student will:

1 Understanding the basic structure of Indian society.

2 Gathering idea about Hindu marriage system in Indian society.

3 Understanding Mulim marriage system in Indian society.

4 Analysing the concept of kinship as prevalent in Indian society.

5 Understanding the approaches to kinship in general and in India.

Text Books:

1 Rao, C.N.S, 2009, Sociology of Indian Society, S. Chand and Company Ltd., New Delhi.

2 Kar, P.K., 2004, Indian Society, Kalyani Publishers, New Delhi.

Reference Books:

1 Kapadia K.M., 1958, Marriage and family in India Oxford University PressBombay.

2 Madan, T.N. 1994, Pathways: Approaches to Study of Society in India, Delhi: Oxford University Press.

3

SO20.301

Crime and Society-I
3-0-0-3
Total Lectures: 39

Objective:
The objective of the course is to provide the fundamental understanding of crime as a major social problem and its sociological explanations.

Unit 1

Criminology: Meaning, definition and subject matter, sociology andcriminology, criminology and penology.
9

Unit 2

Crime and its Extent: Crime- concept, classification and incidence of crime, causes of crime, crime In India
6

Unit 3

Theories of Crime:differential association, theory of delinquent sub-culture, anomie theory and labeling theory.
8

Unit 4

Punishment andCorrectional Methods: Punishment Theories:retributive, deterrent, reformative; Correctional methods: prison based, community based; probation, parole, open prison.
10

Unit 5

Agencies of Criminal Justice System: Roles of police, prosecution and judiciary; main issues in their coordination.
6

Course Outcome: The student will:

1 Understanding criminology as a sub-branch of sociology.

2 Understanding crime and its prevalence.

3 Explaining the sociological perspectives on crime and deviance.

4 Understanding punishment as an essential response to crime.

5 Gaining concrete ideas on the administration of justice.

Text Books:

1 Mohanty, R.K. and S. Mohanty (2012) A Text Book of Criminology, Penology and Victimology, Himalaya Publishing House, Mumbai.

2 Ahuja, R., 2000, Criminology, Rawat Publications, Jaipur,India.

Reference Books:

1 Sutherland E.H. 1960, Principles of Criminology, Chicago Lippincott.

2 Paranjape, N.V., 2016, Crime and Punishment: Trends and Reflections, Lexis Nexis, Gurgaon.

3 Sirohi, J.P.S., 2011, Criminology and Penology, Allhabad Law Agency, Faridabad.

SO20.303

Social Problems in India-I

3-0-0-3

Total Lectures: 39

Objective:

The objective of the course is to provide a conceptual understanding on social problemwith specific reference to AIDS, child issues and corruption.

Unit 1

Social Problems: Concept, theoretical approaches to social problems:social problemsand social disorganization.

8

Unit 2

AIDS: The extent, causes, consequences, AIDS control, preventivemethod and curative treatment, social stigma relating to AIDS.

9

Unit 3

Child Abuse: Child Abuse- concept, types, causes, effects and remedies.

6

Unit 4

Child Labour: concept, causes, consequences and remedies.

7

Unit 5

Corruption: Concept, characteristics, forms and causes; legislative measures to control corruption- The Santhanam Committee, Introductionof the Lokpal and anti-corruption movements in India.

9

Course Outcome: The student will:

1 Understanding social problem from sociological perspective.

2 Gaining knowledge about AIDS as an emerging danger to mankind.

3 Understanding child abuse with reference to its concept and allied dimensions.

4 Understanding child labour as a growing social issue.

5 Gaining concrete ideas about corruption in different counters of society and the remedies for it.

Text Books:

1 Ahuja, R. 1999. Social problems in India, Rawat Publication: New Delhi.

2 Madan, G.R. 1976. Indian Social problems, Allied Publisher, New Delhi.

Reference Books:

1 Robert K. Merton and Robert Nisbet, (ed.). 1971, Contemporary social problems, Harcourt Brace, New York.

2 Gill, S.S. 1998, The Pathology of Corruption, New Delhi: Harper Collin Publishers.

3 Memoria, C.B., Social Problem & Social Disorganisation in India, Kitab Mahal,

SO20.302

Crime and Society-II
3-0-0-3
Total Lectures: 39

Objective:
The objective of the course is to provide a complete understanding of sophisticated crimes and crime against women in Indian society.

Unit 1

White Collar Crime: Meaning and nature of white collar crime; genesis of white collar crime; scope of white collar crime; preventivemeasures.
8

Unit 2

Cyber Crime in India: Concept, causes, consequences and remedial measures.
6

Unit 3

Crime against Women in India: Rape-causes, consequences and remedial measures; Domestic Violence- causes, consequences and remedial measures; Trafficking- causes, consequences and remedial measures;
Female feticide- causes, consequences and remedial measures.
10

Unit 4

Laws to Address Crime Against Women: Provisions in the Indian Pinal Code and Indian constitution
9

Unit 5

Special Legislations to Control Crime Against Women: Vishaka Guideline, Protection of Women from Domestic Violence Act 2005, Pre-Conception and Pre-Natal Diagnostic Techniques (PCPNDT) Act, 1994
6

Course Outcome: The student will:

1 Understanding high profile crimes and their remedies in India.

2 Gathering idea about the crimes committed using internet and computer.

3 Analysing different crimes committed against women in India and their remedies.

4 Analysing constitutional and IPC provisions to address crime against women.

5 Understanding the special provisions to address crime against women in India.

Text Books:

1 Mohanty, R.K. and S. Mohanty, 2012, A Text book of Criminology Penology and Victimology, Himalaya Publishing House, Mumbai.

2 Ahuja, R., 2000, Criminology, Rawat Publications, Jaipur, India.

Reference Books:

1 Criminal Procedure Code1978.

2 Sirohi, J.P.S., 2011, Criminiligy and Penology, Allhabad Law Agency, Faridabad.

3

SO20.304

Social Problems in India-II

3-0-0-3

Total Lectures: 39

Objective:

The objective of the course is to provide an extensive understanding of severe social problems in India.

Unit 1

Juvenile Delinquency: Concept, Causes, Types, consequences and preventive measures; Juvenile justice system- The Juvenile Justice (Careand Protection of Children) Act, 2005.

8

Unit 2

Drug Addiction: Drug addiction- Causes, consequences and control- Role of family and peer groups, Prevention of drug abuse.

8

Unit 3

Prostitution: Concept, causes, effect, preventive measures and control mechanism, rehabilitation of prostitutes.

5

Unit 4

Alcoholism: The concept, extent, causes and the treatment of alcoholics

9

Unit 5

Terrorism: Concept, characteristics, background of the growth of terrorism in India, incidents of terrorist attacks in India, causes and impact of terrorismin India,remedies.

9

Course Outcome: The student will:

1

Understanding crime from legal minors‘ perspective.

2

Gaining extensive knowledge about drug related problems.

3

Understanding prostitution as a growing social problem.

4

Understanding the extent and remedies for alcoholism.

5

Gaining concrete ideas about terrorism as a major social problem.

Text Books:

1

Ahuja, R. 1999. Social problems in India, Rawat Publication: New Delhi.

2

Madan, G.R. 1976. Indian Social problems, Allied Publisher, New Delhi.

Reference Books:

1

Robert K. Merton and Robert Nisbet, (ed.). 1971, Contemporary social problems, Harcourt Brace, New York.

2

Gill, S.S. 1998, The Pathology of Corruption, New Delhi: Harper Collin Publishers.

3

Memoria, C.B., Social Problem & Social Disorganisation in India, Kitab Mahal, Allahabad, 1981.

4

FR20.101

Written Expression-I

3-0-0-3

Total Classes: 39

Objective:

Student will have an enhanced vocabulary based on various categories of words on thecompletion of this paper

Unit 1

Les nombres cardinaux, Les professions, Les nationalités, Les adjectifs

8

Unit 2

Les jours de la semaine, Les mois de l'année, Les mots de courtoisies,

8

Unit 3

Les couleurs, Les articles du bureau, Les nombres ordinaux, Les vêtements, Les projets d'affaires, achats et ventes, L'entreprise, le e-commerce

8

Unit 4

Le temps, la banque, l'assurance, principaux termes du commerce international

8

Unit 5

Le courrier, le prix, la communication interne d'une société

7

Course Outcome:

1 The student will have learnt French words for cardinal numbers, nationalities etc.

2 The student will have learnt French words for the days of the week, months etc.

3 The student will have learnt French ordinal numbers, terms of office use etc.

4 The student will have acquired knowledge of French words for weather, commerce etc.

5 The student will know French words related to various aspects of French culture

6 The student will have acquired knowledge of French words for various walks of life,colours, dresses etc.

Text Books

1 Jiradet,Jacky et al. *Panorama - 1*, CLE International, Paris, 2000

2 Mérieux, Régine et Loiseau Yves,.*Connexxions -1*, Didier, Paris.2001

Reference Books

1 Merieux,D. et al. *Cadences - 1*, Hatier/Didier, Paris, 2000

2 Monnerie-Goarin,Annie et al. *Ado-1*, CLE International, Paris, 1999

3 https://www.bonjourdefrance.com

4 Courtillon,J et al. *Libre Echange - 1*, Didier, Paris. 1995

5

FR20.103

Oral Expression-I
0-1-4-3
Total Practical Classes: 26

Objective:
Student will learn the nuances of spoken French on the completion of this paper

Unit 1

Échanger pour entrer en contact/saluer/ /s'excuser, Communiquer avec tu et vous, Comprendre et réutiliser quelque gestes, Réciter l'alphabet, Épelerquelque mots

12

Unit 2

Se présenter, Présenter quelqu'un, Demander à quelqu'un de se présenter,Comprendre une interview

10

Unit 3

Exprimer ses goûts, Parler de soi, Exprimer la possession, Comprendre des opinions

10

Unit 4

Demander à quelqu'un de faire quelque chose, Échanger sur ses projets, S'exprimer sur les fêtes

10

Unit 5

Comprendre les dates et heures de rendez-vous, Prendre/fixer rendez-vous par téléphone, S'exprimer sur ses loisirs, Inviter quelqu'un

10

Course Outcome:

1

The student will learn to pronounce French alphabet, basic expressions for introduction etc.

2

The student will learn to pronounce the spelling and orthography basics in French.

3

The student will learn to express their taste and express their opinion in French.

4

The student will learn to speak in French about things of everyday need.

5

The student will know how to use French to meet someone in real life etc.

6

The student will learn the difference between various registers of language, ask someoneto present themselves in French.

Text Books

1

Mérieux, Régine et Loiseau Yves,.*Connexxions -1*, Didier, Paris.2001

2

Dominique,Philippe et al. *Nouveau Sans Frontières-1*, CLE International, Paris, 1999

Reference Books

1

Mathurin Dondo, *Modern French Course,* Oxford University press, New-Delhi, 2003

2

Mishra, Sushant Kumar et al. *Entreprise*, Langers International, New Delhi, 2019

3

Cocton, Marie-Noël.et al. *Saison-1*, Didier, Paris.2015

4

FR20.102

Written Expression-II

3-0-0-3

Total Classes: 39

Objective:

Student will have learnt about French written communication in real lifesituation on the completion of this paper

(39)

Unit 1

Comprendre un message électronique, Complétez un court dialogue,

8

Unit 2

Présenter un personnage, Découvrir et remplir un formulaire official

8

Unit 3

Écrire une carte postale à un ami, Résoudre des énigmes, Identifier un récitcorrespondant à une situation, Écrire un dialogue

8

Unit 4

Complétez une carte postale, Écrire une lettre à un ami, Comprendre etutiliser un calendrier

8

Unit 5

Refuser une invitation, Lire un agenda, Remplir un agenda, Lire unprogramme de cinéma, Comprendre des statiques

7

Course Outcome:

1

The student will get acquainted with email and short dialogues in French.

2

The student will learn how to present someone and how to fill up a form.

3

The student will learn writing postcards, a dialogue etc.

4

The student will gain knowledge of ways of writing letters in French.

5

The student will know how to use his language skills in practical life situations.

6

The student will learn the difference between the formal and informal types of writtencommunication.

Text Books

1

Jiradet,Jacky et al. *Panorama - 1*, CLE International, Paris, 2000

2

FR20.104

Oral Expression-II

0-1-4-3

Total Practical Classes: 26

Objective:

Student will learn spoken French for practical use

Unit 1

Comprendre des avis positifs et négatifs, Faire un achat dans une librairie

12

Unit 2

Faire connaissance, inviter et répondre à une invitation, décrire les personne

10

Unit 3

Exprimer l'ordre et l'obligation, demander et commander, évaluer et apprécier, féliciter et remercier

10

Unit 4

Raconteur et rapporter, donner son avis, se plaindre, et réprimander, expliquer et justifier

10

Unit 5

Demander l'autorisation, interdire, formuler des projets, discuter et débattre

10

Course Outcome:

1

The student will get acquainted with the ways to express himself in a book shop inFrench.

2

The student will learn how to differentiate between positive and negative tone and usethem.

3

The student will learn to find his way and invite and respond to invitation in French.

4

The student will gain knowledge of ways of describing persons in French.

5

The student will know how to use French to judge, thank etc.

6

The student will learn to tell stories and about past events in French.

Text Books

1

Mérieux, Régine et Loiseau Yves,.*Connexxions -1*, Didier, Paris.200

2

Dominique, Philippe et al. *Nouveau Sans Frontières-1*, CLE International, Paris, 1999

Reference Books

1

Mathurin Dondo, *Modern French Course,* Oxford University press, New-Delhi, 2003

2

Mishra, Sushant Kumar et al. *Entreprise*, Langers International, New Delhi, 2019

3

Cocton, Marie-Noël.et al. *Saison-1*, Didier, Paris.2015

FR20.201

Written Expression-III
3-0-0-3
Total Classes: 39

Objective:

Student will have learnt about the finer and deeper details of French written communication in real life situation on the completion of this paper

Unit 1

Comprendre et résoudre quelque énigmes, Décrire un lieu, Rédiger unehistoire à partir d'information donnée

8

Unit 2

Écrire des recommandations à un ami, Faire le récit de sa journée, Rédigerune biographie

8

Unit 3

Décrire le temps, Écrire des histoires à partir des éléments donnés

8

Unit 4

Comprendre un article de presse, rédiger un récit (au présent/au passé) a partir d'une BD

8

Unit 5

Comprendre des documents publicitaire, Vanter un produit dans une publicité, comprendre un message électronique, Comprendre un article

7

Course Outcome:

1

The student will get acquainted with understanding a story in French.

2

The student will learn how to describe a place.

3

The student will learn writing recommendation letters.

4

The student will gain knowledge of ways of describing weather in French.

5

The student will know how to form a story from given outline and elements.

6

The student will get practice on real life written popular literature comprehension.

Text Books

1

Jiradet, Jacky et al. *Panorama - 2*, CLE International, Paris, 2000

2

Mérieux, Régine et Loiseau Yves,.*Connexxions -2*, Didier, Paris.2001

Reference Books

1

Merieux, D. et al. *Cadences - 2*, Hatier/Didier, Paris, 2000

2

Monnerie-Goarin,Annie et al. *Ado-2*, CLE International, Paris, 1999

3

FR20.203

Oral Expression-III

0-1-4-3

Total Practical Classes: 26

Objective:

Student will have a better grasp of real life French oral communication on the completionof this paper

Unit 1

Comprendre une chanson française, S'exprimer sur ses goûts musicaux et lestendances de son pays

12

Unit 2

Exprimer son opinion sur une œuvre d'art, Interroger quelqu'un sur sesgoûts

10

Unit 3

Comprendre les différences de deux éléments comparés, Comparer deux villes à partir d'informations données, S'exprimer sur un texte sur lapublicité

10

Unit 4

Raconter une anecdote au passé, Commenter des photos, Comprendre le récit d'un voyage

10

Unit 5

S'exprimer sur les différentes formes de discrimination, Exprimer sa joie ou colère en situation

10

Course Outcome:

1

The student will get acquainted with how to understand songs in French.

2

The student will learn how to talk about taste in music etc.

3

The student will learn how to talk about art, literature etc.

4

The student will gain knowledge of ways of comparing elements in French.

5

The student will know how to compare two cities from the information given.

6

The student will be able to tell a personal anecdote from the past.

Text Books

1

Mérieux, Régine et Loiseau Yves,.*Connexxions -2*, Didier, Paris.2001

2

Dominique, Philippe et al. *Nouveau Sans Frontières-2*, CLE International, Paris, 1999

Reference Books

1

Mathurin Dondo, *Modern French Course,* Oxford University press, New-Delhi, 2003

2

Mishra, Sushant Kumar et al. *Entreprise*, Langers International, New Delhi, 2019

3

Cocton, Marie-Noël.et al. *Saison-2*, Didier, Paris.2015

FR20.202

Written Expression-IV
3-0-0-3
Total Classes: 39

Objective:

Student will have learnt about the finer and deeper details of French written communication in real life situation on the completion of this paper

Unit 1

Rédiger un dialogue à partir d'illustrations, Comprendre un article sur l'évolution technique, S'exprimer sur les progrès technique

8

Unit 2

Comprendre un texte littéraire, Comprendre un témoignage et des incitations sur une liste de diffusion

8

Unit 3

S'exprimer sur la fréquence de ses propres actions, Comprendre une BD sur les discriminations, Comprendre les panneaux de la ville

8

Unit 4

Comprendre les informations d'un site internet, Comprendre et formuler des instructions, Créer des panneaux,

8

Unit 5

Écrire un court texte à la forme passive, Comprendre des témoignages sur un forum, Comprendre un article sur la mode

7

Course Outcome:

1

The student will learn to write dialogues based on images.

2

The student will learn to understand literary texts.

3

The student will learn to write about their daily life.

4

The student will get acquainted with comic strips in French.

5

The student will know how to interpret information at websites.

6

The student will get practice of passive voice writing.

Text Books

FR20.204

Oral Expression-IV
0-1-4-3
Total Practical Classes: 26

Objective:

Student will have a better grasp of real life French oral communication on the completionof this paper

Unit 1

S‘exprimer sur les différentes formes de discrimination, Exprimer sa joie ousa colère en situation, Exprimer des objectifs, S‘exprimer sur la question du logement

12

Unit 2

Comprendre des annonces de répondeurs téléphoniques, Jouer une scène de rencontre dans la rue, Exprimer ses impressions dans une situation donnée

10

Unit 3

S‘exprimer sur diverses règles de savoir-vivre, Comprendre des prise de position sur un sujet, Reprocher, se justifier dans des situations données

10

Unit 4

Réagir à un texte de presse, Organiser le programme d‘une manifestation, Comprendre des personnes qui parle de leur engagement pour de grandecauses

10

Unit 5

Distinguer des actes de parole variés, exprimés avec le conditionnel, Exprimer les rêves de quelqu‘un, Comprendre des explications et desarguments

10

Course Outcome:

1

The student will get acquainted with discrimination.

2

The student will learn how to express pleasure and displeasure.

3

The student will learn how to role play in real life scenes.

4

The student will express himself in French conditional sentences.

5

The student will know how to comprehend someone‘s argumants.

6

The student will be able to understand people talking about their passion.

FR20.301

History of French Literature-I

3-0-0-3

Total Classes: 39

Objective:

Student will have learnt about French literary history on the completion of this paper

Unit 1

Moyen age,Seizième Siècle,La poésie française au seizième siècle, La Pléiade, Ronsard

8

Unit 2

La prose française au 16ème siècle, Rabelais, Montaigne, Influence de Rabelais et de Montaigne, Idées Générales sur le 16ème Siècle, Beaux-Arts

8

Unit 3

Dix-Septième Siècle, Classicisme, La Formation de la Littérature Classique, Les salons, La Philosophie: la Cartésianisme, Jansénisme, La Poésie Lyriqueau Dix-Septième Siècle, Le Théâtre au 17ème Siècle

8

Unit 4

La Prose au 17ème Siècle, La Fin du 17ème Siècle, Idee générales sur le 17ème Siècle,

8

Unit 5

Dix-Huitieme Siecle: Vue generale, Les Philosophes, Les salons, Caractère Généraux de la Littérature du 18ème Siècle

7

Course Outcome:

1

The student will get acquainted with medieval age of literature.

2

The student will learn how to critically understand the poetry of sixteenthcentury.

3

The student will learn about French prose in the sixteenth century.

4

The student will get acquainted with writers like Rabelais, Montaigne etc.

5

The student will learn about literature in seventeenth century France.

6

The student will learn about literature in eighteenth century France.

FR20.303

Oral Expression-V
0-1-4-3
Total Practical Classes: 26

Objective:
To enhance oral comprehension and expression skills in order to enable thelearners to communicate more effectively and confidently.

Unit 1
Dire sa sympathie ou son antipathie, Exprimer l'obligation et l'interdiction
12
Unit 2
Formuler des demandes, Exprimer la certitude et le doute
10
Unit 3
L'expression de l'espoir, du souhait, du regret, de la crainte, de la satisfaction ou de l'insatisfaction
10
Unit 4
L'explication, la logique et le raisonnement
10
Unit 5
Exprimer son opinion, Le mode et la publicite
10

Course Outcome:

1 Enable learners to partially attain B1 Level of listening and speaking skills in the concerned language.

2 Develop upon the linguistic skill sets already acquired with enhanced focus on oral comprehension and expression.

3 Produce simple coherent and structured texts on topics that are familiar to them or of personal interest.

4 Tackle effectively most situations likely to arise while travelling in an area where the language is spoken.

5 Enable learners to express opinions on a given set of situations.

6 Enable learners to express feelings like hope, doubt, fear, satisfaction, etc.

Text Books

1 Dominique, Philippe et al. *Nouveau Sans Frontières-3*, CLE International, Paris, 1999

2 Mérieux, Régine et Loiseau Yves,.*Connexxions -3*, Didier, Paris.2001

Reference Books

1 Jiradet, Jacky et al. *Panorama -3* CLE International, Paris, 2000

2 Capelle,G, *Le Nouvel Espaces - 3*, Hachette, Paris, 1995

3 Mishra, Sushant Kumar et al. *Entreprise*, Langers International, New Delhi, 2019

4 Cocton, Marie-Noël.et al. *Saison-3*, Didier, Paris.2015

FR20.302

History of French Literature-II

3-0-0-3

Total Lectures: 39

Objective:

Student will have learnt more about French literary history on the completion of this paper

Unit 1

Les écrivains français du 18ème siècle, Les Philosophes, Les lettres Persanes

8

Unit 2

Montesquieu, Voltaire, Jean Jacques Rousseau

8

Unit 3

Le Théâtre au 18ème siècle, Marivaux, Beaumarchais

8

Unit 4

Le roman au 18eme Siècle, Les Moraliste au 18ème Siècle, La Poésie au 18ème Siècle, La Littérature de la période révolutionnaire, Idée généralessur le 18ème Siècle

8

Unit 5

Dix-Neuvieme Siecle: Vue generale, Le romantisme, Le realisme,L'idealisme,

7

Course Outcome:

1

The student will get acquainted with French writers of 18th century.

2

The student will learn about the philosophes and the Parnassian literature.

3

The student will learn about Montesquieu, Voltaire, Jean Jacques Rousseau etc.

4

The student will get acquainted with French drama in 18th century.

5

The student will get acquainted with French fiction in 18th century.

6

The student will learn about literature in ninteenth century France.

Text Books

1

Cadoux,Charles.Les Grandes Étapes de la Littérature Française, Universite de Poona, Inde

2

Girard, Louis : Du Moyen Age aux Temps Modernes, Bordas, Paris

Reference Books

1

Eliana Gardaire : La France vous connaissez, Librairie Marcel Didier, Paris

2

Duby G. : Histoire de la France, Larousse, Paris.

3

Riviere, D. : Histoire de la France, Hachette, Paris.

FR20.304

Oral Expression-VI

0-1-4-3

Total Practical Classes: 26

Objective:

To enhance oral comprehension and expression skills in order to enable thelearners tocommunicate more effectively and confidently.

Unit 1

Exprimer la probabilité et la possibilité, Dire sa surprise ou son indifférence,Délinquance et justice, Argent, banque, épargne, Vieillesse et mort

12

Unit 2

Enchaîner des idées, Le cinéma, L'aventure et l'exploit, Convaincre,Comparer

10

Unit 3

Les animaux, la pollution, L'intelligence et la folie, Conseiller, Deconseiller, proposer, suggerer

10

Unit 4

Actes relatifs à la prise de parole, Jeux et hasad, Rire et humour

10

Unit 5

Attitudes et comportements, La presse, Le cinema francais

10

Course Outcome:

1

Enable learners to partially attain C1 Level of reading,listening and speaking skills in the concerned language.

2

Develop upon the linguistic skill sets already acquired with enhanced focus on oral comprehension and expression.

3

Produce simple coherent and structured texts on topics that are familiar to them or of personal interest.

4

Tackle effectively most situations likely to arise while travelling in an area where the language is spoken.

5

Exchanging, checking and confirming accumulated factual information on familiar routine and non-routine matters within one's field with some confidence.

6

Describe experiences and events, dreams, hopes and ambitions and briefly give reasons and explanations for opinions and plans.

Text Books

1

Cocton, Marie-Noël.et al. *Saison-3*, Didier, Paris.2015

2

Dominique, Philippe et al. *Nouveau Sans Frontières-3*, CLE International, Paris, 1999

Reference Books

1

Jiradet, Jacky et al. *Panorama -3* CLE International, Paris, 2000

2

Capelle,G, *Le Nouvel Espaces - 3*, Hachette, Paris, 1995

PL20.101

Basic Psychological Processes-I

3-0-0-3

Total Lectures: 39

Objective:

To introduce students to the basic concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Unit 1

Introduction: Meaning and Definition of Psychology, Historical Background, Psychology as a Scientific Study of Behaviour, Scope of Psychology.

8

Unit 2

Methods of Psychology: Experimental Method, Observational Method, Case Study, Survey Method, Field Study and Field Experiment.

7

Unit 3

Biological Bases of Behavior: Structure and Organization of the nervous system, function of the brain; Autonomic Nervous system.

8

Unit 4

Learning: Meaning and Nature, Theories of Learning: Trial and Error, Learning by Insight, Classical and Instrumental Conditioning. Schedules of Positive Reinforcements.

7

Unit 5

Personality: Meaning and Nature, Determinants of Personality, Personality Traits,Development of Personality, Trait and type approaches, Freudian's Psycho-Sexual
Theory and Erikson's Psycho-Social Theory, Assessment of personality.

9

PL20.103

Statistical Methods for Psychological Research-I
2-0-0-2
Total Lectures: 26

Objective:
To familiarize students with the use of statistical methods in psychological research and the techniques of descriptive statistics for quantitative research.

Unit 1

Scientific Foundations of Research: Nature of Science and Scientific Method, Meaning and Purpose of Research, Techniques of data collection: Questionnaire, Interview, Observation, Survey, Experimental Method.

5

Unit 2

Problem, Variable and Hypothesis: Nature, Type and Sources. Control of variables

5

Unit 3

Meaning and Purpose of Statistics in Psychology: Discrete and Continuous Scores. Nature and Levels of Measurement.

5

Unit 4

Frequency Distribution and Their Graphical Presentation: Frequency Polygons, Histograms and Ogive. Percentile Point and Percentile Ranks.

6

Unit 5

Measures of Central Tendency: Mean, Median and Mode

5

PL20.102

Basic Psychological Processes -II

3-0-0-3

Total Lectures: 39

Objective:

To introduce students to the basic concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Unit 1

Sensory and Perceptual Processes: Visual and Auditory Senses: Structure and Functions, Attention: Nature and Types, Perception: Nature and Determinants, Perceptual Organization, Form, Space and Depth Perception.

8

Unit 2

Thinking: The Thinking Process, Problem Solving and Creative Thinking, Role of Set and Insight, Concept Formation.

7

Unit 3

Intelligence: Nature, Theories of Intelligence: Factor, Process andGardener's Theories of Intelligence; Assessing Intelligence: Stanford-Binet Intelligence Scale and Wechsler Tests.

7

Unit 4

Memory and Forgetting: Sensory, Short-Term and Long-Term Memories; Theories of Memory: Information-Processing and the Levels-of-Processing Theories; Causes and Theories of Forgetting, Forgetting Curve, Reconstructive Memory.

7

Unit 5

Motivation and Emotion: Meaning and Nature, Types of Motives:Primary and Secondary, Biogenic and Sociogenic Motives, Intrinsicand Extrinsic Frame Work, Theories of Motivation – Drive Reduction, Arousal, Incentive, Opponent Process, Cognitive and Need Hierarchy; Techniques of Assessment of Motivations; Frustration and Conflict . Nature of Emotions, Physiological Correlates, Theories of Emotion: James-Lange, Cannon-Bard and Schachter-Singer.

10

PL20.104

Statistical Methods for Psychological Research-II
2-0-0-2
Total Lectures: 26

Objective:
To familiarize students with the use of statistical methods in psychological research and the techniques of descriptive statistics for quantitative research.

Unit 1
Sampling Methods: Probability and Non-Probability Sampling Methods.
5

Unit 2
Experimental Design: Single Group Design, Between Subject Design, Randomized, Matched Groups and Factorial Designs
5

Unit 3
Measures of Variability: Range, Quartile Deviation and Standard Deviation.
5

Unit 4
Normal Probability Curve: Properties and Applications. Skewness and Kurtosis.
5

Unit 5
Reliability of Statistics: Product Moment Method and Rank OrderMethod, Chi-Square, t-test: Mean for large and small independent samples,ANOVA.
6

PL20.201

Understanding Psychological Disorders-I

3-0-0-3

Total Lectures: 39

Objective:

The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information on psychopathology and dispel myths regarding it.

Unit 1

Concept of normality and abnormality: Criteria for determining abnormality,Historical perspectives on abnormal behavior, Research methods in abnormal psychology: Scientific Method, Naturalistic Observation, Correlational Method, Experimental Method, Epidemiological studies, Kinship studies and Case studies

8

Unit 2

Contemporary perspectives Methods of Assessment and Treatment: Biological,Psychodynamic, Behavioristic, Humanistic, Socio-Cultural and Bio-psychosocial perspective; Types of helping professionals, Methods of Treatment by therapies.

7

Unit 3

Stress related Disorders: Stress And Health; Endocrine System, Immune System, General Adaptation Syndrome, Stress and Life Changes, Psychological factors that moderate stress, Adjustment Disorder; Traumatic Stress Disorders; Theoretical perspective and treatment approaches.

8

Unit 4

Anxiety Disorders: Overview, Panic disorder, Phobic disorder, Generalized AnxietyDisorder, Obsessive Compulsive and related disorders, theoretical perspective and treatment approaches.

8

Unit 5

Mood Disorders: Types: Major Depressive Disorder, Persistent Depressive Disorder, Premenstrual Dysphoric Disorder, Bipolar disorder, Cyclothymic disorder;Causal factors and treatment.

8

PL20.203

Introduction to Indian Psychological Thought
2-0-0-2
Total Lectures: 26

Objective:
To introduce students to the basic psychology with reference to Indian context.

Unit 1

Introduction to Indian psychological thought – what is psychology and whatcould it be: alternative perspectives; what the Indian tradition can contribute: a psychology friendly philosophy; rigorous methods of enquiry in the subjective domain; effective methods for therapy and the harmonious development of the individual and the society;
Sri Aurobindo's 4 types of knowledge; stages in experiential learning; self- knowledge for its own sake, for healing, and for developing one's potential.

5

Unit 2

Self and personality: Who am I? – different Indian traditions on the self and the structure of personality; the character and location of the border between self and world; personality types; emotion and attitudes; states of consciousness and theireffect on perception and quality of life.
Individual development – various determinants of who and how we are; prenatal influences; past impressions and formations during childhood, adolescence and
adulthood; Ashramas then and now .

5

Unit 3

Self in action: Self in the social context – relationships with family, friends and partners, social groups, work and the world; relationship with oneself and one'sSelf; group membership by birth and by choice; roles and hierarchies; shifting
identities; positive and negative group-derived values and judgments.

5

Unit 4

Application of Indian Psychology in Counselling and therapy – Vipassana and mindfulness; Hathayoga-based therapies; The Gita as guide.

5

Unit 5

Application of Indian Psychology in Education, Organizational behaviour&community work – Gandhi's NaiTalim; Tagore's system of education; Sri
Aurobindo's integral education; Gita-based approaches to OB.

6

PL20.202

Understanding Psychological Disorders-II

3-0-0-3

Total Lectures: 39

Objective:

The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information onpsychopathology and dispel myths regarding it.

Unit 1

Dissociative Disorders & Psychological Factors Affecting Physical Health: Dissociative Identity Disorder, Dissociative Amnesia, Depersonalization Disorder; Theoretical perspective and treatments. Psychological factors affecting physical health: Headaches, Cardiovascular Disease, Asthma, Cancer and AIDS.

7

Unit 2

Schizophrenia Spectrum Disorder:Course of development, Diagnostic features,Theoretical perspectives,Treatment approaches;Other Schizophrenia Spectrum disorders:Brief Psychotic disorder,Schizophreniform disorder, Delusional disorder, Schizoaffective disorder.

8

Unit 3

Personality Disorders & Impulse Control Disorders: Types: Personality Disorders characterized by odd or eccentric behavior, Schizotypal disorder, Personality disorders characterized by dramatic, emotional or erratic behavior, Antisocial behavior, Personality disorders characterized by Anxious or Fearful behavior; Theoretical perspectives and Treatment. Impulse Control Disorders: Kleptomania, Intermittent Explosive Disorders, Pyromania.

9

Unit 4

Substance related and Addictive Disorders: Substance use and Abuse, Clarifying terms, Pathwaysto addiction, Drugs of abuse: Depressants, Stimulants, Hallucinogens. Theoretical perspectives and treatment.

8

Unit 5

Therapeutic Approaches: Psychodynamic therapies ; Behaviour therapies; Client centered therapy; Cognitive therapies; Indigenous therapies (Yoga, Meditation); Bio-feedback therapy; Prevention and rehabilitation of the mentally ill; Fostering mental health.

7

PL20.204

Psychometrics
2-0-0-2
Total Lectures: 26

Objective:
To provide an advanced understanding of psychometrics and its research applications.

Unit 1

Psychological Tests: Historical antecedents. Characteristics, types andapplications. Sources of bias in Psychological Testing. Ethics of Psychological Testing.

5

Unit 2

Psychometric properties of tests: Reliability: Meaning, sources of error, methods of estimate, and special problems. **Validity:** meaning, validationprocedures, and special problems.

5

Unit 3

Construction and Standardization of Psychological Tests
General steps of test construction: Preparation for Item writing, item analysis,reliability, validity. Development of norms, Item analysis for speed test; cross validation.

6

Unit 4

Personality Tests: Purpose and Types, Inventories-Cattell's 16 PF, MMPI and Neo-five factors. Projective- Rorschach and TAT.

5

Unit 5

Intelligence Tests: WAIS, Raven's Standard and Color progressive Matrices, Bhatia battery.

5

PL20.301

Educational Psychology
3-0-0-3
Total Lectures: 39

Objective:
To understand the applications of psychology in the area of education.

Unit 1

Introduction to Educational Psychology: Nature, scope & relevance of Educational Psychology, professional knowledge and skills of effective teaching

6

Unit 2

Conceptual and Theoretical Perspectives in EducationalPsychology: Information-Processing approach, Behavioral and
Social Cognitive approaches, Social Constructivist approach.

9

Unit 3

Human Diversity and Education: Intelligence & Creativity, Learning & thinking styles, Personality and Temperament; Socio- Cultural diversity- culture & ethnicity, multicultural education and gender.

10

Unit 4

Classroom Management: Classroom management issues, designing physical environment of classroom, creating positive environment for learning, being a good communicator, dealing with problem behaviours, technology and education.

8

Unit 5

Exceptionality and Special Education: ConceptualizingExceptionality: Categorization, Labelling and its educational implications; Responsibilities of Teachers towards learners withSpecial Needs.

6

PL20.303

Industrial and Organizational Psychology-I
2-0-0-2
Total Lectures: 26

Objective:
To develop an awareness of the concepts related to organizational behavior.

Unit 1

Industrial/Organizational Psychology: Nature, historical development and scope.

5

Unit 2

Personnel selection and development: Procedures and Assessment method for selection. Measurement of individual differences. Basic selection model. Techniques of selection. Application blank, interview and testing.

6

Unit 3

Training of Personnel: Nature, Principles and Methods: On the job and of the job training methods. Evaluation of trainingprogramme.

5

Unit 4

Performance Appraisal: Necessity. Performance criteria, Techniques of performance appraisal

5

Unit 5

Work environment: Noise, atmospheric conditions. Illumination and performance.

5

PL20.302

Cognitive Psychology
3-0-0-3
Total Lectures: 39

Objective:
To give students knowledge of the most important concepts, themes, problems andempirical research in modern cognitive theory as it concerns how we receive, interpret, edit, use and save information.

Unit 1

Introduction to Cognitive Psychology: Definition, philosophical and psychological antecedents, Research methods, Fundamentalideas in cognitive psychology.

7

Unit 2

Memory: Models of memory, Exceptional memory and neuropsychology; Memory processes: Encoding and transfer ofinformation, Retrieval, Process of Forgetting and memory distortion; Mental images, maps and propositions.

8

Unit 3

Language: Properties of language: basic components of words and sentences; Language comprehension: Understanding words, semantics and syntax; Language and thought; Neuropsychology of language

8

Unit 4

Problem Solving and Creativity: Problem solving cycle, types of problems, Obstacles and aids to problem solving; Creativity: characteristics of creative people, neuroscience and creativity.

9

Unit 5

Decision Making and Reasoning: Judgment and Decision making, Neuroscience of Decision Making, Deductive Reasoning, Inductive Reasoning, Neuroscience of Reasoning.

7

PL20.304

Industrial and Organizational Psychology-II
2-0-0-2
Total Lectures: 26

Objective:
To develop an awareness of the concepts related to organizational behavior.

Unit 1

Work motivation: Nature, Theories: Need theories, Expectancy theory, equity, goal setting, reinforcement and self- efficacytheory.

6

Unit 2

Job Satisfaction, Supervision and leadership: Concept, determinants and measurement; Functions and approaches.Trait, behavioral and contingency models.

5

Unit 3

Accident and safety: Risk taking behavior and accidents. Accident proneness. Causes. Preventive and safety measures of accidents.

5

Unit 4

Human engineering: Man-machine system. Designs, displays, controls and action.

5

Unit 5

Occupational stress: Counterproductive behavior, role conflicts, absenteeism and burnouts, their causes andinterventions.

5

GY20.101

Physical Geography-I
3-0-0-3
Total Lectures: 39

Objective:

1. This course shall provide basic framework of the solar system and theories associatedwith the origin of the planets.
2. This course shall introduce the components of earth and earth movements.
3. This course shall introduce elucidate about work of different agents and their landforms.

Unit 1

Solar System and origin of planets: Introduction to Solar System, Theories regarding origin of planets- hypothesis by Kant, Nebular hypothesis by Laplace, Planetesimal hypothesis of Chamberlin, Tidal hypothesis by James Jeans,Binary Star hypothesis by Russell and Big-bang theory.

10

Unit 2

Earth & Its components: Rotation, revolution of the earth and its consequences, Axis of the earth, Longitude and Latitude of the earth, Shape of the earth, Local time and standard time, Time zone and International Date line, Internal structure of the earth, Distribution of land and water on the earth.

7

Unit 3

Rocks: Mode of occurrences of rocks: Igneous, Metamorphic and Sedimentary.

8

Unit 4

Earth movements, Volcanoes & Earth quake: Earth movements-folding andfaulting of rocks, Earth quake: causes and consequences, Volcanoes: types and consequences

5

Unit 5

Work of different agents and resulted landforms: Weathering: Physical, Chemical and biological, Work of River, Wind, Glacier, Sea wave and Karst: erosion, transportation, deposition and resulted landforms, Groundwater, springs and artesian wells.

9

GY20.103

Bio-Geography-I
2-0-0-2
Total Lectures: 26

Objective:

1. This course shall introduce Various dimensions of biogeography.
2. This paper shall explain detailed analysis of energy cycles and their function.
3. This course shall elucidate the concept of floral, faunal biodiversity, biome andbiodiversity hotspots.

Unit 1

Biogeography: Meaning, Definitions, Concept, importance and relevance of biogeography, Ecology and Ecosystem: Definitions and principles, Dimensions in Ecology: Definition of Ecotope, Ecotone and Habitat, Biosphere, food chain, food web and ecological pyramid

10

Unit 2

Biogeochemical Cycles and Soil: Biogeochemical cycles- Carbon cycle, Nitrogen cycle, Oxygen cycle and Phosphorus cycle, Soil: forming processes, factorsresponsible. Soil profile.

4

Unit 3

Distribution of Flora and fauna: Distribution of flora and fauna over geographicalspace, Factors affecting plant ecology: light, temperature, moisture etc.

4

Unit 4

Introduction to Biome: Biome: meaning, concept and importance, Introduction toBio-diversity-meaning and concept,

4

Unit 5

Biodiversity hotspots and Issues: Major bio-diversity hotspots in India, Issues related to the bio-diversity with special reference to India,

4

GY20.105 **Practical Geography-I**

0-0-2-1

Total Practical classes: 13

Objective:

1. This course shall introduce basic concept of practical geography.
2. This paper shall provide the concept different types of scales.
3. This paper shall provide the ways to construct different of scales.

Unit 1

Introduction to Practical Geography:

Introduction to Practical Geography, Concept of Maps and their importance in Geography.

1

Unit 2

Concept of Scales:

Concept of Scales and their importance in Geography

2

Unit 3

Construction of Linear Scales:

Calculation and construction.

3

Unit 4

Construction of Diagonal Scale:

Calculation and construction.

3

Unit 5

Construction of Vernier Scale:

Calculation and construction.

GY20.102

Physical Geography-II

3-0-0-3

Total Lectures: 39

Objective:

1. This course shall introduce basic concepts of isostasy.
2. This course shall provide a detailed understanding about the mechanism of landform development.
3. This course shall introduce the evolution of drainage network on different topography.

Unit 1

Isostasy: Theories of Isostasy: Models of Pratt & Airy.

6

Unit 2

Geological time scale and forces responsible for landform development: Brief understanding of Geological time, Endogenetic and Exogenetic forces.

7

Unit 3

Processes and Mountain building: Concept of geosynclines and orogenicprocesses, Mountains: types and their formations, Mountain building theories: theories by Kober, Joly, Holmes, Daly

8

Unit 4

Concept of Scale, Cycles and landform evolution

Concept of scale in physical geography: spatial and temporal, Cyclic and non-cyclic concept of erosion, Normal cycle of erosion by W.M. Davis, Landscape evolution theory by W. Penk

10

Unit 5

Evolution of drainage network on different topography: Development ofdrainage network on uniclinal structure, Development of drainage network on folded structure, Development of drainage network on faulted structure

8

GY20.104

Bio-Geography-II
2-0-0-2
Total Lectures: 26

Objective:

1. This course shall provide detailed understanding of community and consequences ofhuman interventions into it.
2. This course shall elucidate spatial distribution of different biomes and ecological regions.
3. This paper shall explain mechanism of soil formation its management.

Unit 1

Introduction to Community: Concept of community, Factors affecting community: Succession, vegetation climax.

3

Unit 2

Human Interventions in Community:
Effects of human interventions in the community (with special reference to India), Effects of industrial effluents on thecommunity with special reference to India, management practices.

3

Unit 3

Spatial distribution of Biomes: Description of major biomes ofthe world in reference to the location, extension, climate, soil, flora, fauna, succession and human activities.

4

Unit 4

Soil formation, erosion and management: Mechanism offormation of podzol, laterite, chernozem and saline alkaline soils,
Soil erosion and land degradation:

10

Unit 5

Types and factors, their impacts on soil fertility and theirmanagement.

6

Course Outcome:

1

Explain the meaning of Succession and climax.

2

Explain the impact of human interventions in the community ecology.

3

Describe major biomes of the world.

4

Define different types of soil forming processes.

5

Explain ecological regions.

6

Define major ecological regions of India.

Text Books:

1

Singh, S. (2011). *Bio Geography*. Allahabad, Prayag Pustak Mahal.

GY20.106 **Practical Geography-II**
0-0-2-1
Total Practical classes: 13

Objective:

1. This course shall introduce basic concept of projection.
2. This paper shall provide the ways to construct different types of projections.
3. This course shall introduce ways to construct different types of contour features.

Unit 1

Concept of Projection: Concept of projection in their importance, types and uses in Geography.

3

Unit 2

Construction of Projection: Construction of projection in graphical method: polar cases.

3

Unit 3

Construction of Projection: Construction of projection in graphical method: conical cases.

2

Unit 4

Construction of Projection: Construction of projection in graphical method: cylindrical cases.

2

Unit 5

Contours: Concept and representation.

GY20.201

Geography of India
3-0-0-3
Total Lectures: 39

Objective:

1. The aim of this paper is to give detailed understanding about the physical aspects ofIndia.
2. This paper shall provide the description about the demographic aspects of India.
3. This paper shall elucidate the cultural and social aspects of India.

Unit 1

Physiography and brief Geology of India:

India: location, shape, size, boundaries and extent; Major physiographic divisions of India: Northern Hills, Northern plains, Peninsular Plateau, Coastal plains, Indian deserts and the islands, Brief understanding of major Geological structures of India

8

Unit 2

Drainage and Climate of India:

Drainage of India: Himalayan drainage and Peninsular drainage, National Water grid, Characteristics of Indian climate and seasons (Temperature, Humidity and Precipitation), Indian Monsoon: mechanism and consequences and its relation to Indian agriculture.

8

Unit 3

Soils and Vegetation of India:

Distribution of Soils of India, Distribution of Vegetation of India, Problem of flood and drought in India.

4

Unit 4

Demographic Aspects of India:

Population distribution, density, sex ratio and literacy pattern ofIndia.

8

Unit 5

Cultural and Social Aspects of India:

Schedule tribes and schedule caste, Religious diversity in India, Linguistic diversity in India, Distribution of different races in India, Contemporary Issues: Poverty, Population explosion, globalization and its impact on the environment, regional disparity.

11

GY20.203

Human Geography
2-0-0-2
Total Lectures:26

Objective:

1. This paper shall clarify the basic concept of population and demographic aspects.
2. The aim of the paper is to provide detailed understanding about the adaptation ofhumans in different parts of the world and anthropogenic effects.
3. This paper shall give better understanding about the migration and urbanizations.

Unit 1

Basic concepts and Theory of Population: Introduction to the Human Geography: meaning, definitions and concept, Relation of Human geography with other fields of sciences, Population resource relationship: concept of over population, optimum population and under population, Population transition theory.

8

Unit 2

Adaptation and Distribution of Population: Human adaptation in different parts of the world: Equatorial, Tropical, Temperate, and Polar area; Settlements: meaning and concept; Rural and Urban
settlements: types and pattern.

8

Unit 3

Impact of Environment on Humans and World Population: Elements of the environment and their impact on the Habitat,economy and Societyof Eskimos, Pygmies, Bushman,
Distribution of Population.

4

Unit 4

Migration: Migration of population: causes and consequences,brain drain,

3

Unit 5

Population Problems, Urbanization and Globalization:
World population problems and policies, Urbanization, problemsof urbanization, Globalization: causes and its impact.

3

GY20.205

Practical Geography-III

0-0-2-1

Total Practical classes: 13

Objective:

1. This course shall introduce basic concept and ways of construction of cartographicgraphs and diagrams.
2. This course shall introduce basic concept of topographical maps.
3. This course shall introduce the ways of interpreting topoheets.

Unit 1

Cartographic techniques: Construction of one dimensional graphs and diagrams.

1

Unit 2

Cartographic techniques: Construction of two dimensional graphs and diagrams.

2

Unit 3

Cartographic techniques: Construction of three dimensional graphs and diagrams.

2

Unit 4

Topographical Maps: Introduction.
Introduction to topographical maps, their concept and types.

2

Unit 5

Interpretation of Topographical Maps:
Exercises and interpretation of physical and socio-economic aspectsof toposheets.

GY20.202

Economic Geography
3-0-0-3
Total Lectures: 39

Objective:

1. This course shall introduce the components of economic geography.
2. This papers shall give better understanding about different sectors of economy.
3. This course shall provide detailed understanding about the Industrial locations andeconomic zones.

Unit 1

Introduction to Different Economic Sectors: Introduction to economic geography: definition, meaning and concept, Economic geography and its relation to human geography, Classification of economic activities of the world: Primary, Secondary and tertiary activities (Hunting and food gathering, agriculture, industries and market economy).

11

Unit 2

Agricultural Resources: an Introduction to Primary activities: Agriculture systems: Intensive subsistence agriculture (Rice) and plantation agriculture (Tea), Commercial grain farming (Wheat), Horticulture and mixed farming.

8

Unit 3

Industrial locations and Manufacturing Industries: Industrial activities: anintroduction, Factors Affecting location of Economic Activity with special reference to Industry; Secondary Activities: Manufacturing (Cotton Textile, Ironand Steel) (World pattern).

10

Unit 4

Manufacturing Regions:
Concept of Manufacturing Regions.

4

Unit 5

Economic Zones and Tertiary Activities: Special Economic Zones and Technology Parks., Tertiary activities: Transport, Trade and Services.

6

GY20.204

Geography of Resources

2-0-0-2

Total Lectures:26

Objective:

1. This paper shall introduce the components of geography of resources and distribution ofit.
2. This papers shall give better understanding about the concept of industrial resources.
3. This course shall give understanding about the economic zones and humans as recourse.

Unit 1

Distribution of Mineral Resources: Resources: meaning, concept and Definitions; Mineral resources: Uses and distribution: Iron ore, Coal, Bauxite,Zinc, Gold, Silver, Mica.

5

Unit 2

Energy Resources: Renewable energy resource: Wind energy and Solar energy, Non-renewable energy resource: Petroleum, Natural Gas.

4

Unit 3

Distribution of Agricultural Resources and Agricultural Infrastructure: Rice, wheat, Millet, Cotton, Sugarcane, Tea and Coffee; HYV seeds, Irrigation, Fertilizers and Pesticides.

7

Unit 4

Concept of Industry, industrial resources and Industrial Regions: Iron and steel industry, Cotton textile industry, Aluminum industry, Cement Industry;

8

Unit 5

Human Resource: Concept of Human Resource.

2

GY20.206

Practical Geography-IV

0-0-2-1

Total Practical classes: 13

Objective:

1. This paper shall provide the ways to do chain and tape survey and plot it.
2. This course shall give introduction to remote sensing.
3. This course shall give introduction to GIS and GPS.

Unit 1

Basics of Field Survey and Chain and Tape Survey: Introduction to the field survey,

1

Unit 2

Chain and tape surveying and plotting.

5

Unit 3

Introduction of Remote Sensing: Mechanism of remote sensing, Different platforms of Remote sensing,

3

Unit 4

Spectral signature and its application in remote sensing,

2

Unit 5

GIS and GPS: Introduction to GPS and GIS, Applications of GIS.

2

GY20.301

Climatology and Oceanography

3-0-0-3

Total Lectures:39

Objective:

1. This paper shall provide detailed concept about basic structure and general circulationof the atmosphere.
2. This papers shall give better understanding about the atmospheric disturbances.
3. This course shall provide thorough concept about dynamics of ocean.

Unit 1

Basic Components of atmosphere and General Circulation: Atmosphere, Climate and Seasons: concept and meaning;Structure and composition of atmosphere, Humidity; Distribution of Temperature. Pressure and wind and their broad pattern, General circulation of atmosphere, jet streams.

11

Unit 2

Atmospheric Disturbances and Winds: Different types of atmospheric disturbances: Tropical cyclone, Extra-tropical cyclone and Hurricane, Winds: planetary, seasonal and local, Climatic classification, climate change: causes and consequences.

8

Unit 3

Geography of Ocean Basins: Ocean basin relief (Indian ocean, Atlantic ocean and pacific ocean).

4

Unit 4

Salinity and Temperature of ocean water: Salinity: causes,determinants and distribution, Distribution of temperature and salinity.

5

Unit 5

Dynamics of Ocean water, Coral Reefs and Ocean Deposits: Waves, Currents and Tide: formation and types, Coral reefs:types and theories; Ocean deposits.

11

GY20.303

Man and Environment

2-0-0-2

Total Lectures:26

Objective:

1. The aim of this paper is to give detailed understanding about the changing nature ofrelation of humans and environment.
2. This paper shall provide the description about environmental issues.
3. This paper shall elucidate the concept of environmental management.

Unit 1

Basics of Environment: Environment: meaning, concept, definitions and types; Components of physical and culturalenvironment.

3

Unit 2

Relationship between Man and Environment:
Man and environmental relationship of time and space; Approaches in understanding the man and environment relation- Deterministic approach, Possibilistic approach and neo determinism, Geography and geographers: association with man and environment.

10

Unit 3

Changing relationship of Man and Environment and Issues:
Population explosion, Man-made issues.

5

Unit 4

Environmental Issues: Environmental issues in Tropical, Temperate and Polar areas;

6

Unit 5

Environmental Management: Environmental policies, Management.

2

GY20.305

Practical Geography-V

0-0-2-1

Total Practical classes: 13

Objective:

1. This course shall introduce basic concept of survey.
2. This paper shall provide the way to survey and plotting with prismatic compass.
3. This paper shall provide the way to survey and plotting with plane table.

Unit 1

Basics of Survey:
An introduction to survey and different instruments.
1

Unit 2

Prismatic Compass Survey: (Open traverse)
Prismatic compass survey: open traverse and its plotting.
3

Unit 3

Prismatic Compass Survey: (Closed traverse)
Prismatic compass survey: closed traverse and its plotting. Importance and error.
3

Unit 4

Plane Table Survey:
Plane Table Surveying and its importance and error.
3

Unit 5

Plane Table Survey: Plotting
3

GY20.302

Geography of Settlement

3-0-0-3

Total Lectures:39

Objective:

1. This course shall introduce Various dimensions of settlements.
2. This paper shall explain mechanism of hierarchy of rural and urban settlement.
3. This course shall elucidate the urban land use and site and situation.

Unit 1

Basics of Settlement: Introduction: Nature and Scope; Basic Concepts:Rural and Urban Settlements, Hamlet, Village, Town, City, Metropolis, Megalopolis, Conurbation, Rural-Urban Fringe.

9

Unit 2

Rural Settlements: Types and Patterns, Determinants.

4

Unit 3

Theories of Settlement: Regional Settlement Hierarchy: Central Place Theory, Rank-Size Rule, Primate City.

10

Unit 4

Urban Land use: Models; Types – Residential, Commercial,Industrial, Institutional, Recreational, Heritage, Public and Green Spaces, and Transport.

9

Unit 5

Site and situation: Concept of Site and Situation, and Landuse, Services and Infrastructure; Problems and their prospects.

7

GY20.304

Spatial Dimensions of Development

2-0-0-2

Total Lectures: **26**

Objective:

1. This course shall provide detailed understanding of development.
2. This course shall elucidate theories of development.
3. This paper shall explain mechanism of impact of development in developing anddeveloped countries.

Unit 1

Introduction to Development: Concept of Development; Measures of Development (Economic, Social and Environmental);Efficiency-Equity Debate.

6

Unit 2

Regional Development: Concept of Region and Regional Development; Intral and Inter-regional Development pattern.

6

Unit 3

Theories of development: Myrdal, Hirschman and Friedmann.

6

Unit 4

Impact of Development: Interrelationship between environment and development; Impact on physical environment in terms soilerosion, land degradation, deforestation.

6

Unit 5

Different Issues in Developed and Developing Countries: Pollution and issues in developed and developing countries of theworld.

2

GY20.306

Practical Geography-VI

0-0-2-1

Total Practical classes: 13

Objective:

1. This paper shall provide the mechanism of different types of weather instruments.
2. This paper shall provide the ways to construct different types of weather data.
3. This course shall ways to handle statistical data.

Unit 1

Weather instruments: Introduction to weather instruments

1

Unit 2

Weather Maps and graphs: Interpretation of weather maps, Hythergraph and climograph: uses and applications.

4

Unit 3

Introduction to Statistical Techniques: Frequency distribution

3

Unit 4

Central tendency: mean, median and mode

3

Unit 5

Measures of dispersions.

PS20.101	**Fundamentals of Political Science**	**3-0-0-3** **Total** **Lectures: 39**

Objective: State and Government are the Institutions which are regulating the behaviour of the individual in the society by its laws; Political science is the subject which is dealing with these Institutions. The objective of the course is to create awareness among the student about the basic concepts of Political Science and to make them acquaint of the various dimensions
of the subject by introducing them to underline principles of state & Governance.

Unit 1	Introduction: Nature and scope of Political Science-conceptual analysis, Relationship of Political Science with other disciplines – History, Economics, Sociology	8
Unit 2	State, Government and Sovereignty: Concept and theories of origin of State: Divine Theory, Force Theory, Theory of Social Contract and Evolutionary Theory; Government & State; Forms of Government: unitary, Federal, Quasi – Federal, Parliamentary Presidential;	9
Unit 3	Sovereignty: Concept and types of Sovereignty and challenges to Sovereignty, Theories of Sovereignty: Pluralist, Legal, Monistic Theory.	7
Unit 4	Political Concepts : Power, Authority & Legitimacy : Inter-Relationship; Law, Citizenship, Property	12
Unit 5	Political Obligation : Political obligation: Concept and its basis	3

PS20.103 Indian Political Thought-I 3-0-0-3

Total Lectures: 39

Objective: This course introduces the specific elements of Indian Political Thought spanning over two millennia. The basic focus of study is on individual thinkers whose ideas are however framed by specific themes. The course as a whole is meant to provide a sense of the broad streams of Indian thought while encouraging a specific knowledge of individual thinkers and texts.

Unit 1	Traditions of Pre-colonial Indian Political Thought: Brahmanic and Shramanic	8
Unit 2	Ved Vyasa (Shantiparva): Rajadharma	5
Unit 3	Manu: Origin of state, Saptang theory, Inter-state relations, Functions of state	9
Unit 4	Kautilya: Origin of state, Saptang theory, Inter-state relations, Functions of state	9
Unit 5	Barani: Ideal Polity; AbulFazal: Monarchy	8

PS20.102	Understanding Political Theory	3-0-0-3 Total Lectures: 39

Objective: This course introduces the students to the idea of political theory, its history and approaches, and an assessment of its critical and contemporary trends. Further it is designed to reconcile political theory and practice through reflections on the ideas and practices related to democracy.

Unit 1	What is Politics: Theorizing the 'Political'; Traditions of Political Theory: Liberal, Marxist, Anarchist and Conservative	10
Unit 2	Approaches to Political Theory: traditional, Behaviouralism, Post-behaviouralism, System approach	6
Unit 3	Critical and Contemporary Perspectives in Political Theory: Feminist and Postmodern	7
Unit 4	Democracy: The history of an idea, Procedural Democracy and its critique	8
Unit 5	Deliberative Democracy, Participation and Representation	8

PS20.104	Indian Political Thought-II	3-0-0-3 Total Lectures: 39

Objective: Based on the study of individual thinkers, the course introduces a wide span of thinkers and themes that defines the modernity of Indian political thought. The objective is to study general themes that have been produced by thinkers from varied social and temporal contexts. Selected extracts from original texts are also given to discuss in the class.

Unit 1	Introduction to Modern Indian Political Thought; Rammohan Roy: Rights; DayanandSaraswati: Swarajya	7
Unit 2	Pandita Rama Bai: Gender; Gopal Krishna Gokhale: Political Testament; Bal GangadharTilak: Swarajya	9
Unit 3	Gandhi: Ideal State; B. R. Ambedkar: Social Justice	9
Unit 4	Muhammad Iqbal: Community; V. D. Savarkar: Hindutva	6
Unit 5	J. L.Nehru: Democratic Socialism; J .P. Narayan: Socialism	8

PS20.201 **National Movement & Constitutional Development in India** **3-0-0-3**

Total Lectures: 39

Objective: The purpose of this course is to help students understand the struggle of Indian people against colonialism. The course begins with the nineteenth century Indian responses to colonial dominance in the form of reformism and its criticism and continues through various phases up to the events leading to the Partition and Independence. In the process, the course tries to highlight its various conflicts and contradictions by focusing on its different dimensions: communalism, class struggle, caste and gender questions.

Unit 1	Phases of Nationalist Movement: Liberal, Extremists and the Revolutionaries	9
Unit 2	Gandhi and Mass Mobilization: Non-Cooperation Movement, Civil DisobedienceMovement and Quit India Movement	7
Unit 3	Social Movements: a. The Women's Question: Participation in the National Movement and its Impact b. Peasant, Tribals and Workers Movements	8
Unit 4	Partition and Independence: a. Communalism in Indian Politics b. The Two-Nation Theory, Negotiations over Partition	6
Unit 5	Major Acts, Indian Council Act 1909, Mont-Chelmsford Reform Act 1919, Government of India Act 1935, Indian independence Act 1947	9

3-0-0-3
Total Lectures: 39

PS20.203 Comparative Government & Politics-I

Objective: This is a foundational course in comparative politics. The purpose is to familiarize students with the basic concepts and approaches to the study of comparative politics. More specifically the course will focus on examining politics in a historical framework while engaging with various themes of comparative analysis in developed and developing countries.

Unit 1	Understanding Comparative Politics : Nature and scope	3
Unit 2	Historical context of modern government: a. Capitalism: meaning and development; globalization b. Socialism: meaning, growth and development	8
Unit 3	Approaches to Studying Comparative Politics: Constitutionalism; Culture; Political Development; Political Modernization; Political Socialization	10
Unit 4	Electoral System: Definition and procedures: Types of election system (First Pastthe Post, Proportional Representation, Mixed Representation); Political parties and pressure groups	6
Unit 5	Salient Features of Major Constitutions: United States, England, France, Switzerland and China	12

PS20.202	**Constitutional Government & Democracy in India**	**3-0-0-3**
		Total Lectures: 39

Objective: This course acquaints students with the constitutional design of state structures and institutions, and their actual working overtime. The Indian Constitution accommodates conflicting impulses (of liberty and justice, territorial decentralization and a strong union, for instance) within itself. It further encourages a study of state institutions in their mutual interaction, and in interaction with the larger extra-constitutional environment.

Unit 1	The Constituent Assembly, Preamble, Features of the Constitution and Federalism	8
Unit 2	Fundamental Rights, Directive Principles and Fundamental Duties	8
Unit 3	The Legislature: Parliament and State Legislatures	8
Unit 4	The Executive: President, Prime Minister, Governor, Council of Ministers	8
Unit 5	The Judiciary: Supreme Court and High courts	7

PS20.204	**Comparative Government & Politics-II**	**3-0-0-3 Total Lectures: 39**

Objective: This paper studies some model constitutions of the world. The historical background of individual constitutions is to be emphasized to gain an understanding of its evolution. Furthermore the political institutions are to be studied in the light of the political process to gain an understanding of the dynamics of actual politics and policy making

Unit 1	Britain: British Parliament, Monarchy and Prime Minster in Britain, British Judicial System	7
Unit 2	USA: US Congress, President of US, Supreme Court of America	7
Unit 3	Switzerland: Swiss Federal Assembly, Federal Council of Switzerland, Federal Tribunal of Switzerland	8
Unit 4	France: French Parliament, President and Prime Minister of France, French Judicial Structure	9
Unit 5	China: Chinese National People's Congress, President and Premier of China, Supreme People's Court in China	8

PS20.301	Ancient and Medieval Political Thought	3-0-0-3 Total Lectures: 39
Objective:	This course goes back to Greek antiquity and familiarizes students with the manner in which the political questions were first posed. Further the course deals with medieval political thought. This is a basic foundation course for students.	
Unit 1	Greek Political Thought: the Sophists, Plato and Aristotle.	9
Unit 2	Roman Political Ideas and their concept of Law, the Roman contribution to Political thought with special reference to Cicero.	8
Unit 3	The Growth of the Christian Church and Political ideas of early Christianity; St. Augustine.	8
Unit 4	Beginning of Medieval Era: Chief features of its Growth of the Papal Power-Church State Controversy.	8
Unit 5	St. Thomas Aquinas; Close of the Middle Ages and the Councillor Movement.	6

PS20.303	Perspectives on International Relations and World History	3-0-0-3 Total Lectures: 39

Objective: This paper seeks to equip students with the basic intellectual tools for understanding International Relations. It introduces students to some of the most important theoretical approaches for studying international relations. The course begins by historically contextualizing the evolution of the international state system before discussing the agency-structure problem through the levels-of-analysis approach. After having set the parameters of the debate, students are introduced to different theories in International Relations. It provides a fairly comprehensive overview of the major political developments and events starting from the twentieth century.

Unit 1	Studying International Relations: How do you understand International Relations: Levels of Analysis	6
Unit 2	Theoretical Perspectives: Classical Realism & Neo-Realism; Liberalism & Neoliberalism, Marxist Approaches	10
Unit 3	Theoretical Perspectives: Feminist Perspectives; Euro-centricism and Perspectives from the Global South	7
Unit 4	An Overview of Twentieth Century IR History: World War I: Causes and Consequences; World War II: Causes and Consequences	8
Unit 5	Cold War: Different Phases; Collapse of the USSR and the End of the Cold War	8

PS20.302	Modern Western Political Thought(From Machiavelli to Marx)	3-0-0-3 Total Lectures: 39

Objective: With the help of this paper the student will develop an understanding about the development of political thought in western world.

Unit 1	Transition from the Middle Ages to the Modern Period: Political Thought of the Renaissance and Reformation: Machiavelli and Jean Bodin.	8
Unit 2	The Contractualists: Hobbes, Locke and Rousseau,	10
Unit 3	Utilitarianism: Bentham and J.S. Mill	7
Unit 4	The Idealist Tradition in Political Thought – Hegel & Green.	6
Unit 5	Scientific Socialism and Karl Marx.	8

PS20.304	**Understanding Global Politics**	**3-0-0-3** **Total Lectures: 39**

Objective:	This course is about the international political affairs and the various ways to define global politics, which is a subject to enhance the world system	
Unit 1	United Nations: Structure, Reforms and Significance in Contemporary era.	10
Unit 2	Nuclear Issues and disarmament: NPT, CTBT, other efforts for disarmamentation and India's nuclear policy.	6
Unit 3	Foreign policy of major countries:United States, United Kingdom,Russia and China	8
Unit 4	New International Economic Order: North- South Dialogue, South-South Cooperation	6
Unit 5	Regional organizations and Issues: SAARC, ASEAN, NAM and BRICS; Major contemporary trends and issues in the world.	9

M.A English 2020-2021

M.A. EnglishFirst Year

EL20. 501 **English Grammar, Linguistics and Phonetics** **4-1-0-5**

Total Lectures: 52

Objective: To develop in the student communicative competence by re-aligning the components of grammatical competence already gained back at graduation. To enhance students' understanding of linguistic structures and their functioning.

Unit 1	**Basic Sentence Types:** Subject, Predicate, Object, Adjunct	8
Unit 2	**Theme Writing:** Development of thoughts, Consistency in writing, Vocabulary	8
Unit 3	**Fallacies** **Précis Writing** **Literary Appreciation**	12
Unit 4	**Introduction:** Linguistics and its Scope, Branches of Linguistics, Some Basic Concepts in Linguistics	12
Unit 5	**Syllable structure, Supra-segmental features, GIE, Phonemic Transcription** **Morphology and Syntax:** Morpheme, Word Formation processes in English	12

Course Outcome: The student will be able to:

1. Learn the essentials of English Grammar.
2. Apply the rules of grammar to use flawless English in speech and writing.
3. Gain an appreciation for the field of linguistics and its main sub-fields.
4. Use the International Phonetic Alphabets (IPA) to transcribe English phonetically.
5. Evaluate a piece of writing keeping in mind all the rules studied.
6. Read and comprehend English.

Text Books:

1. Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
2. Abercrombie, D. Elements of General Phonetics (Edinburgh University Press, 1967).

Reference Books:

1. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.
2. George Yule: The Study of Language- Cambridge University Press; 5 edition (10 March 2014)
3. Quirk & Greenbaum: University English Grammar, Longman Publications, 1973.
4. Sharma, R.C. & Krishna Mohan: Business Correspondence & Report writing; Tata McGraw Hill, New Delhi (Latest edition).

EL20.503	**Middle Ages to the Seventeenth Century English Literature-I**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance the student' speaking & writing skills, along with the understanding of different ways in which poetry and drama were written in different time periods & critically analyze them.

Unit 1	**Geoffrey Chaucer:** General Prologue to the Canterbury Tales	10
Unit 2	**Christopher Marlowe:** Doctor Faustus	8
Unit 3	**William Shakespeare:** As You Like It (detailed), King Lear (non-detailed)	10
Unit 4	**Francis Bacon:** Of Envy, Of Love, Of Adversity **John Donne:** The Extasie, The Relique, The Flea	12
Unit 5	**John Milton:** Paradise Lost, Book I	12

Course Outcome: The student will be able to:

1. Learn to read, analyze and appreciate poetry critically.
2. Discuss the significant figures and events of the period.
3. Have an understanding of the major Literary and Cultural Trends in literature.
4. Recognize the rhythms, metrics and other musical aspects of poetry.
5. Have an understanding of the circumstances that shape the processes of literary production.
6. Know about the diverse poetic/dramatic devices and strategies employed by the writers.

Text Books:

1. Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd, 1995.
2. Daiches, David: A Critical History of English Literature (vol. I), Delhi, Allied Publishers, 1998

Reference Books:

1. Grose, M. W.: Chaucer: Literature in Perspective.(OUP, 2000).
2. Broadbrook, M.C.: Themes and Conventions of Elizabethan Comedy, 1998.
3. Rudram, Alan: A Critical Commentary on Milton's Paradise Lost, 1999.

EL20.505	Eighteenth Century to the Twentieth Century English Literature-I	4-1-0-5 Total Lectures: 52

Objective: To enhance the student' writing skills and understanding of different ways in poetry were written in the specified time period and critically analyze them.

Unit 1	**John Dryden:** Absalom and Achitophel (Lines 1 – 200)	10
Unit 2	**Jonathan Swift:** The Battle of the Books (Chapter no. 6)	8
Unit 3	**Alexander Pope:** The Rape of the Lock	10
Unit 4	**William Wordsworth:** The Prelude, Book I	12
Unit 5	**S.T. Coleridge :** The Rime of Ancient Mariner **Robert Browning:** My Last Duchess	12

Course Outcome: The student will be able to:

1. Recognize poetry from a variety of cultures, languages and historic periods.
2. Identify personal experiences that can be used when writing poems.
3. Analyze the various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc.
4. Develop their critical thinking skills.
5. Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.
6. Examine the rhythms, metrics and other musical aspects of poetry.

Text Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.1994.
2. Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harward University Press.1964

Reference Books:

1. R. Humphreys, The Augustan World (London, 1954)
2. A,R, Humphreys, The Augustan World (London, 1964)
3. P. Rogers, An Introduction to Pope (London, 1975)
4. R. Alter, Fielding and the Nature of the Novel (Cambridge,1968)

EL20.507	**American Literature**	**4-1-0-5** **Total Lectures: 52**

Objective: Introduces the literature of the land which is now the United States from before European contact through the mid-nineteenth century.

Unit 1	**Ralph Waldo Emerson:** The American Scholar **Walt Whitman:** Crossing Brooklyn Ferry, I Hear It Charged Against Me	14
Unit 2	**Sojourner Truth :** Ar'n't I a Woman?- Speech to the Women's Rights Convention in Akron, Ohio, 1851	8
Unit 3	**Robert Frost:** Birches, Mending Wall **Wallace Stevens :** Thirteen Ways of looking at a Blackbird	10
Unit 4	**Eugene O'Neill:** Emperor Jones	12
Unit 5	**Tony Morrison:** The Bluest Eye	8

Course Outcome: The student will be able to:

1. Describe the major historical and cultural developments of colonial America
2. Appreciate poetry as a literary art and its various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc
3. Demonstrate knowledge of foundational texts of Early American literature through 1860s.
4. Identify and discuss the roles which gender, race, age, class, ethnicity, wealth, poverty, and geography have played in creating American literature.
5. Use literary texts to examine the historical, cultural, and rhetorical contexts in which they were written.
6. Write clear, focused, coherent essays about literature for an academic audience, using standard English conventions of grammar and style.

Text Books:

1. Robert Spiller: Literary History of the United States, (Amerind Publishing Co.2006)
2. SD Palwekar, Literature and Environment:A Select Study of British, American and Indian Writings, Lambert Academic Publishing, Germany, 2012.

Reference Books:

1. Morrison, Toni. Playing in the Dark, I Chapter.2004.
2. Allan. American Plays and Playwrights of the Contemporary Theatre. New York:Crown, 1965.
3. Mukharjee, Sujit, and D.V.K. Raghara-Charyulu eds. Indian Essays in American Literature. 1969.
4. George McMichel : Concise Anthology of American Literature.2000.

EL20.509	**World Literature(s)**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance student' LSRW skills and understanding of different ways in poetry, dramas and fiction were written to critically analyze them.

Unit 1	**Ibsen:** A Doll's House	10
Unit 2	**Brecht:** Mother Courage	12
Unit 3	**Dario Fo:** Accidental Death of an Anarchist	12
Unit 4	**Rabindranath Tagore:** Gitanjali **Albert Camus:** The Outsider	10
Unit 5	**Pablo Neruda:** Everyday You Play **Rainer Maria Rilke:** Fear of the Inexplicable	8

Course Outcome: The student will be able to:

1. To remember the social, economic, and political perspectives of the literatures produced and also translated into English.
2. To understand the social, economic, and political perspectives of the literatures produced.
3. Appreciate world fiction, with all its individual fragments, represents collective humanity.
4. Analyze the relationship between drama and its socio-cultural context representing myriad colors of the genre.
5. Evaluate the technicalities and themes of the playwrights
6. Gain insight into variety of issues relating to English drama in the modern context and write a well-organized paragraph in answer to a question about a literary text

Text Books:

1. Kahns, Richards. Tragedy: Contradictions and Repression. Chicago: Chicago University Press, 1993
2. Metzger, Erika A. & Metzger, Michael M. (eds.). A Companion to the Works of Rainer Maria Rilke (Studies in German Literature Linguistics and Culture). New York: Camden House, 2004.

Reference Books:

1. Ellmann, Richard (ed.). The Modern Tradition: Backgrounds of Modern Literature. New York: Oxford University Press, 1992.
2. Parkar, Emmett. Albert Camus: the Artist in the Arena. New York: Routledge and Kegan Paul, 1965
3. Bloom, Harold. Modern Critical Views: Gabriel Garcia Marquez. New York: Chelsea House Publishers, 1989
4. Hirst, David. Dario Fo and Franca Rame. Hampshire: Macmillan, 1989.

Spring Semester

EL20.502	**Indian Writing in English**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance the students' LSRW skills and understanding of different literary genres and their analysis.

Unit 1	**Raja Rao** : Kanthapura **Anita Desai** : Clear Light of Day	10
Unit 2	**A. K. Ramanujan** : Is There an Indian Way of Thinking: An Informal Essay **Toru Dutt** : Savitri- Part I	12
Unit 3	**Nissim Ezekiel** : "Goodbye Party for Ms Pushpa T.S., Background, Casually, Night of the Scorpion	10
Unit 4	**Jayanta Mahapatra** : Evening Landscape by the River, From Temple	8
Unit 5	**Mahesh Dattani:** Tara **Sudha Murthy :** Mahashweta (non-detailed)	12

Course Outcome: The student will be able to:

1. Study a selection of novels which focuses on the understanding of Colonialism and Postcolonialism
2. Examine how Indian Writing in English explores various social, economic, historical and political conditions.
3. Know some of the developments, themes, and narrative strategies of Indian writings in English.
4. Appreciate the ways in which the Indian Writing in English embodies the diversity of the nation.
5. Reflect on what it means to be an Indian from gender, racial, class, and national perspectives.
6. Learn to read, analyze and appreciate poetry, drama, novel and essays critically

Text Books:

1. Vishwanathan, Gauri, Masks of Conquest: Literary Study and British Rule in India.1984., Columbia University Press; Twenty-fifth Anniversary edition (28 November 2014)
2. Gopal, Priyamvada: Indian English Novel: Nation,History and Narration, 2005., OUP UK (25 February 2009)/ Oxford University Press, USA; 1 edition (April 15, 2009).

Reference Books:

1. Boehmer, Elleke: Colonial-and-Postcolonial-Literature, Oxford University Press; 2 edition (5 February 2014).
2. Mukherjee, Meenakshi. The Twice Born Fiction, 2nd edn, 2001.
3. Guha, Ranajit, ed. The Subaltern Studies Reader (Selected Essays), Delhi: OUP.2006
4. Naik, M.K. and Shyamala A. Narayan. Indian English Literature 1980-2000: A Critical Survey. 2001.

EL20.504	**Middle Ages to the Seventeenth Century English Literature-II**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance the student' speaking & writing skills, along with the understanding of different ways in which poetry and drama were written in different time periods & critically analyze them.

Unit 1	**Geoffrey Chaucer:** The Squire's Tale	10
Unit 2	**Ben Jonson:** Every Man in His Humour	12
Unit 3	**Shakespeare:** Othello	8
Unit 4	**Edmund Spenser:** Epithalamion **John Donne:** Forbidding Mourning, Forbidding Weeping	10
Unit 5	**John Milton:** Paradise Lost, Book II	12

Course Outcome: The student will be able to:

1. Remember the culture, thought, literary trends and movements of the period through the prescribed texts.
2. Understand the social, economic, and political perspectives of the age
3. Appreciate the prescribed texts, with all their individual fragments
4. Analyze theme, plot and technique in the plays of Shakespeare and Ben Johnson
5. Critically evaluate and appreciate poems of John Donne, Geoffrey Chaucer, John Milton, Edmund Spencer
6. Write a well-organized paragraph in answer to a question about a literary text

Text Books:

1. Chaucer, Geoffrey: The Canterbury Tales, Hertfordshire: Wordsworth Edition Ltd.1995
2. Daiches, David:A Critical History of English Literature (vol. I), Delhi, Allied Publishers.1998

Reference Books:

1. Grose, M. W.: Chaucer: Literature in Perspective.2002
2. Broadbrook, M.C.: Themes and Conventions of Elizabethan Comedy.1988
3. Rudram, Alan: A Critical Commentary on Milton's Paradise Lost.1978

EL20.506	Eighteenth Century to the Twentieth Century English Literature-II	4-1-0-5 Total Lectures: 52

Objective: To enhance the student' writing skills and understanding of different ways in poetry were written in the specified time period and critically analyze them.

Unit 1	**Gerard Manly Hopkins:** The Windhover, Felix Randal **William Collins:** Ode to Simplicity, Ode to Music, Ode to Evening	10
Unit 2	**Thomas Gray:** Distant Prospects of Eton College, Death of a Favourite Cat, Elegy Written in a Country Churchyard	12
Unit 3	**W. B. Yeats:** When You Are Old, A Bronze Head, Lapis Lazuli, Sailing to Byzantium	8
Unit 4	**W. H. Auden:** Sir, No Man's Enemy, September 1, 1939, In Memory of W. B. Yeats	10
Unit 5	**James Joyce:** A Portrait of the Artist as a Young Man (non-detailed)	12

Course Outcome: The student will be able to:

1. Recognize poetry from a variety of cultures, languages and historic periods.
2. Identify personal experiences that can be used when writing poems.
3. Analyze the various elements of poetry, such as diction, tone, form, genre, imagery, figures of speech, symbolism, theme, etc.
4. Develop their critical thinking skills.
5. Describe their vocabularies and to develop an appreciation of language and its connotations and denotations.
6. Examine the rhythms, metrics and other musical aspects of poetry.

Text Books:

1. Ford, Boris (Ed): Pelican Guide to English Literature (Blake to Byron, vol. 5), Delhi, Penguin.2004
2. Perkins, David: Wordsworth and the Poetry of Sincerity, Massachusetts, Belknap Harvard University Press.1964

Reference Books:

1. A.R. Humphreys, The Augustan World (London, 1964)
2. J. Sutherland, A Preface to Eighteenth Century Poetry, Oxford,1948
3. Hough, Graham: The Romantic Poets, London, Hutchinson's University Library.1953
4. W.J. Bate, The Achievement of Samuel Johnson (New York, 1955

EL20.508	Creative and Technical Writing	4-1-0-5 Total Lectures: 52

Objective: To enable the student to understand different ways to write creative content and technical writing to blossom in the business world

Unit 1	**Study of Literary Works in progress:** Analysis of the Creative Writing Components (Poem, Novel, Short Story, Drama, Diary)	10
Unit 2	**Craft of poetry:** Subject matter, theme, rhythm, metre, stanza forms, sub-genres of Poetry	12
Unit 3	**Fundamental Norms of Writing** **Tools of Technical Writing:** Feature Writing and Technical Writing	8
Unit 4	**Editing & Proof Reading** **Business Correspondence**	10
Unit 5	**Writing for various media:** Learning to write scripts for Publishers and Copy Writing, Writing for Radio, Theatre, Television and Films. **Assignment in Creative Writing:** Poetry/Fiction/Drama	12

Course Outcome: The student will be able to:

1. To read complex literary texts deeply and critically
2. To demonstrate familiarity with the social and political forces shaping culture during the time period
3. To acquire oral and formal written discussion of assigned texts, without dismissing or oversimplifying views
4. To organize and develop initial reactions to assigned texts, through informal writing, peer critiques, and discussion
5. To explore theories with positive learning
6. To understand different genres of literature.

Text Books:

1. Belcher, Diane D. (ED.) English for Specific Purposes in Theory and Practice. (University of Michigan Press, 2009)
2. Mullins, Carolyne J. A Guide to Writing and Publishing, New York; John Wiley & Sons, (1987

Reference Books:

1. Corbeff, Edward P. J. The little Rhetorica, Handbook. New York; John Wiley Sons, (1977
2. Watkins, F. C. and Knight, K. E. Write to Write: Readings on the Craft of Writing. Bouston, HoughtounMifelin, (1966
3. Vrooman Alan. Good writing An informal Mannual of Style. Athemeum: New York, 1972
4. Baker, Sheridial. The Practical Stylistics, New York; Harper and Raw, 1977

EL20.510	**Women Studies**	**4-0-0-4** **Total Lectures: 52**

Objective: To enhance students' understanding of feminist writings and their significance in the formation of female identity, freedom and independence.

Unit 1	**Rokeya Sakhawat Hussain:** Sultana's Dream **Katherine Mansfield:** A Cup of Tea	10
Unit 2	**Charlotte Perkins Gilman:** If I were a Man **Ernest Hemingway:** The Short Happy Life of Francis Macomber	12
Unit 3	**Coventry Patmore:** Angel in the House **Imtiaz Dharker:** Purdah, Battle Line, She Must Be From Another Country	12
Unit 4	**Virginia Woolf:** A Room of One's Own (non-detailed)	10
Unit 5	**Suniti Namjoshi:** The Mothers of Maya Diip(non-detailed)	8

Course Outcome: The student will be able to:

1 To understand the role of women in the contemporary society
2 To study about the turmoil, conflict in women's life.
3 To analyze the various writers' work on feministic approach
4 To enact the main plot of the play Harvest
5 To study about the freedom for women.
6 To develop confidence in women students.

Text Books:

1 Sedgwick, Eve Kosofsky. Gender Criticism: What Isn't Gender.2002.
2 Gardener, Judith Kegan, ed. Masculinity Studies and Feminist Theory: New Directions (Columbia University Press, 2002).

Reference Books:

1 Mill, John Stuart: The Subjection of Woman (1869)./ Nine Books; 1st edition (2015)
2 Lal, Malashri. The Law of the Threshold (Shimla: Indian Institute of Advanced Study, 1995)
3 de Beauvoir, Simone: The Second Sex (1949)./ Vintage (3 May 2011)/ Jonathan Cape (26 November 2009)
4 Butler, Judith: Gender Trouble (1990)., Routledge Classics; Edition edition (2016)/ Routledge; 1 edition (May 12, 2006)

EL 20.512	**Comparative Literature**	**4-0-0-4**
		Total Lectures: 52

Objective: To enhance students' understanding of comparative literary analysis of world lite.

Unit 1	**History of Development of Schools of Comparative Literature** (French, American, & Indian) Influence Study	12
Unit 2	**Reception Study** **Genology** **Literary History** (Period and Movement Study)	9
Unit 3	**Thematology** **Comparative Literature and Intercultural Studies**	10
Unit 4	**Comparative Literature and Other Disciplines** **The Future of Comparative Literature**	10
Unit 5	**The Future of Comparative Literature** **Assignment in Comparative Literature**	11

Course Outcome: The student will be able to:

1 Have knowledge of different methods of analyzing literature.
2 Analyse the role of translation studies in comparative literature.
3 Realize the importance of reading literary texts in their cultural context.
4 Demonstrate a greater understanding of different literary genres and their functions.
5 Have a deeper and better understanding of the interdisciplinarity of comparative Literature.
6 Develop an informed appreciation of cross-cultural interconnections and Historicity of literary outputs.

Text Books:

1 Brandt, Corstius J.: Introduction to the Comparative Study of Literature. (OUP, 2002)./ Random House (1968)
2 Jost, Francois: Introduction to Comparative Literature. (Penguin, 2002)./ Pegasus Publications (1 May 1975)

Reference Books:

1 Susan Bassanett: Comparative Literature: Introduction, (Routledge, 2002)./ Wiley-Blackwell (3 September 1993)
2 Wellek, Rane& Warren, Austin: Theory of Literature. (OUP, 1998)./ Mariner Books; 3 edition (1 June 1956)
3 Michael Ryan: Cultural Studies A Practical Introduction, March 2010 Wiley-Blackwell
4 Nagendra: Comparative Literature. Delhi, University of Delhi, OUP, 2004./ Delhi University, 1977

Second Year
Autumn Semester

EL20.601	**Principles of Criticism-I**	**4-1-0-5**
		Total Lectures: 52

Objective: To enable the student to understand different theories and its implications in the world of literature.

Unit 1	**Aristotle**: Poetics	10
Unit 2	**Horace**: Ars Poetica **John Dryden**: Essay on Dramatic Poesy	12
Unit 3	**Alexander Pope**: Essay on Criticism **Dr. Samuel Johnson:** Preface to Shakespeare	8
Unit 4	**Samuel Taylor Coleridge:** Biographia Literaria **Thomas Love Peacock:** Four Ages of Poetry	10
Unit 5	**T. S. Eliot:** Metaphysical Poets	12

Course Outcome: The student will be able to:

1. To read complex literary texts deeply and critically
2. To demonstrate familiarity with the social and political forces shaping culture during the time period
3. To acquire oral and formal written discussion of assigned texts, without dismissing or oversimplifying views
4. To organize and develop initial reactions to assigned texts, through informal writing, peer critiques, and discussion
5. To explore theories with positive learning
6. To understand different genres of literature.

Text Books:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2016.
2. Sedgwick, Eve Kosofsky. “Introduction: Axiomatic” from Epistemology of the Closet, 2006

Reference Books:

1. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002
2. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987
3. Said, Edward. “Crisis in Orientalism”. 1987
4. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984

EL20.603	**Literature and Society-I**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance students' understanding of British literary, social and political history and its significance in the formation of the nation.

Unit 1	**The Middle English Period:** Norman Conquest of England **Manorial System of the Normans**	10
Unit 2	**Crusades in the Middle Ages** **Hundred Years War**	12
Unit 3	**Social Life of England** **England in the Sixteenth to the Eighteenth Century:** Reformation and Renaissance in England	8
Unit 4	**University Wits, Social Life in the Age of Milton** **Puritan Revolution, Glorious Revolution of 1688** **Industrial Revolution**	10
Unit 5	**Main Literary Trends in Poetry and Drama** **Emergence of Novel** **Humanism**	12

Course Outcome: The student will be able to:

1. Realize the importance of literature in fostering social reflection.
2. Comprehension of literary, social, political and economic traditions and conventions of the Anglo Saxon and Anglo Normans.
3. Discuss and analyse the prominent aspects of Medieval Life & Wars
4. Examine the ways in which literary texts address the past and changing social norms in English Society.
5. Appreciate the emergence of Reformation & Renaissance in England.
6. Discussion & interpretation of different literary trends, social & economic movements from Jacobeans to Victorians

Text Books:

1. Routledge History of Literature, Routledge; 1 edition (29 May 1997)
2. W.H. Long: English Literature: Its History and Its Significance for the Life of the English Speaking World, Rupa Publications India; First edition (4 October 2015)

Reference Books:

1. Frank N. Magill: Masterpieces of World Literature – Import, 8 Sep 1991, Collins Reference (8 September 1991)
2. A.K. Mehrotra: The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008./ Palgrave Macmillan; 2009 edition (29 September 2009)/ The Orient Blackswan (2017)
3. Boehmer, Elleke: Colonial-and-Postcolonial-Literature, Oxford University Press; 2 edition (5 February 2014)
4. The Oxford Companion to Twentieth Century Literature in English, OUP Oxford (26 September 1996)

RM 20. 601 **Research Methodology** **4-0-0-4**

Total Lectures:52

Objective: This course will introduce students to understand the fundamental process of doing research in the social sciences, with special reference to tools they are likely to use in Political Science. It will position it such that a student can go from a common-sense understanding to a complex, conceptual one. The student will also have a sense of hands-on training, by undertaking some limited research idea, with an appropriate methodology and write a report on it.

Unit 1	Introduction: Meaning and definition, objective of research, types of research, significance of research.	7
Unit 2	Research Problem: definition, necessity and techniques of defining research problem, formulation and objectives of research problem, Research Designs: meaning, need, features, types, Synopsis design for research topic	9
Unit 3	Sampling Designs: surveys, types of sample designs, characteristics, Data collection and validation: types, methods of collecting data, methods of editing and data validation.	12
Unit 4	Hypothesis: definition, testing of hypothesis, procedures for testing, Parametric and non-parametric test for testing, limitations of tests of hypothesis.	12
Unit 5	Report writing: basic concepts of paper writing and report generation, review of literature, concepts of bibliography and references, significance of report writing, steps of report writing, methods of presentation of report.	12

Course Outcome: The student will be able to:

1. Understand the complex universe of social science and its modes of understanding
2. Effectively reflect upon the issues of social science research
3. Employ competently the techniques and methods in social research
4. Demonstrate knowledge of research processes (reading, evaluating, and developing)
5. Identify, explain, compare, and prepare the key elements of a research proposal/report
6. Describe sampling methods, measurement scales and instruments, and appropriate uses of each

Text Books:

1. Goode,W.J. and P.K Hatt, Methods in Social Research, New Delhi, McGraw Hill International Editions, Sociology Series, 1981.
2. Kothari, C. R. &Garg, G., Research Methodology, Methods and Techniques, 4th Ed, Delhi, New Age International Publishers, 2018.

Reference Books:

1. Magal, S.K. &Mangal, S., Research methodology in Behavioural Sciences, New Delhi, Prentice Hall of India Pvt. Ltd, 2013
2. Ahuja, R., Research Methods, Rawat Publishers, Jaipur, 2001.
3. Best,J.W. and J.V. Kahn, Research in Education, 6thed, New Delhi, Prentice Hall of India Pvt. Ltd, 1992
4. Marjory L. Joseph, William D Joseph, Research Fundamentals in Home economics/ Human ecology, California, Plycon Press, 1996.
5. Charles Y. Clock (ed.) : Survey Research in Social Sciences (New York : Russle Sage Foundation)

EL20.605	**Commonwealth Literature-I**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance the student' writing skills and understanding of different types of poetry and texts written by commonwealth writers and critically analyze them.

Unit 1	**Dom Moraes:** A Letter **Gopal Honnalgere:** The Donkeys	10
Unit 2	**Kenneth Slessor:** Country Towns **A.D. Hope:** Australia	12
Unit 3	**Les Murray:** The Wilderness **Gabriel Okara:** Were I to Choose	8
Unit 4	**David Rubadiri:** A Negro Labourer in Liverpool **Wole Soyinka:** Death and the King's Horseman	10
Unit 5	**Ngugi' wa Thiong'O:**A Grain of Wheat (non-detailed) **Chinua Achebe:**Things Fall Apart (non-detailed)	12

Course Outcome: The student will be able to:

1. To read and appreciate commonwealth poetry.
2. To dip into the outpourings of commonwealth writers.
3. To enjoy the tradition, artistic expression and culture.
4. To analyze fictional writings.
5. To understand the facts of actual life.
6. To make comparative studies of different literatures.

Text Books:

1. Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002)
2. Gilbert, Helen and Joanne Tompkins. Post-Colonial Drama: Theory, Practice, Politics (London: Routledge, 1996).

Reference Books:

1. Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
2. Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).
3. Said, Edward. Orientalism: Western Conceptions of the Orient (London: Routledge, 1978)
4. Rushdie, Salman. Imaginary Homelands: Essays and Criticism,1981-1991 (London: Granta, 1991).

EL20.607	Indian Writing in Translation Studies	4-1-0-5 Total Lectures: 52

Objective: To enable students to have an understanding of the origin, evolution and growth of translation studies and its significance in the literary world to understand different works of translation and critically analyze them.

Unit 1	**Concept of Translation in the West and in the Indian Tradition** **Types of translation –** intra-lingual and inter-semiotic; 'word for word' or 'sense for sense'; decoding and recoding	10
Unit 2	**Munshi Premchand:** Godan **Mohan Rakesh:** Aadhe Adhure	12
Unit 3	**U. R. Ananthamurthy:** Samskara **Saadat Hasan Manto:** Toba Tek Singh	12
Unit 4	**Mahasweta Devi:** Draupadi **Vijay Tendulkar:** Kanyadan	10
Unit 5	**Baby Kamble:** The Prisons We Broke	8

Course Outcome: The student will be able to:

1. Developing an understanding of the Origin and Development of Translation Studies in India and Abroad.
2. Understanding the different types of translations
3. Know some of the developments, themes, and narrative strategies of Indian writings in English.
4. Appreciate the ways in which the Indian Writing in English embodies the diversity of the nation.
5. Reflect on what it means to be an Indian from gender, racial, class, and national perspectives.
6. Learn to read, analyze and appreciate poetry, drama, novel and essays critically

Text Books:

1. E. Grossman: Why Translation Matters, Orient black swan Pvt. Ltd, 2007./ Yale University Press; Why X Matters Series edition edition (4 March 2011)/ Yale University Press (6 April 2010)/ Orient BlackSwan; First edition (2011)
2. P.France: The Oxford Guide to Literature in English Translation (Oxford, 2000). OUP UK (9 February 2012)

Reference Books:

1. A.K. Mehrotra: The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008./ Palgrave Macmillan; 2009 edition (29 September 2009)/ The Orient Blackswan (2017)
2. Mukherjee, Sujit. Translation as Discovery and Other Essays, and Translation as Recovery.2004.
3. Venuti, Lawrence. Translation's Invisibility: A History of Translation.2009.
4. A.K. Mehrotra, The Concise History of Indian Literature in English. Delhi: Permanent Black. 2008.

Spring Semester

EL20.602 **Principles of Criticism-II** **4-1-0-5**

Total Lectures: 52

Objective: To enable the student to understand different theories and its implications in the world of literature

Unit 1	**Northrop Frye** : The Archetypes of Literature **Ferdinand de Saussure** : The Object of Study	10
Unit 2	**Jacques Derrida** : Structure, Sign and Play in the Discourse of the Human Sciences **Elaine Showalter**: Towards a Feminist Poetics	12
Unit 3	**Jean-François Lyotard** : Answering the Question: What is Postmodernism? **Michel Foucault** : What is an Author?	12
Unit 4	**Roland Barthes** : From Work to Text **Homi K. Bhabha** : Cultural Diversity and Cultural Difference	10
Unit 5	**Jacques Lacan** : The Agency of the Letter in the Unconscious or Reason since Freud	8

Course Outcome: The student will be able to:

1. To read complex literary texts deeply and critically
2. To demonstrate familiarity with the social and political forces shaping culture during the time period
3. To acquire oral and formal written discussion of assigned texts, without dismissing or oversimplifying views
4. To organize and develop initial reactions to assigned texts, through informal writing, peer critiques, and discussion
5. To explore theories with positive learning
6. To understand different genres of literature.

Text Books:

1. Butler, Judith. Gender Trouble: Feminism and the Subversion of Identity.2016.
2. Goldmann, Lucien. “The Genetic-Structuralist Method in the History of Literature”.

Reference Books:

1. Sedgwick, Eve Kosofsky. “Introduction: Axiomatic” from Epistemology of the Closet, 2006
2. Greimas, A. J. Basil Soup or the Construction of an Object of Value.2002
3. Jameson, Fredric. On Interpretation: Literature as a Socially Symbolic Act.1987
4. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?”1984

EL20.604	**Literature and Society-II**	**4-1-0-5** **Total Lectures: 52**

Objective: To enable the student to understand different societies and their prevailing effects on literature.

Unit 1	**England in the Nineteenth Century:** Social and Religious tendencies of the Victorian Age	10
Unit 2	**Oxford Movement** **Feminist Movement**	12
Unit 3	**The Naughty Nineties** **England in the Twentieth Century:** Social and Literary Tendencies of the Early Twentieth Century	12
Unit 4	**Emergence of the Labour Party** **The Rise of the Problem Plays**	10
Unit 5	**The Stream of Consciousness Technique in Fiction** **Main Trends in Poetry, Drama and Fiction**	8

Course Outcome: The student will be able to:

1. To understand the social and literary tendencies of the ages.
2. To interpret the literary texts critically
3. Perform research, analysis, and criticism of the literary and cultural texts
4. Write analytically in a variety of formats, including research, essays, etc.
5. Strengthen and deepen critical reading, writing and interpretative practices
6. Examine the historical developments of the society and its literature

Text Books:

1. Literary Movements for the students, second edition, gale publication , 2004.
2. Abrams, M H -A Glossary of Literary Terms, 7th edition, 2002.

Reference Books:

1. Cuddon, J C. The Penguin Dictionary of Theory and Criticism , Blackwell, 2004
2. Coyle, Martin. Encyclopedia of English literature and criticism, 2003
3. Payne, Michael. The Blackwell Encyclopedia of Theory of Literature, Blackwell, 2014
4.

EL20.606	**Commonwealth Literature-II**	**4-1-0-5** **Total Lectures: 52**

Objective: To enhance the student' writing skills and understanding of different types of poetry and texts written by commonwealth writers and critically analyze them.

Unit 1	**George Frederick Cameron:** The Future **J. M. Smith:**Ode on the Death of William Butler Yeats	10
Unit 2	**Margaret Atwood:** Journey to the Interior **Edward Brathwaite:** Tizzic	12
Unit 3	**Edwin Thumboo:** Gods Can Die **Yasmine Goooneratne:** There was a Country	12
Unit 4	**Katherine Mansfield:** The Man with the Wooden Leg **Pankaj Mishra:** The Romantics	10
Unit 5	**Kiran Desai:** The Inheritance of Loss	8

Course Outcome: The student will be able to:

1 To read and appreciate commonwealth poetry.
2 To dip into the outpourings of commonwealth writers.
3 To enjoy the tradition, artistic expression and culture.
4 To analyze fictional writings.
5 To understand the facts of actual life.
6 To make comparative studies of different literatures.

Text Books:

1 Ashcroft, Bill, Gareth Griffiths and Helen Tiffin. The Empire Writes Back: Theory and Practice in Post Colonial Literatures (2nd edition, 2002).
2 Trivedi, Harish and Meenakshi Mukherjee, eds. Interrogating Post-Colonialism: Theory, Text and Context (Shimla: Indian Institute of Advanced Study, 1996).

Reference Books:

1 Rushdie, Salman. Imaginary Homelands: Essays and Criticism,1981-1991 (London: Granta, 1991).
2 Ashcroft.. Postcolonial Studies: Key Concepts (London: Routledge, 2000).
3 Bhabha, Homi K., ed. Nation and Narration.(London: Routledge, 1990).
4 Gilbert, Helen and Joanne Tompkins. Post-Colonial Drama: Theory, Practice, Politics (London: Routledge, 1996).

EL20.608 **Dissertation** **0-0-0-4**

Objective: To enable student acquire skills as a basis for the study of literature and history through English texts and also apply knowledge in solving/analyzing/exploring a real life situation/difficult problem.

Course Outcome:

1. Appreciate a work of art critically employing a theory of criticism
2. Substantiate their views with apt illustrations and critical support
3. The ability to develop a research project, including formulation of a research problem, searching for sources, and engaging in analytic discussion.
4. Competence in academic writing and oral presentation skills.
5. Use a working knowledge of research methodology to format the dissertation.
6. Organize the views and format them into a dissertation of about twenty five to thirty pages.

Reference Books:

1. Latest edition of MLA Handbook for Writers of Research Papers

The length of the dissertation to be submitted at the end of Spring Semester of Second year shall be between 8,000 words and 10,000 words. It should be the outcome of a systematic study written in a lucid language. The Bibliography of the dissertation should reflect the current status of scholarship in the area. The Dissertation could be on a topic related to either the core or elective courses. The dissertation should conform to the seventh edition of MLA Handbook.

M.A M.Sc.Psychology 2020-2021

PL 20.501 **ADVANCED GENERAL PSYCHOLOGY-I** **4-0-0-4**

Total Lectures:52

Objective: To introduce students to the advanced concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Unit 1	**Introduction to Psychology:** Definition, Nature, Scope, Purpose of psychology, Methods of Psychology: Observation, Experimental, Case Study.	6
Unit 2	**Biological Basis of Behaviour** : Neuron and its structure, Nervous System; Peripheral & Central Nervous system, Endocrine gland and Personaliy.	12
Unit 3	**Sensory-Perceptual Processes:** Visual, Auditory- Structure and function of eye and ear. Attention: Nature of Attention and its determinants, Perceptual organization: Perceptual Constancy, Determinants of perception, Types of perception: Form, Space, Depth. Methods of Psychophysics, Signal Detection theory and Subliminal Perception.	12
Unit 4	**Learning:** Classical Conditioning: Procedure, phenomena & related issues, Operant Conditioning; Procedure, phenomena & related issues, Cognitive theories of learning: Latent, Insight, Observational, Neurophysiology of Learning.	12
Unit 5	**Memory & Forgetting:** Models of memory; Atkinson & Shiffrin, Craik & Lockhart, Tulving, Sensory, Short term & Long term Memory; Flashbulb memory, Reconstruction and distortion of memory, Biological Basis of Memory, Improving memory strategies, Forgetting; Theories of forgetting.	10

Course Outcome:

1. Understand the origin of Psychology
2. Create in-depth awareness of a variety of major issues and theories in psychology.
3. Describe the effect of biology on behavior.
4. Analyze the visual and auditory processes.
5. Evaluate the behavior and leaarning of individuals with whom they have frequent contact.
6. Apply accurate and comprehensive understanding of human behavior and mental life in general.

Text Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

Reference Books:

1. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
2. Baron, R. A. *Psychology: The Essential Science*. Allyn& Bacon, New York.
3. Ajaya, S. (1983). *Psychotherapy east and west: A unifying paradigm.* Pensylvania: The Himalayan Institute.
4. Heiman, B. (1964). *Facets on Indian thought*. London: George Allen and Unwin.
5. Misra, G., &Mohanty, A.K. (2002). *Perspectives on indigenous psychology* .New Delhi Concept.

PL 20.503 **APPLIED PSYCHOLOGY-I** **4-0-0-4**

Total Lectures:52

Objective: To understand different applications of psychology.

Unit 1	**Introduction:** Nature, scope, history, fields, methods and importance of applied psychology in the twenty first century.	8
Unit 2	**Application of Psychology in Educational Field**: Psychological principles underlying effective teaching- learning process; Learning styles: Gifted, retarded, learning disabled and their training; Training for improving memory and better academic achievement; Personality development and value education; Educational, vocational guidance and career counseling; Use of psychological tests in educational institutions; Effective strategies in guidance programmes.	10
Unit 3	**Psychological Well being and Mental Disorders:**Concept of health- ill health; Positive health, well being; Causal factors in mental disorders (Anxiety disorders, mood disorders, schizophrenia and delusional disorders; personality disorders, substance abuse disorders); Factors influencing positive health, well being, life style and quality of life; Happiness disposition.	10
Unit 4	**Psychological problems of social integration:**The concept of social integration; The problem of caste, class, religion and language conflicts and prejudice; Nature and manifestation of prejudice between the in-group and out-group; Causal factors of social conflicts and prejudices; Psychological strategies for handling the conflicts and prejudices; Measures to achieve social integration.	10
Unit 5	**Psychology of Community and Gender:**Definition and concept of community psychology; Use of small groups in social action; Arousing community consciousness and action for handling social problems; Group decision making and leadership for social change; Effective strategies for social change.**:**Issues of discrimination, Management of diversity; Glass ceiling effect, Self fulfilling prophesy, Women and Indian society.	14

Course Outcome:

1. Understand the nature and importance of applied psychology.
2. Create awareness regarding the field of education.
3. Analyze the role of clnical psychologists.
4. Describe the contribution of psychologists in the area of mental health and wellbeing.
5. Understand work of psychologists towards gender and identity.
6. Apply knowledge to help and understand community.

Text Books:

1. Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2. Goldstein, A. P., & Krasner, B. *Modern AppliedPsychology*. Pergmon Press, NewYork.

Reference Books:

1. Sue, R., Sue, D., & Sue, S. *Understanding AbnormalBehaviour*. Houghton Mifflin.
2. Kloos, B., Hill,J.Thomas,E.,Wandersman,A.,Elias,M.,& Dalton, J.H.(2012). *Community Psychology: Linking individuals and communities(*3rd ed.). Wadsworth, Cengage Learning: Belmont, CA, USA.
3. Korchin, S.J,(1976)*Modern Clinical Psychology,* Basic Box inc. Publishers, New York.

PL 20.505 **PRACTICAL- I** **0-0-4-2**

Total Lab Classes: 26

Objective: To apply the concepts of psychology in real world.

Minimum 8 of the following:

1.	Sentence Completion Test	3
2.	Maudsley Personality Questionnaire	3
4.	Parent Child Relationship Scale	3
5.	Muller Lyer Illusion	3
7.	Serial Position Effect(nonsense syllables)	3
8.	Miller's Span of Attention	3
9.	Depth Perception	3
10.	Size Constancy	3
11.	Standard Progressive Matrices	3
12	DBDA	3

Course Outcome:

1 Assess the personality and aptitude of the subject.
2 Evaluate the menory and IQ of the subject.
3 Measure the Perception of the subject.
4 Measure the attention span of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL 20.507	LIFE SPAN DEVELOPMENT PSYCHOLOGY	4-1-0-5 Total Lectures:52

Objective: To understand the transition from childhood to adolescence to adulthood.

Unit 1	**Introduction to life span psychology:** Meaning, nature, purpose, scope; Methods: Longitudinal, cross- cultural; Stages of human development; Difference between growth and development, Types of development: Qualitative and Quantitative.	12
Unit 2	**Pre-natal and Neonate Development**: Conception, Stages of Prenatal development, Types of birth and its impact.	10
Unit 3	**Infancy and Childhood:** Developmental Milestones; Cognitive; Motor; Moral ; Social ; Emotional and Language development.	10
Unit 4	**Adolescent:** Physical and Psychological changes; developmental task of adolescents ; Problems of adolescents.	10
Unit 5	**Adulthood and Old Age**: Choices of vocation, Adjustment to career, marriage and family, Developmental tasks of adulthood, Problem of aging, Special issues of Old Age.	10

Course Outcome:

1. Understand the development of mind and behavior during life span.
2. Understand the development during infancy and childhood.
3. Demonstrate knowledge of the physical, social/emotional, cognitive and language development of children, both typical and atypical, in major developmental stages.
4. Apply the main theories of adolescent and emerging adult development.
5. Analyze the developmental issues facing adolescents and old age people.
6. Understand the adjustment during middle adulthood.

Text Books:

Hurlock, E. *Developmental psychology*. Tata McGraw-Hill, New Delhi.
Santrock, J. W. *Life-Span Development*. McGraw-Hill, New York.

Reference Books:

Shaffer, D. R. *Developmental Psychology*. Brooks & Cole, California.
Kaluger, G. S., &Kaluger, M. F. *Human Development:The Span of Life*. Times Mirror, St. Louis.
Hurlock, E. *Child Development*. Tata McGraw-Hill, New Delhi.
Berk, L. E. *Child Development.* Prentice-Hall of India, New Delhi.

PL 20.509 **SOCIAL AND CULTURAL PSYCHOLOGY** **4-1-0-5**

Total Lectures:52

Objective:

1. Develop an understanding of the individual in relation to the social and cultural world
2. Introduce students to the realm of social influence, as to how individuals think, feel and behave in social situations.

Unit 1	**Introduction to Social and Cultural Psychology**: Concept, nature, scope and methods; Cultural relativity and universality; goals of cross- cultural psychology; cultural transmission.	8
Unit 2	**Social and Cultural Cognition**: Social and Cultural influences on perception; Role of schemas, heuristics, automatic and controlled processing, Potential sources of error in social cognition.	12
Unit 3	**Attitudes**: Meaning and characteristics of attitudes; Attitude formation; Attitude change; Theories of Attitude Change; Cognitive Dissonance. **Stereotype, Prejudices and Discrimination**: Meaning and nature of prejudice; Formation of norms and prejudice; techniques for countering its affects; Differences between prejudice, stereotype and discrimination.	10
Unit 4	**Culture, Emotion and Interpersonal Attraction**: Basic emotions, recognition and judgement of emotions; cultural display rules, cultural construction of emotional experiences and categories; Meaning and nature of interpersonal attraction, internal and external determinants of attraction, Theories of interpersonal attraction.	12
Unit 5	**Cultural change and adaptations**: Approaches to the study of culture change; acculturation framework; measurement of acculturation, psychological and socio- cultural adaptations; behavior shifts and acculturative stress.	10

Course Outcome:

1. Understand the nature and scope of social and cultural psychology.
2. Analyze the major theories, concepts of social and cultural cognition.
3. Apply the knowledge of stereotype, prejudice and discrimination in everyday lives.
4. Analyze how cultural emotions and interpersonal attractions explain human behavior.
5. Understand the importance of attitudes.
6. Create awareness regarding cultural change and adaptation.

Text Books:

1. Baron, R.A. and Byrne, D (1994). *Social Psychology : Understanding Human Interaction*. ND Prentice Hall
2. Berry,J.W, Poortinga, Y.H., Breugelmans,S.M., Chasiotis,A., & Sam, D.L.(2011). *Cross Cultural Psychology: Research and applications*. Cambridge: Cambridge University Press.

Reference Books:

1. Brigham, J.C (1991). *Social Psychology*. NY : Harper Collins.
2. Fisher, R.J (1982). *Social Psychology: An Applied Approach*. NY: St. Martin's.
3. Hewstone M., Strocbe, W. and Stephenson, G.M. (1996), *Introduction to Social Psychology*. NY: Blackwell.
4. Taylor, S.E. Peplau, L.A. Sears, D.O. *Social Psychology* (12thEd) -Pearson Education.

PL20.511 **DISABILITY AND CHALLENGE** **4-1-0-5**

Total Lectures: 52

Objective: To study the mental lives of disabled individuals with sensory disabilities such as the visually challenged or the auditory challenged and the need to overcome their disabilities with appropriate training as in mobility in space without vision or signing and lip reading in the deaf.

Unit 1	**Introduction to disability and challenge:** Orientation Disabilities: Nature, Types, Causes, Public Awareness Misconceptions, Attitudes and Stereotypes	10
Unit 2	**Interventions: Challenges and issues faced by practitioners:** Multidisciplinary Approach, Role of assessments, Psycho educational interventions	8
Unit 3	**Mental Health issues in disability:** Disabilities and Associated Mental health Issues	10
Unit 4	**Policy and Legal Issues:** PWD act, RCI act, SSA,UNCRPD, Biwako Millennium Framework, RTI	12
Unit 5	**Case Studies:** choosing any one disability and focus on an aspect related to stereotypes existing in community.	12

Course Outcome: The student will be able to:

1. Understand the challenges and issues that practitioners face while dealing with different disabilities in the Indian context.
2. Debate policy and legal provisions for the disabled in our country.
3. Understand different intervention strategies and explore the ideology behind inclusion, in principle and practice.
4. Evaluate issues related to the mental health of the disabled.
5. Study Socio-cultural background of the disabled.
6. Innovate tools and methods to give abilities to the concerned.

Text Books:

1. Hegarty, S. & Alur, M. (2002). *Education and Children with Special Needs. From Segregation to Inclusion*. New Delhi: Sage Publications
2. Burt, D., Primeaux-Hart, K., Loveland, K., Cleveland, L., Lewis, K., Lesser, J., & Pearson, P. (2005). Aging in adults with intellectual disabilities. *American Journal on Mental Retardation, 110,* 268–284

Reference Books:

1. Oldfield, J., Humphrey, N. and Hebron, J. (2017), Risk factors in the development of behaviour difficulties among students with special educational needs and disabilities: A multilevel analysis. Br J Educ Psychol, 87: 146–169. doi:10.1111/bjep.12141
2. Carpenter, N. C., & Paetzold, R. L. (2013). An examination of factors influencing responses to requests for disability accommodations. Rehabilitation psychology, 58(1), 18-27
3. Markel, K. S., & Barclay, L. A. (2009). Addressing the underemployment of persons with disabilities: Recommendations for expanding organizational social responsibility. Employee Responsibilities and Rights Journal, 21(4), 305-318

Spring Semester

PL 20.502 **ADVANCED GENERAL PSYCHOLOGY-II** **4-0-0-4**

Total Lectures:52

Objective: To introduce students to the advanced concepts of the field of psychology with an emphasis on applications of psychology in everyday life.

Unit 1	**Motivation:** Motivational Cycle, Biological & Social Motives, Theories of motivation.	6
Unit 2	**Emotion:** Physiological correlates of emotions**,** Theories of emotions, Conflict & Stress management.	12
Unit 3	**Thinking:** Language &Thought, Imagination, Theories of thinking**,** Problem Solving, Reasoning, Decision Making & Creative thinking with classroom implication.	12
Unit 4	**Cognition & Meta-cognition:** Factor & Process theories, Abilities & achievement- concept & Role of Emotional Intelligence, Classroom implication of Gardner's Multiple Intelligence Theory, Meta-cognition-Concept & Implication.	12
Unit 5	**Personality** Approaches of personality- Psychoanalytic, Neo-Freudian, Social Learning, Trait & Type, Cognitive, Existential & Humanistic**,** Personality Assessment- Projective, psychometric & Behavioral measure.	10

Course Outcome:

1. Understand the origin of Psychology
2. Create in-depth awareness of a variety of major issues and theories in psychology.
3. Describe the effect of biology on behavior.
4. Analyze the visual and auditory processes.
5. Evaluate the behavior and leaarning of individuals with whom they have frequent contact.
6. Apply accurate and comprehensive understanding of human behavior and mental life in general.

Text Books:

1. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. *Introduction to Psychology*. Harcourt Brace Jovanovich, New York.
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Baron, R. A. *Psychology: The Essential Science*. Allyn& Bacon, New York.
3. Ajaya, S. (1983). *Psychotherapy east and west: A unifying paradigm*. Pensylvania: The Himalayan Institute.
4. Heiman, B. (1964). *Facets on Indian thought*. London: George Allen and Unwin.
5. Misra, G., &Mohanty, A.K. (2002). *Perspectives on indigenous psychology* .New Delhi Concept.

PL 20.504 **APPLIED PSYCHOLOGY-II** **4-0-0-4**

Total Lectures:52

Objective: To understand different applications of psychology.

Unit 1	**Work Psychology and Organizational Behaviour:**Personnel selection and training; Use of psychological tests in the industry; Training and human resource development; Theories of work motivation – Herzberg, Maslow, Adam Equity theory, Porter and Lawler, Vroom; Leadership and participatory management; Advertising and marketing; Stress and its management; Ergonomics; consumer psychology; Managerial effectiveness; Transformational leadership; Sensitivity training; Power and politics in organizations.	10
Unit 2	**Application of Psychology to disadvantaged groups:** The concepts of disadvantaged, deprivation; Social, physical, cultural and economic consequences of disadvantaged and deprived groups; Educating and motivating the disadvantaged towards development; Relative and prolonged deprivation.	10
Unit 3	**Application of psychology to environment and related fields:** Environmental psychology-effects of noise, pollution and crowding; Population psychology: psychological consequences of population explosion and high population density; Motivating for small family norm; Impact of rapid scientific and technological growth on degradation of environment.	10
Unit 4	**Forensic and Law Psychology:** Introduction and HistoricalPerspective, Fields of Forensic Psychology, Criminal Identification techniques, Psychology and judicial process, Eyewitness testimony, role of psychologist in legal judicial system, juvenile delinquency, ethical issues in forensic psychology, Police interrogation and false confession, Legal rights of inmates: Rights to treatment, Right to refuse treatment.	10
Unit 5	**Application of Psychology in Military and Sports**: Devising psychological tests for defence personnel for use in selection, Training, counseling; training psychologists to work with defence personnel in promoting positive health; Human engineering in defence. Psychological interventions in improving performance of athletes and sports. Persons participating in Individual and Team Games.	12

Course Outcome:

1 Understand the nature and role of industrial psychologist.
2 Create awareness regarding the disadvangate groups of society.
3 Analyze the role of environmental psychologists.
4 Describe the contribution of psychologists in the area of law.
5 Understand work of psychologists towards forensic science.
6 Apply knowledge to help and understand military and sports community.

Text Books:

1 Anastasi, A. *Fields of Applied Psychology*. Tata McGraw-Hill, New Delhi.
2 Goldstein, A. P., & Krasner, B. *Modern AppliedPsychology*. Pergmon Press, NewYork.

Reference Books:

1 Sue, R., Sue, D., & Sue, S. *Understanding AbnormalBehaviour*. Houghton Mifflin.
2 Hall, R. &Mangelsdroff,D.(1991). *Handbook of military psychology*. John Wiley: USA.
3 Kennedy,C.H.,&Zillmer, E.A. (2006). *Military psychology: Clinical and operational applications*. Guilford: New York, USA.
4 Bartol, C.R.&Bartol,A.M. (2004). Introduction to forensic psychology.Thoudsandoaks,CA: Sage Publications.
5 Bell,P., Greene,T., Fisher, J.,&Baum,A. (2001). *Environmental Psychology*(5th ed). NY: Harcourt Brace Inc.

PL 20.506 **PRACTICAL- II** **0-0-4-2**

Total Lab Classes: 26

Objective: To apply the concepts of psychology in real world.

Minimum 8 of the following:

1.	Big Five Personality Test	3
2.	Rorschach Inkblot Test	3
4.	Thematic Apperception Test	3
5.	Bhatia Battery	3
7.	Eyesenck Personality Questionnaire (Revised)	3
8.	Defense Mechanism Inventory	3
9.	Happiness Scale	3
10.	General Wellbeing Scale	3
11.	Multiphasic Interest Inventory	3
12.	Koh's Block Design	3

Course Outcome:

1 Assess the personality and aptitude of the subject using projective techniques.
2 Evaluate the IQ of the subject using projective techniques.
3 Measure the wellbeing of the subject.
4 Measure the defense mechanism of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL20.508 **PSYCHOMETRICS AND STATISTICS IN PSYCHOLOGY** **4-1-0-5**

Total Lectures:52

Objective: To develop an awareness of the concepts related to psychometrics and statistics in psychology.

Unit 1	**Psychometrics:** Measurement in psychology; history of psychological measurement and testing; Levels of measurement; Scales; Functions of measurement, General problems of measurement.	10
Unit 2	**Test Development:** Meaning and classification of psychological tests, Characteristics of a good test, Ethical issues in psychological testing, Uses and limitations of psychological tests, General steps of test construction; Item Writing Item analysis, reliability, validity and norms.	12
Unit 3	**Overview of descriptive statistics and probability:** Measures of central tendency, variability, curves and graphs; Percentiles, percentile ranks and standard scores; Characteristics of normal distribution curve.	10
Unit 4	**Parametric Statistics:** T- Test and ANOVA; Correlation and Regression Analysis.	10
Unit 5	**Non- Parametric Statistics:**Chi-Square, Mann Whitney U test, Rank-difference method, Coefficient of Concordance, Friedman Test.	10

Course Outcome:

1. Apply methods of test development in construction of a psychological tool.
2. Understand the nature of descriptive statistics.
3. Understand the properties of NPC.
4. Apply the parametric statistics.
5. Understand the role of researcher in psychology.
6. Analyze non parametric statistics.

Text Books:

1. Garrett, H. E. *Statistics in Psychology and Education*. Paragon International Publishers, New Delhi.
2. Singh, A.K. (2006). *Tests, Measurements and Research Methods in Behavioural Sciences* .Patna: Bharati Bhavan

Reference Books:

1. Anastasi, A. &Urbina, S. (1997). *Psychological testing*. N.D.: Pearson Education.
2. Broota, K. D. *Experimental Design in Behavioural Research*. Wiley Eastern, New Delhi.
3. Guilford, J. P., &Fruchter. *Fundamentals of statistics inPsychology and Education*. Kogakusha, Tokyo.
4. Kerlinger,F.N.(1973)*Foundations of Behavioural Research*. Holt Rinehart and Winston.Inc., New York.

PL 20.510	SYSTEMS OF PSYCHOLOGY	4-1-0-5 Total Lectures:52
Objective:	To develop the understanding of various schools of psychology.	
Unit 1	**Development of Psychology as a discipline:** Sources of history of Psychology; Evolution of psychology as an independent discipline, Structuralism: Wundt and Titchener; Functionalism: Dewey, William James and Galton.	10
Unit 2	**Behaviorism school of psychology:** Pavlov, Skinner, Thorndike, Watson, Lashley.	12
Unit 3	**Gestalt school of psychology:** Wertheimer, Koffka and Kohler.	10
Unit 4	**Psychoanalysis and Neo- Psychoanalytic Perspective:** Freud, Jung, Erikson, Adler, Horney, Eric Fromm.	10
Unit 5	**Humanistic- Existentialist Perspective:** Maslow, Carl Rogers, Victor Frankl, Rollo May.	10

Course Outcome:

1. Create insight of the contribution of different schools of Psychology.
2. Understand the importance of the work of behaviourists'.
3. Develop knowledge of the work of Sigmund Freud.
4. Describe Gestalt school of Psychology.
5. Analyze the role of neo psychoanalysts in psychology.
6. Evaluate contribution of humanistic-existential psychologists.

Text Books:

1. Schultz & Schultz. *History of Modern Psychology* (10th ed). Wadsworth Cengage Learning.
2. Chaplin, T. Kraweic, T.S. *Systems and Theories of psychology*. Holt Rinehart and Winston.

Reference Books:

1. . Wolman, B.B., *Contemporary theories and systems of psychology*, Harper and Bros, N.Y.
2. Leahey, Thomas. Hardy, *History of Psychology:Main currents in psychological thought*, New Delhi: Peacock Books.
3. Marks, M.H and William, A. Cronan-Hillix, *Systems and theories in psychology*. McGraw Hill International Editions, Psychology series.Marx, M.H. & Hillix, W.A. (1986). *Systems and Theories in Psychology.* NY: Mc Graw Hill.
4. Hall C.S. :Lindzey, G. *Theories of Personality*. New York : Wiley Eastern Limited.

PL 20.512 **CROSS CULTURAL COMMUNICATION** **4-1-0-5**

Total Lectures: 52

Objective: To encourage students to engage with different cultures in a hands-on way and to meaningfully experience cross-cultural communication.

Unit 1	**Basic Concepts in Communication, Communication Styles:** Verbal and Nonverbal, Communication Barriers and Breakdowns, Communication in Relational Contexts	10
Unit 2	**Intercultural communication:** its nature and assumptions, global and domestic diversity trends, value orientations and intercultural encounters, mindful intercultural verbal and non-verbal communication, biases in cross-cultural communication	12
Unit 3	**Inter-cultural and Trans-cultural communication:** Constructive Inter-cultural conflict management, Trans-cultural communication competence, Identity change and Inter-cultural adaptation	10
Unit 4	**Cross – cultural Negotiation**: Process, verbal and non-verbal behaviour, composition of the negotiation team	8
Unit 5	**Cross – cultural Bargaining:** persuasion tactics, planning, working through the contract	12

Course Outcome: The student will be able to:

1. Analyze barriers and breakdowns of communication.
2. Evaluate the concept of intercultural communication.
3. Understand the application of trans-cultural communication.
4. Discuss how to negotiate cross-culturally.
5. Apply skills of working through contact.
6. Reflect on their own personal experience with cultural difference

Text Books:

1. Danziger, K. (1976). Interpersonal communication. New York: Pergamon Press.
2. Gudykunst, W. B. (Ed.) (2003). Cross-cultural and intercultural communication. Thousand Oaks, CA: Sage Publications.

Reference Books:

1. Prasad, L. M. (2012). Organizational behaviour. New Delhi: Sultan Chand & Sons.
2. Reynolds, S.; Valentine, D. and Munter, M.M. (2010). Guide to Cross-Cultural Communications, 2nd Edition, Pearson
3. Mattock, J. (2003). Cross-cultural communication : the essential guide to international business, Kogan Page publishers

PL 20.514 **COGNITIVE PSYCHOLOGY** **4-0-0-4**

Total Lectures:52

Objective: To understand cognitive aspect of psychology.

Unit 1	**Cognitive approach to Psychology:** Origin and current status of cognitive psychology, assumptions and methods of cognitive psychology.	10
Unit 2	**Thinking:** Language &Thought, Imagination, Theories of thinking**,** Problem Solving, Reasoning, Decision Making & Creative thinking with classroom implication.	10
Unit 3	**Intelligence:** Factor & Process theories, Abilities &achievement- concept & Role of Emotional Intelligence, Classroom implication of Gardner's Multiple Intelligence Theory, Meta-cognition-Concept & Implication.	10
Unit 4	**Memory Processes:** Current models and direction, types of memory- working memory, semantic, episodic, procedural, eye- witness and flash bulb memory, traumatic and false memory, everyday memory; Approaches to memory- Information Processing and Connectionist.	12
Unit 5	**Language Processes:** Language Acquisition, Models of Reading and Language Comprehension, Language Production, Language and thought.	10

Course Outcome:

1. Understand the nature and origin of cognitive psychology.
2. Create awareness regarding human language and thoughts.
3. Analyze the role of emotional intelligence.
4. Describe the contribution of intelligence theories.
5. Understand the concept of memory anf forgetting.
6. Apply knowledge to help and understand language processes.

Text Books:

1. Baddley, A. (1997). *Human Memory: Theory and Practice* . New York: Psychology Press.
2. Solso, R. L., MacLin, M. K., &MacLin, O. H. (2005). *Cognitive psychology*. Boston: Pearson/A and B.

Reference Books:

1. . Harley, Treror, A. (1997). *The psychology of language: From data to theory.* Taylor Francis.
2. Smith, E.E. &Kosslyyn, (2007). *Cognitive psychology: mind and brain.* Prentice Hall.
3. Sternberg, R.J.(2007). *Cognitive psychology*. New Delhi. Cengage Learning.
4. Reigler, G.R &Reigler, B.R.(2008).*Cognitive psychology*. New Delhi: Pearson education

Second Year

Autumn Semester

PL20.601	**PERSONALITY PSYCHOLOGY**	**4-0-0-4**
		Total Lectures:52

Objective: To develop an awareness of the concepts and theories related to personality.

Unit 1	**Introduction to Personality Psychology:** Nature of Personality; Basic Issues of Personality: individual versus individual differences, heredity versus environment, abnormal versus abnormal personality; Unconconsious; self uniqueness; gender; self concept; self identity and self esteem.	10
Unit 2	**Psychosocial and Cultural determinants of Personality**: Stress, Adjustment and Health Differences; Cultural and Ethnic Differences; Gender Differences in personality from eight perspectives.	12
Unit 3	**Psychoanalytic Theory**: Freud, Jung; Personality Theories by Adler, Horney, Fromm, Sullivan.	10
Unit 4	**Humanistic Theories**: Rogers, Maslow; S-R Theories: Dollard, Miller; Bandura's Reinforcement Theory.	10
Unit 5	**Trait and Type Theories**: Allport, Cattell, Eysenck, McCrae and Costa.	10

Course Outcome:

1. Understand the concept of personality.
2. Analyze cultural determinants of personality.
3. Analyze gender differences in personality.
4. Describe psychometric theory of personality.
5. Understand humanistic theories of personality.
6. Analyze trait and type theories.

Text Books:

1. Hall &Lindzey, *Theories of personality*, John Wiley, New York.
2. Friedman, H.S. &Schustack, M.W. (2006). *Personality*. Pearson Education.

Reference Books:

1. Chaplin,T. Kraweic, *T.S. Systems and Theories of Psychology*. Holt Rinehart and Winston.
2. Schultz,D.P., & Schultz, S.E. (2004). *A history of modern psychology*. 8th ed. Belmont,CA: Thomson/ Wadsworth.
3. Leahey, Thomas. Hardy, *History of Psychology:Main currents in psychological thought*, New Delhi: Peacock Books.
4. Marks, M.H and William, A. Cronan-Hillix, *Systems and theories in psychology*. McGraw Hill International Editions, Psychology series.

PL 20.603 **POSITIVE & SELF PSYCHOLOGY** **4-0-0-4**

Total Lectures:52

Objective: The paper aims at providing an overview of the concept of positive psychology.

Unit 1	**Introduction to Positive Psychology:** Positive Psychology; Goals &Definition, Western &Eastern view of Positive Psychology, Classification and measurement of Human Strengths & Positive outcomes**,** Developing Strength and living well.	10
Unit 2	**Positive Emotional states and processes:** Pleasure, positive effect,Happiness& Wellbeing, Emotional intelligence**,** Living well across life stages.	10
Unit 3	**Positive cognitive states and processes:** Self efficacy and self acceptance, wisdom, optimism & hope, Mindfulness and flow.	10
Unit 4	**Pro-social behavior and well-being:** Empathy, altruism, gratitude,Forgiveness, attachment, Positive experiences in school life.	10
Unit 5	**Spirituality and Positive Psychology:** Creativity, giftedness andindustry, Religion & spirituality, Emotional and social intelligence.	12

Course Outcome:

1 Understand the concepts of positive psychology.
2 Analyze different emotional states.
3 Understand the pro-social behavior.
4 Determine the importance of well-being.
5 Apply spiritual aspect to develop positivity.
6 Understand positive cognitive states and processes.

Text Books:

1 Snyder, C.R. & Lopez, S.J., *Positive Psychology*. New Delhi: Sage.
2 Baumgardner, S. & Crothers, M. *Positive Psychology*, New Delhi, Pearson Education.

Reference Books:

1 Snyder, C.R. & Lopez, S.J., *Handbook of Positive Psychology*.N.Y.Oxford.
2 Wong.P.T. & Fry. *The Human Quest for meaning*. Mahwah, New Jersey. Lawrence, Erlbum.

PL 20.605 **PROJECT** **0-0-0-2**

Objective: The student has to submit two copies of research proposal by first week of November in the department. It will be followed by a presentation for approval.

Course Outcome:

1 Enhance the ability of the student to use their knowledge of research, statistics, and evaluation methods to inform all areas of practice, from choosing appropriate methods for collecting information to making recommendations for interventions based on empirical evidence.
2 Formulate and identify null and alternative hypotheses in research
3 Define and give examples of independent variables, dependent variables, and scales of measurement.
4 Generate and interpret various types of graphical displays and tables from research data.
5 Differentiate between descriptive and inferential statistics
6 Analyze data using statistical software (SPSS)

Reference Books:

1 Latest APA manual for dissertation.

RM 20. 601	RESEARCH METHODOLOGY	4-0-0-4 Total Lectures:52
Objective:	This course will introduce students to understand the fundamental process of doing research in the social sciences, with special reference to tools they are likely to use in Political Science. It will position it such that a student can go from a common-sense understanding to a complex, conceptual one. The student will also have a sense of hands-on training, by undertaking some limited research idea, with an appropriate methodology and write a report on it.	
Unit 1	Introduction: Meaning and definition, objective of research, types of research, significance of research.	7
Unit 2	Research Problem: definition, necessity and techniques of defining research problem, formulation and objectives of research problem, Research Designs: meaning, need, features, types, Synopsis design for research topic	9
Unit 3	Sampling Designs: surveys, types of sample designs, characteristics, Data collection and validation: types, methods of collecting data, methods of editing and data validation.	12
Unit 4	Hypothesis: definition, testing of hypothesis, procedures for testing, Parametric and non-parametric test for testing, limitations of tests of hypothesis.	12
Unit 5	Report writing: basic concepts of paper writing and report generation, review of literature, concepts of bibliography and references, significance of report writing, steps of report writing, methods of presentation of report.	12

Course Outcome: The student will be able to:

1	Understand the complex universe of social science and its modes of understanding
2	Effectively reflect upon the issues of social science research
3	Employ competently the techniques and methods in social research
4	Demonstrate knowledge of research processes (reading, evaluating, and developing)
5	Identify, explain, compare, and prepare the key elements of a research proposal/report
6	Describe sampling methods, measurement scales and instruments, and appropriate uses of each

Text Books:

1. Goode,W.J. and P.K Hatt, Methods in Social Research, New Delhi, McGraw Hill International Editions, Sociology Series, 1981.
2. Kothari, C. R. &Garg, G., Research Methodology, Methods and Techniques, 4th Ed, Delhi, New Age International Publishers, 2018.

Reference Books:

1. Magal, S.K. &Mangal, S., Research methodology in Behavioural Sciences, New Delhi, Prentice Hall of India Pvt. Ltd, 2013
2. Ahuja, R., Research Methods, Rawat Publishers, Jaipur, 2001.
3. Best,J.W. and J.V. Kahn, Research in Education, 6thed, New Delhi, Prentice Hall of India Pvt. Ltd, 1992
4. Marjory L. Joseph, William D Joseph, Research Fundamentals in Home economics/ Human ecology, California, Plycon Press, 1996.
5. Charles Y. Clock (ed.) : Survey Research in Social Sciences (New York : Russle Sage Foundation)

PL 20.607	COUNSELING & GUIDANCE PSYCHOLOGY: PROFESSIONAL FOUNDATION	4-0-0-4 Total Lectures:52

Objective: To develop an understanding of basic concepts, processes, and techniques of Counseling.

Unit 1	**Guidance Psychology:** Historical Perspective**,** Objectives & Principles of guidance**,** Types of guidance -Educational, Career, Personal and Social.	10
Unit 2	**Counseling Psychology:** Nature, Concept, history with special reference to Indian context, professional training and personal qualities of a counselor.	10
Unit 3	**Process and Ethics in Counseling and Guidance**: Preparation, Pre-counseling interview, Rapport and Relationship, Exploration and Identification of goals, Selection of counseling therapy, Termination and follow up; Guidelines and Issues of Counseling ethics.	10
Unit 4	**Counseling Skills:** Pre-counseling skills - listening and attending; skills for building trust and empathy –paraphrasing, reflecting, pacing; skills for conveying genuineness and positive regard – congruence, self-disclosure, immediacy and enhancing responses.	10
Unit 5	**Basic Techniques of Counseling**: Sensitivity training, Transactional analysis, Assertive training, Relaxation training, Socio and Psycho drama.	12

Course Outcome:

1. Create the learner with the challenges of Counseling.
2. Understand the concepts of guidance and counseling.
3. Apply process of counseling to real life counseling.
4. Analyze step wise guide to counseling.
5. Create awareness of the ethics of a professional counselor.
6. Understand different skills of counselors.

Text Books:

1. Gladding, T. Samuel. *Counselling: A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Bhatnagar, Asha, *Guidance and Counselling*, Vikas Publishing House pvt. Ltd

Reference Books:

1. Jones. A.J., *Principal of Guidance*, McGraw Hill, N.Y.
2. Psricha, *Guidance and Counselling in Indian education*, New Delhi, NCERT.
3. Mayers, G.E., *Principles and Techinques of Vocational Guidance*, McGraw Hill, N.Y.
4. Nelson-Jones, R. (1994). *Handbook of Counselling Psychology.* London : Sage.

PL 20.609	APPLIED COUNSELING:SPECIALTIES IN PRACTICE OF COUNSELING	4-0-0-4 Total Lectures:52
Objective:	To develop an understanding of applied concepts of Counseling.	
Unit 1	**Child and Adolescent Counseling:** Developmental theories- cognitive theory, moral theory and psychosocial theory; Preventive and Remediation services for special childhood and adolescent problems – child abuse and neglect, Depression and Anxiety, Drug abuse, Delinquency, Sex abuse, Teenage – pregnancy. Special Counseling Approaches – Conflict Resolution and Play Therapy.	10
Unit 2	**School and Career Counseling**: Role and functions of school and career counselor, special skills and problems- consultation, counseling exceptional children, special problems, career counseling for women, computer-assisted career counseling.	10
Unit 3	**Marriage and Family Counseling**: Theoretical Foundations – System theory, Family life cycle; Marital Assessment; Counseling for special family and marriage problems – Inter-parental conflict, Interpersonal communication. Parenting skills, Crisis intervention.	10
Unit 4	**Group Counseling**: Types of Groups – Guidance/Psycho/educational groups; Counseling/Interpersonal problem solving groups, Personality Development/Reconstruction groups. Process of Group counseling. Issues and qualities of an effective group counselor.	10
Unit 5	**Rehabilitation and Mental Health Counseling** Rehabilitation Counseling – Theories and techniques, roles and functions. Mental Health Counseling – Theories and functions, special techniques of stress management and anger management.	12

Course Outcome:

1. Create the learner with the challenges of different areas of Counseling.
2. Understand the counseling techniques for children and adolescents.
3. Apply process of counseling to educational sector.
4. Analyze assessment tools for marriage and family counseling.
5. Create awareness of the ethics of group counseling.
6. Understand different skills of rehabilitation and mental health counselors.

Text Books:

1. Gladding, T. Samuel. *Counselling: A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.

Reference Books:

1. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
2. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy : Classics on Theories and Issues*. Science and Behavior Books Co.
3. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
4. Clough, P; Pardeck, J.T.; Yuen, F. (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.

PL 20.611 PRACTICAL OF COUNSELING PSYCHOLOGY-I 0-0-4-2

Total Lab Classes:26

Objective: To apply the concepts of psychology in real world. Assignments are based on the courses PL20.605-Counseling and Guidaance Psychology: Professional Foundation and PL20.607-Applied Counseling: Specialities in practice of Counseling. That also accompany by field visit, and practical's related to compulsory papers. The students can avail internship and field visit during the summer term breaks, for a period of 1 or 2 months.

Minimum 8 of the following:

1.	Maze Learning	3
2.	Psychological Needs for Counseling Scale	3
3.	Guidance Need Inventory	3
4.	Fear Checklist	3
5.	Home Environment Inventory	3
6.	Retroactive Inhibition	3
7.	Verbal test for Creative Thinking	3
8.	Ergograph	3
9.	Seguin Form Board Test	3
10.	Mirror Drawing Apparatus	3
11.	Home Environment Inventory	3
12.	Judging Emotions through Photograph	3

Course Outcome:

1 Understand difference between tests and experiments.
2 Evaluate the need for counseling.
3 Measure the fears of the subject.
4 Measure the emotions of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL20.613 **ADVANCED INDUSTRIAL PSYCHOLOGY** **4-0-0-4**

Total Lectures:52

Objective: To develop an awareness of the concepts related to organizational behavior.

Unit 1	**Introduction to Industrial Psychology:** Definition, role, Nature and scope**,** Origin and History of industrial psychology**,** Contribution of Hugo Munsterberg, Taylor, Gilbreth and Alton Mayo.	10
Unit 2	**Job Analysis:** Purpose, importance and uses of job analysis**,** Variousmethods of job analysis**,** Job design approaches and job enrichment.	10
Unit 3	**Recruitment and selection:** Purpose and importance of recruitmentand selection**,** Recruitment process; external and internal**,** Stages in selection process**,** Selection methods.	10
Unit 4	**Personnel Training:** Nature and principals of training**,** Assessingtraining needs**,** Training methods; on-the job training, of the job apprenticeship, business games, Evaluation of training programme.	10
Unit 5	**Performance Appraisal System**: Purpose, importance, Uses of Performance appraisal, Methods of evaluating performance appraisal; traditional methods, 360 degree appraisal and management by objectives; issues and biases related to performance appraisal.	12

Course Outcome:

1. Develop connectivity between concepts and practices of organizations.
2. Describe major topics and subspecialties including critical theory and research finding that have defined the field of I/O psychology
3. Measure personnel performance through different criteria.
4. Apply procedures and assessment methods for personnel selection.
5. Understand purpose and importance of performance appraisal system.
6. Analyze effect personnel training on performance.

Text Books:

1. Blumm M.L. & Nylor, J.C. *Industrial Psychology*. N.Y : Harper & Row.
2. Tiffin J. and McCormic E.J. (1975) *Industrial Psychology*, Prentice Hall, 6th Ed.

Reference Books:

1. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
2. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co.
3. Hersay, R.E. and Blanchard, T.*The Management of organizational behaviour*,New Delhi : Prentice Hall
4. McCormick E.J.(1976) *Human Factors Engineering and Design*, McGraw Hill, 4th ed.

PL20.615 **DYNAMICS OF ORGANIZATIONAL BEHAVIOR-I** **4-0-0-4**

Total Lectures:52

Objective: To develop an awareness of the concepts related to organizational behavior.

Unit 1	**Introduction:** Meaning and Importance of OB, Historical overview;Classical and Neo-classical**,** Approaches of OB; contingency and system approach.	10
Unit 2	**Motivation in Organization:** Needs theories of motivation**,** Equitytheories of motivation**,** Job Design and work motivation**,** Determinants of job satisfaction**,** Organizational commitment, citizenship behavior and organizational justice.	10
Unit 3	**Leadership:** Trait Theories, Behavioural Theories,Contingencytheories:Fiedler Modal and situational leadership Theory; Path Goaltheory, Inspirational Approaches to leadership: Charismatic Leadership;Transformational Leaders**,** Authentic Leadership: Ethic and trust are the foundation of leadership**,** Contemporary Leadership Roles: Mentoring, self Leadership, E-Age.	10
Unit 4	**Organizational Communication:** Meaning and functions**,** Directionsof communication in organization**,** Directions and methods of improving communications**,** Barriers of effective communication.	10
Unit 5	**Decision Making:** Nature of decision making; Behavioural decision making, making: decision rationality, models, decision making techniques: traditional and Modern Participation technique.	12

Course Outcome:

1. Develop connectivity between concepts and practices of organizations.
2. Describe major topics and subspecialties including critical theory and research finding that have defined the field of I/O psychology
3. Measure personnel performance through different criteria.
4. Apply procedures and assessment methods for personnel selection.
5. Understand purpose and importance of performance appraisal system.
6. Analyze effect personnel training on performance.

Text Books:

1. Robbins, Stephen. P., *Organizational Behaviour,* New Delhi, Oxford Uni. Press.
2. Luthans F, *Organizational Behaviour,* Prentice Hall of India pvt. Ltd. New Delhi.

Reference Books:

1. Pareek, U. *Understanding OrganizationaBehaviour*, Oxford University Press, New Delhi.
2. Steven, I. McShaneMarayann.VonGlinow, *OrganizationalBehaviour*, Tata McGraw Hill, New Delhi.
3. Nelson, D.B. and Quick J.C. (2005) *UnderstandingOrganizational Behavior.* South Western Thomson Learning.

PL 20.617 PRACTICAL OF INDUSTIRAL AND ORGANIZATIONAL PSYCHOLOGY-I **0-0-4-2**
Total Lab Classes:26

Objective: To apply the concepts of psychology in real world. Assignments are based on the courses PL20.611 Advanced Industrial Psychology, PL20.613 Dynamics of Organizational Behaviour-I. That also accompany by field visit, and practical's related to compulsory papers. The students can avail internship and field visit during the summer term breaks, for a period of 1 or 2 months.

Minimum 8 of the following:

1.	Maze Learning	3
2.	Leader Behavior Scale	3
3.	Occupational Stress Inventory	3
4.	Fear Checklist	3
5.	Work Motivation Questionnaire	3
6.	Retroactive Inhibition	3
7.	Verbal test for Creative Thinking	3
8.	Ergograph	3
9.	Seguin Form Board Test	3
10.	Mirror Drawing Apparatus	3
11.	Home Environment Inventory	3
12.	Judging Emotions through Photograph	3

Course Outcome:

1 Understand difference between tests and experiments.
2 Evaluate the leadership behavior and occupational stress.
3 Measure the fears of the subject.
4 Measure the emotions of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL 20.619 **PSYCHOPATHOLOGY-I** **4-0-0-4**

Total Lectures:52

Objective: The paper aims at providing an overview of the concept of abnormality and the symptoms and etiology of various psychological disorders. This will sensitize them to information on psychopathology and dispel myths regarding it.

Unit 1	**Approaches of Psychopathology:** Psychodynamic, Behaviouristic, Humanistic-Existential, and Cognitive approaches.	10
Unit 2	**Classifications in Psychopathology:** (I) WHO Classification (ICD-10), and (II) Multiaxial System (DSM V) similarities, differences and critical evaluation.	10
Unit 3	**Anxiety Disorders:** Nature, etiology, and symptoms of panic, phobic, generalized anxiety disorders. Obsessive-compulsive disorder.	10
Unit 4	**Somatoform Psycho-physiological Disorders:** Nature, etiology and symptoms of dissociative disorder and Psychophysiological disorder.	12
Unit 5	**Organic Mental Disorder:** Clinical features of organic mental disorders, organic system syndrome, delirium, epilepsy, dementia and Alzheimer.	10

Course Outcome:

1. Understand the concepts of normality and abnormality.
2. Define DSM and ICD guidelines.
3. Analyze methods of assessment and treatments.
4. Determine etiology, symptoms, diagnosis and treatment of stomatoform psycho-physoplogical disorders.
5. Apply etiology, symptoms, diagnosis and treatment of anxiety disorders.
6. Understand etiology, symptoms, diagnosis and treatment of organic mental disorders.

Text Books:

1. Carson, R.C.; Butcher, J.N., et al. Abnormal Psychology; New Delhi: Pearson Education**.**
2. Davison, G.C. & Neale, J.M. Abnormal Psychology ; New York: Wiley

Reference Books:

1. Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM V). Washington, D.C. : APA Publication.
2. American Psychological Association. (1998). Diagnostic and statistical manual of mental disorders (5th .ed.): text revision (DSM-1V-TR). New Delhi: Jaypee Brothers Medical Publishers (pvt) Ltd.
3. Ahuja N (2002). A short text book of Psychiatry (5th edition). New Delhi. JaypeeBrothers.
4. Sarason, I.G. and Sarason, B.R. *Abnormal Psychology: The Problem of Maladaptive Behavior*. New Delhi: Pearson Education Inc

PL 20.621 **PSYCHO-DIAGNOSTICS** **4-0-0-4**

Total Lectures:52

Objective: The paper aims at providing an overview of the concept of diagnosis and the symptoms and etiology of various psychological disorders.

Unit 1	**Introduction:** Brief history: Early & recent, Definition and nature of clinical psychology. Scope of clinical psychology. Role of clinical psychologists. Issues in clinical psychology. Employment settings for Clinical Psychologists. Ethics and values of the profession.	9
Unit 2	**Clinical Assessment:** Nature and purpose of clinical diagnosis and assessment. Stages of clinical assessment. Behavioural assessment, Psychological Assessment, Cognitive and Personality Assessment: Interviewing, Observing behaviour, Mental State Examination, and case study.	11
Unit 3	**Test in Clinical Use:** Role of psychological test in psycho-diagnosis. Different tests in clinical use: TAT, Rorschach test, Sentence Completion Test (SCT); Picture Frustration Test, WAIS, MMPI, Bender Gestalt test, Wechsler Memory Scale, PGI Memory Scale, Bhatia's Battery Performance Tests of Intelligence, Binet-Kamat test of Intelligence, Raven's progressive Matrices (Standard and Advanced).	12
Unit 4	**Rating Scales in Clinical Use:** Self-rated and observer-rated scales of different clinical conditions such as anxiety, depression, mania, OCD, phobia, panic disorder etc. Issues related to clinical applications and new developments.	10
Unit 5	**Neuropsychological Assessment:** Meaning and purpose of neuropsychological assessment. Concept of minimal brain dysfunction. Techniques of neuropsychological assessment.	10

Course Outcome:

1. Understand the concepts of clinical psychology.
2. Analyze different clinical assessments.
3. Understand the role of psychological tests in clinical use.
4. Determine the role of rating scales in clinical use.
5. Apply neuropsychological assessments on patients.
6. Understand techniques of assessing.

Text Books:

1. Anastasi, A., &Urbina, S. (1997). *Psychological testing* (7th ed.). Delhi, India: Pearson Education.

2. Freeman, F. S. (1965). *Theory and practice in psychological testing* (3rd ed.). New Delhi, India: Oxford and IBH.

Reference Books:

1. Hecker,J.E., &Thorpe,G.L. (2005). *Introduction to clinical psychology: Science, practice, and ethics*. Delhi: Pearson Education**.**
2. Pomerantz, A. M. (2008). *Clinical psychology: Science, practice, and culture*. New Delhi, India: Sage Publications.
3. Holt, R.R. (ed.). (1984). *Diagnostic psychological testing*.Revised edition. New York: International Universities Press.
4. Weiner, I.B. *Clinical methods in psychology*. New York: Wiley inter science V publication.

PL 20.623 **PRACTICAL OF CLINICAL PSYCHOLOGY-I** **0-0-4-2**

Total Lab Classes:26

Objective: To apply the concepts of psychology in real world. Assignments are based on the courses PL6…Psychyopathology-1 & PL 6… Psycho-diagnostics.
That also accompany by field visit, and practical's related to compulsory papers. The students can avail internship and field visit during the summer term breaks, for a period of 1 or 2 months.

Minimum 8 of the following:

1.	Maze Learning	3
2.	Stress Inventory	3
3.	Anxiety Scale	3
4.	Fear Checklist	3
5.	Aggression Scale	3
6.	Retroactive Inhibition	3
7.	Verbal test for Creative Thinking	3
8.	Ergograph	3
9.	Seguin Form Board Test	3
10.	Mirror Drawing Apparatus	3
11.	Home Environment Inventory	3
12.	Judging Emotions through Photograph	3

Course Outcome:

1 Understand difference between tests and experiments.
2 Evaluate the stress and anxiety.
3 Measure the fears of the subject.
4 Measure the emotions of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

Spring Semester

PL 20.602 **HEALTH PSYCHOLOGY** **4-0-0-4**

Total Lectures:52

Objective: The paper aims at providing an overview of the concept of health psychology.

Unit 1	**Health and Wellbeing:** Concept and indicators, medical and bio-psycho-social models of health; cross-cultural perspectives on health; Goals of health psychology; Approaches to health.	10
Unit 2	**Health Behaviour:** Role of behavioural factors in disease and disorders; Changing health habits ; Models and approaches to health behaviour change- cognitive, behavioural and social engineering approaches and transtheoretical model.	12
Unit 3	**Health Problems and their cognitive representation:** General and chronic health problems; causal factors and explanations, health belief systems; HIV/AIDS.	10
Unit 4	**Stress and Coping:** Conceptual models; Stress born health problems; Coping strategies.	10
Unit 5	**Management of health problems:** Preventive, promotive and curative aspects of health; choice of medicinal systems, patient- doctor relationship, treatment adherence, alternative medicines.	10

Course Outcome:

1. Understand the concepts of health psychology.
2. Analyze the role of healthy behavior.
3. Understand the approaches of health psychology.
4. Determine the importance of managing health problems.
5. Apply coping stategies.
6. Understand health problems and its cognitive representation.

Text Books:

1. Baum, A., Gatchel, R.J., &Krantz, D.S.(1997). *An introduction to health psychology*. New York: McGraw Hill.
2. Baum, A., Revenson,T.A., &Singer, J.E.(2001). *Handbook of health psychology*. Mahwah, NJ: Lawrence Erlbaum.

Reference Books:

1. Snyder, C.R. & Lopez, S.J., *Handbook of Positive Psychology*.N.Y.Oxford.
2. Wong.P.T. & Fry. *The Human Quest for meaning*. Mahwah, New Jersey. Lawrence, Erlbum.

PL 20.604	COUNSELING PSYCHOLOGY: APPROACHES AND APPRAISAL	4-0-0-4 Total Lectures:52
Objective:	To develop an understanding of approaches and appraisal of Counseling.	
Unit 1	**Psychoanalytic and Adlerian approaches**: Classical Psychoanalytic Theory – View of human nature, role of counselor, goals, techniques.	10
Unit 2	**Person Centered, Existential and Gestalt Approaches**: Carl Rogers – View of human nature, role of counselor, goals, techniques. Existential Counseling -Rollo May, Victor Frankl – View of human nature, Role of counselor, goals, techniques.	10
Unit 3	**Behavioral and Rational Emotive Therapies**: Becks; Allbert Ellis – View of human nature, Role of Counselor, Goals and techniques; Behavioral approaches – Views of human nature, Role of Counselor, goals, Techniques and Evaluation	10
Unit 4	**Indian Perspective**: Yoga and Meditation	10
Unit 5	**Counselee appraisal**: Autobiography, case study, interview, observation.	12

Course Outcome:

1. Understand the Psychoanalytic approaches of Counseling.
2. Understand the Alderian approach to counseling.
3. Apply the concept of person centered, existential amd Gestalt approaches to patients.
4. Analyze behabioural and Rational Emotive therapy of counseling.
5. Create awareness of the Indian perpective of counseling.
6. Understand counselee appraisal.

Text Books:

1. Gladding, T. Samuel. *Counselling: A Comprehensive Profession*. Prentice-Hall, New Jersey.
2. Belkin, G.S. (1988). Introduction to Counselling. W.G. : Brown Publishers.

Reference Books:

1. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
2. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy : Classics on Theories and Issues*. Science and Behavior Books Co.
3. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
4. Clough, P; Pardeck, J.T.; Yuen, F. (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.

PL 20.606	ASSESSMENT IN COUNSELING	4-0-0-4 Total Lectures:52

Objective: To develop an understanding of assessmet methods of Counseling.

Unit 1	**Nature of Psychological Assessment:** Interview and observation, taking case history, selection of tests, implications of psychological test results, ethics of psychological testing.	10
Unit 2	**Assessment of Aptitude:** Differential Aptitude Test, General Aptitude Test Battery; Assessment of Interests: Chatterjee's Non Language Preference Record. Intelligence : Wechsler's Adult Intelligence Scale-Revised, Bhatia's Performance Test of Intelligence.	10
Unit 3	**The Objective Assessment of Personality:** High School Personality Questionnaire, 16 Personality Factors, Eysenck's Personality Inventory. The projective assessment of personality Thematic Apperception Test, Rosenzweig Picture Frustration Study, Sentence Completion Test.	10
Unit 4	**Behavioral Techniques and Tests:** Behavioral Questionnaires, self-monitoring, problem checklist observation in natural environment.	10
Unit 5	**Report Writing:** Writing case study reports preparing a profile of individual and group career guidance in the report form.	12

Course Outcome:

1. Understand the nature of psychological assessment in coulseling.
2. Understand the apttitude assessment on counseling.
3. Apply the results and norms of various intelligence tests on patients.
4. Analyze various personality assessment techniques in counseling.
5. Create awareness of behavioral techniques and tests of counseling.
6. Understand report writing in counseling sessions.

Text Books:

1. Herr, E.L. Carmer S.H. (1998). Career Guidance and Counselling Through the Life Span. Systematic Approaches, 3rd edition, Scott, Foresman and Company London.
2. Murphy K.R. Davidshofer C.O. (1994). Psychology Testing Principles ad Applications. Prentice Hall of India, New Delhi.

Reference Books:

1. Nelson, J. (1982). *The Theory and Practice of Counselling Psychology*. New York : Holt Rinehart and Winston.
2. Ben, Ard, Hr. (Ed.) (1977). *Counselling and Psychotherapy : Classics on Theories and Issues*. Science and Behavior Books Co.
3. Brammer, L.M. and Shostrom, B.L. (1977). *Therapeutic Psychology : Fundamentals of Counselling Psychotherapy*. (3rd Ed.) (1977). Englewood Cliffs. : Prentice Hall.
4. Clough, P; Pardeck, J.T.; Yuen, F. (2005) *Handbook Emotional and Behavioral Difficulties*. New Delhi, Sage Publication.

PL 20.612 **PRACTICAL OF COUNSELING PSYCHOLOGY-II** **0-0-4-2**

Total Lab Classes: 26

Objective: To apply the concepts of psychology in real world. Assignments are based on the course Interventions in Guidance and Counselling and Areas of Counselling Psychology. That is also accompanied by field visit, and practicals related to compulsary papers. The students can avail internship and field visit during the summer term breaks, for a period of 1 or 2 months.

Minimum 8 of the following:

1.	Sodhi's Attitude Scale	3
2.	Parent Child Relationship Scale	3
3.	8SQ	3
4.	Family Environment Scale	3
5.	Dimensions of Friendship Scale	3
6.	Muller Lyer Illusion	3
7.	Sociometry	3
8.	Emotional Maturity	3
9.	16PF	3
10.	Experiment on memory	3
11.	Experiment on trial and error method of lesrning	3
12.	DAT	3

Course Outcome:

1 Understand difference between attitude and apttitude.
2 Evaluate the group preference.
3 Measure the personality of the subject.
4 Measure the emotional maturity of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL20.610 **ENGINEERING PSYCHOLOGY** **4-0-0-4**

Total Lectures:52

Objective: To develop an awareness of the concepts related to engineering psychology.

Unit 1	**Human engineering:** Scope and origin of engineering psychology; Importance of engineering psychology; Aim of engineering psychology.	10
Unit 2	**Man- Machine system**: Meaning of man- machine system; Design, display, control and action; Application of man- machine system.	10
Unit 3	**Working Conditions:** Concept of efficiency and work curve; Physical environment, noise, illumination, atmospheric conditions, music , rest, pauses; Working conditions and performance.	10
Unit 4	**Accidents and safety:** Definition of accident, risk taking behaviour and accident proneness; Human and economic cost of accidents; Causes of accidents; Individual, situational, organizational factors related to accident reduction; safety measures.	10
Unit 5	**Work and Fatigue:** Concept of work and fatigue; Work schedule; Methods of design; Monotony and boredom; Ways to reduce monotony and boredom; Industrial morale.	12

Course Outcome:

1. Understand human engineering.
2. Describe man-machine system.
3. Measure work efficiency.
4. Apply measures of safety at workplace.
5. Understand concept of work and fatigue.
6. Analyze effect personnel training on performance.

Text Books:

1. Tiffin J. and McCormic E.J. (1975).*Industrial Psychology,* 6th Ed ,Prentice Hall.
2. McCormick D.J. (1976). *Human Factors Engineering andDesign*. 4th Ed McGraw Hill

Reference Books:

1. Blum and Naylor. *Industrial Psychology*. CBS Publishers New Delhi.
2. Blum, Milton, L. *Industrial Psychology*, New Delhi: CBS Publishers.
3. Maier, N.R.F. (1970). *Psychology in Industry*, Oxford and IBH Publishing Co.

PL20.612	DYNAMICS OF ORGANIZATIONAL BEHAVIOUR- II	4-0-0-4 Total Lectures:52
Objective:	To develop an awareness of the dynamics of organizational behavior.	
Unit 1	**Organizational structure:** Meaning and issues of organizationalstructure**,** Work specialization, departmentalization, chain of command, span of control, centralization v/s Decentralization**,** Traditional organizational structure; The team structure, the virtual organization, the boundary less organization.	10
Unit 2	**Organizational culture:** Organizational culture meaning and definitionand related concepts**,** Perspective and topologies of organizational culture**,** Creating and sustaining culture.	10
Unit 3	**Organizational Change and development:** Nature and perspective ofchange**,** Levels of change, structure, technology and leadership**,** Types of change; organizational change as growth, transformation and as turn around**,** Resistance to change**,** Strategies to overcome resistance to change**,** Nature and importance of organizational development**,** Role, values and ethics of organizational development practitioners.	10
Unit 4	**Group Dynamics:** Meaning, nature and types of group, concept ofgroup dynamics and theories of group formation, group role, norms, decision making. Group cohesiveness and group conformity.	10
Unit 5	**Conflict and stress:** Meaning and types of conflict**,** Interpersonal andIntergroup conflict**,** Work-family conflict**,** Strategies for conflict resolution**,** Work stress; sources, consequences**,** managing stress: individual and organizational coping strategies.	12

Course Outcome:

1. Understand organizational structure.
2. Describe organizational culture.
3. Measure organizational change and development.
4. Apply measures of group dynamics at workplace.
5. Understand concept of work confilct.
6. Analyze effect stress on performance.

Text Books:

1. Robbins, Stephen. P., *Organizational Behaviour*, New Delhi, Oxford Uni. Press.
2. Luthans F, *OrganizationaBehaviour*, Prentice Hall of India pvt. Ltd. New Delhi.

Reference Books:

1. Pareek, U. *Understanding OrganizationaBehaviour*, Oxford University Press, New Delhi.
2. Steven, I. McShaneMarayann.VonGlinow, *OrganizationalBehaviour*, Tata McGraw Hill, New Delhi.
3. Nelson, D.B. and Quick J.C. (2005) *Understanding Organizational Behavior* (2nd Edition) South Western Thomson Learning.

PL 20.614 **PRACTICAL OF INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY-II** **0-0-4-2**
Total Lab Classes: 26

Objective: To apply the concepts of psychology in real world. Assignments are based on the courses Engineering Psychology, Dynamics of Organizational Behaviour-II. That also accompany by field visit, and practical's related to compulsory papers. The students can avail internship and field visit during the summer term breaks, for a period of 1 or 2 months.

Minimum 8 of the following:

1.	Sodhi's Attitude Scale	3
2.	Parent Child Relationship Scale	3
3.	8SQ	3
4.	Family Environment Scale	3
5.	Dimensions of Friendship Scale	3
6.	Muller Lyer Illusion	3
7.	Sociometry	3
8.	Emotional Maturity	3
9.	16PF	3
10.	Experiment on memory	3
11.	Experiment on trial and error method of lesrning	3
12.	DAT	3

Course Outcome:

1 Understand difference between attitude and apttitude.
2 Evaluate the group preference.
3 Measure the personality of the subject.
4 Measure the emotional maturity of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL 20.616 **PSYCHOPATHOLOGY-II** **4-0-0-4**

Total Lectures:52

Objective: The paper aims at providing an overview of the concept of diagnosis and the symptoms and etiology of various psychological disorders.

Unit 1	**Personality Disorders:** Meaning and types of personality disorders. Impulse-control disorders, substance related disorders (Alcoholic, and Nicotine).	11
Unit 2	**Psychoses:** Schizophrenia, affective (mood) disorders, delusional disorders and other forms of psychotic disorders – types, clinical features, etiology and management.	12
Unit 3	**Sexual disorders:** Etiology of sexual preferences, deviation and orientation disorder.	8
Unit 4	B**ehavioral, emotional and developmental disorders of childhood and adolescence:** Types, clinical features, etiology and management.	11
Unit 5	**Psychopathology of Old Age:** Process of aging; stress & coping; psychological disorders in old age; research and current trends in this field.	10

Course Outcome:

1. Understand the concepts of personality disorder.
2. Analyze etiology, symptoms, diagnosis, treatment of schizophrenia.
3. Understand the psychotic disorders.
4. Determine various emotional and developmental disorders.
5. Analyze etiology, symptoms, diagnosis, treatment of sexual disorders.
6. Understand psychopathology of old age.

Text Books:

1. Ahuja N (2002). *A short text book of Psychiatry* (5th edition). New Delhi. Jaypee Brothers.
2. American Psychological Association. (1998*). Diagnostic and statistical manual of mental disorders* (5th .ed.): text revision (DSM-1V-TR). New Delhi: Jaypee Brothers Medical Publishers (pvt) Ltd.

Reference Books:

1. Carson, R.C.; Butcher, J.N., et al. *Abnormal Psychology*; New Delhi: Pearson Education.
2. Davison, G.C. & Neale, J.M. *Abnormal Psychology*; New York: Willy.
3. Sadock, B.J. &Sadock, V.A. (2003). *Kaplan &Sadock's Synopsis of psychiatry: Behavioral sciences/clinical psychiatry* (9th. Ed.). Philadelphia: Lippincott Williams & Wilkins.
4. Sarason, I.G. and Sarason, B.R. *Abnormal Psychology: The Problem of Maladaptive Behavior* ; New Delhi: Pearson Education Inc.

PL 20.618 **PSYCHOTHERAPIES AND COUNSELLING** **4-0-0-4**

Total Lectures:52

Objective: The paper aims at providing an overview of the therapies used for psychological treatment.

Unit 1	**Introduction:** Meaning and nature of psychotherapy, goals of psychotherapy, types of psychotherapy, needs of psychotherapy, role of client-therapist relationship.	11
Unit 2	**Psychoanalytic Therapy**: Meaning and historical perspective, goals of psychoanalytic therapy, Freudian psychoanalytic therapy and its evaluation. Brief orientation to four psychoanalytic psychologies – Drive, ego, objects relations & self-psychology.	12
Unit 3	**Behaviour Therapy:** Meaning and nature of behaviour therapy, historical background, Techniques: Systematic desensitization, Aversive therapy, Implosive therapy, Flooding, Assertiveness training, Contingency management, and Biofeedback. Evaluation of behaviour therapy.	8
Unit 4	**Cognitive Behaviour Therapy:** Meaning and nature, Types of cognitive behaviour therapy- Rational emotive therapy, Beck's Cognitive therapy, Stress inoculation therapy, Social problem solving.	11
Unit 5	**Humanistic-Existential & transpersonal Therapies**: Nature and goals of Humanistic-Existential therapy, Client-centered therapy, Gestalt therapy, Logo therapy, Transpersonal therapy, Existential therapy, Evaluation of Humanistic-Existential & Transpersonal therapy.	10

Course Outcome:

1. Understand the concept of psychotherapy.
2. Analyze psychoanalytic theapy.
3. Understand the nature of behavior therapy.
4. Determine various cognitive behavior therapy.
5. Analyze humanistic-existential therapy.
6. Understand transpersonal therapy.

Text Books:

1. Feltham, C. (ed.) (1999). *Controversies in psychotherapy and counseling*. New Delhi: Sage.
2. Hecker,J.E., &Thorpe,G.L. (2005). *Introduction to clinical psychology: Science, practice, and ethics* (Low Price Edition). Delhi: Pearson Education.

Reference Books:

1. Ivey, A.E., Ivey, M.B., &Simek-Morgan, L. (1997). *Counseling and psychotherapy: A multicultural perspective* (4th ed.). Boston: Allyn& Bacon.
2. Palmer, S. (ed.). (1999). *Introduction to counseling and psychotherapy: The essential guide*. New Delhi: Sage.
3. Sundel,M., &Sundel,S.(1999). *Behavior change in the human services: An introduction to principles And applications* (4th ed.). New Delhi: Sage.
4. Todd, J., &Bohart, A.C. (1999). *Foundations of clinical and counseling psychology* (3rd Ed.).New York: Longman.

PL 20.620 **PRACTICAL OF CLINICAL PSYCHOLOGY-II** **0-0-4-2**

Total Lab Classes: 26

Objective: To apply the concepts of psychology in real world. Assignments are based on the courses Psychopathology-II & Psychotherapies &Counselling. That also accompany by field visit, and practical's related to compulsory papers. The students can avail internship and field visit during the summer term breaks, for a period of 1 or 2 months.

Minimum 8 of the following:

1.	Sodhi's Attitude Scale	3
2.	Parent Child Relationship Scale	3
3.	8SQ	3
4.	Family Environment Scale	3
5.	Dimensions of Friendship Scale	3
6.	Muller Lyer Illusion	3
7.	Sociometry	3
8.	Emotional Maturity	3
9.	16PF	3
10.	Experiment on memory	3
11.	Experiment on trial and error method of lesrning	3
12.	DAT	3

Course Outcome:

1 Understand difference between attitude and apttitude.
2 Evaluate the group preference.
3 Measure the personality of the subject.
4 Measure the emotional maturity of the subject.
5 Analyze, interpret and discuss the report on the basis of results and scores
6 Understand the usage of psychological tools in practice.

Text Books:

1. Manuals of above mentioned psychological tools.

Reference Books:

1. Ciccarelli, K. Saundra: *Psychology* Pearson, South Asian Edition
2. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. *Introduction to Psychology*. Tata McGraw-Hill, New Delhi.

PL 20.622 **DISSERTATION** **0-0-0-4**

Objective: The student has to submit two copies of dissertation by the first week of May in the department. It will be followed by presentation and viva-voce.

Course Outcome:

1 Enhance the ability of the student to use their knowledge of research, statistics, and evaluation methods to inform all areas of practice, from choosing appropriate methods for collecting information to making recommendations for interventions based on empirical evidence.
2 Formulate and identify null and alternative hypotheses in research
3 Define and give examples of independent variables, dependent variables, and scales of measurement.
4 Generate and interpret various types of graphical displays and tables from research data.
5 Differentiate between descriptive and inferential statistics
6 Analyze data using statistical software (SPSS)

Reference Books:

1 Latest APA manual for dissertation.