DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.TECH. ECE (SPECIALISATION IN ARTIFICIAL INTELLIGENCE AND CYBERNETICS) CURRICULUM STRUCTURE & SYLLABI (2023-2027 BATCH ONWARDS)

SCHOOL OF ENGINEERING AND TECHNOLOGY
MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH

B.Tech Electronics and Communication Engineering (Specialization in Artificial Intelligence and Cybernetics) Four Year Program
Academic Curriculum (2023-2027 Batch Onwards)

Curriculum Components

Component	Credits	Courses	
1. University Core (4 Courses)	06	UC 23.101 Human Values & Professional Ethics UC 23.102 Pragmatic English Communication UC 25.201 Management and Entrepreneurship	
2. University Elective (2 Courses)	06	Mody University Elective I Mody University Elective II	
3. Basic Science (8 Courses)	23	MA 23.101 Mathematics I CY 23.102 Environmental Sciences MA 23.102 Mathematics II MA 23.201 Mathematics-III PY 23.101 Engineering Physics CY 23.101 Engineering Chemistry PY 23.111 Physics Laboratory CY 23.111 Chemistry Laboratory	
4. Engineering Science (23 Courses)	45	ME 25.101 Applied Mechanics ME 23.111 Computer Aided Engineering Drawing ME 23.112 Mechanical Workshop EC 25.101 Basic of Electronics Engineering EE 25.101 Basic Electrical Engineering EE 19.203 Network Analysis and Synthesis CS 23.101 Programming for Problem Solving CS 23.102 Object Oriented Programming through C++ CS 23.205 General Purpose Programming CS 23.203 Data Structures CS 23.252 Advanced Programming Laboratory	CS 23.202 Advanced Programming EE 19.303 Control System Engineering CS 23.111 Programming Laboratory CS 23.112 Object Oriented Programming Laboratory CS 23.255 General Purpose Programming Laboratory CS 23.204 Database Management Systems CS 23.254 Database Management Systems Laboratory CS 19.253 Data Structures Laboratory CS 19.252 Object Oriented Programming Laboratory EE 19.223 Network Analysis and Synthesis Laboratory EC 23.111 Electronics Laboratory EE 23.111 Electrical Laboratory
5. Program Core (21 Courses)	46	EC 23.201 Electronics Devices and Circuits EC 23.206 Principles of Electromagnetics EC 23.221 Electronics Devices and Circuits Laboratory EC 23.202 Digital Electronics EC 23.204 Integrated Circuits and Applications EC 23.222 Integrated Circuits and Applications Laboratory EC 23.224 Digital Electronics Laboratory EC 23.301 Microprocessors and Microcontrollers EC 23.303 Principles of Analog Communication EC 23.305 Signal Processing and its Application	EC 23.323 Digital Signal Processing Laboratory EC 23.325 Microprocessor and Microcontroller Laboratory CS 23.302Artificial Intelligence and Machine Learning EC 23.341 Artificial Intelligence and Machine Learning Laboratory EC 23.302 VLSI Design EC 23.337 Cybernetics and its applications EC 23.306 Digital Communication EC 23.308 Antenna & Wave Propagation EC 23.322 VLSI Laboratory EC 23.324 Antenna Laboratory EC 23.326 Digital Communication Laboratory
6. Program Elective / MOOCs (5 Courses)	15	MOOC-01 Programme Elective – 04	
7. Project / Summer Internship Project (6 Courses)/PBL	21	Summer Internship Project -02 Technical Seminar – 01 Project -02 Capstone Project – 02 Project Based Learning	
8. Proficiency (Non-Credit / Non-Graded)	00	SEFS – 04	
Total	**162**		

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First Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P				MTE	ETE
UC 23.101	UC 23.101 Human Values & Professional Ethics	2	0	0	2	3	10	40	50
MA 23.101	Mathematics I	3	1	0	4	3	10	40	50
CY 23.101	Engineering Chemistry	3	0	0	3	3	10	40	50
EC 25.101	Basic of Electronics Engineering	3	0	0	3	3	10	40	50
CS 23.101	Programming for Problem Solving	3	0	0	3	3	10	40	50
ME 23.111	ME 23.111 Computer Aided Engineering Drawing	0	0	4	2	2	20	20	40
CY 23.111	Chemistry Laboratory	0	0	2	1	2	50	-	50
EC 23.111	Electronics Laboratory	0	0	2	1	2	50	-	50
CS 23.111	Programming Laboratory	0	0	4	2	2	50	-	50
CY 23.102	Environmental Sciences	2	0	0	2	3	10	40	50
PB 25.101	Project Based Learning	0	0	2	1	-	-	50	50
SF 101	Personal Grooming and Fine Dinning (Non Graded)	0	0	2	1	2	50		50
	Total	16	1	16	24				

First Year -Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
UC 23.102	Pragmatic English Communication	2	0	0	2	3	10	40	50
MA 23.102	Mathematics II	3	1	0	4	3	10	40	50
PY 23.101	Engineering Physics	3	0	0	3	3	10	40	50
ME 25.101	Applied Mechanics	3	0	0	3	3	10	40	50
EE 25.101	Basic Electrical Engineering	3	0	0	3	3	10	40	50
CS 23.102	Object Oriented Programming through C++	3	0	0	3	3	10	40	50
PY 23.111	Physics Laboratory	0	0	2	1	2	50	-	50
EE 23.111	Electrical Laboratory	0	0	2	1	2	50	-	50
CS 23.112	Object Oriented Programming Laboratory	0	0	2	1	2	50	-	50
ME 23.112	Mechanical Workshop	0	0	2	1	2	50	-	50
PB 25.102	Project Based Learning	0	0	2	1	-	-	50	50
SF 102	Social Grooming, Home & Décor and Business Communication (Non Graded)	0	0	2	1	2	50		50
	Total	17	1	12	23				

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Second Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P				MTE	ETE
MA 23.201	Mathematics-III	3	1	0	4	3	10	40	50
CS 23.205	General Purpose Programming	3	0	0	3	3	10	40	50
EC 23.201	Electronics Devices and Circuits	3	0	0	3	3	10	40	50
EC 23.205	Principles of Electromagnetics	3	0	0	3	3	10	40	50
EE 23.203	Network Analysis and Synthesis	3	0	0	3	3	10	40	50
CS 23.203	Data Structures	3	0	0	3	3	10	40	50
CS 23.253	Data Structures Laboratory	0	0	2	1	2	50	-	50
EC 23.221	Electronics Devices and Circuits Laboratory	0	0	2	1	2	50	-	50
EE 23.223	Network Analysis and Synthesis Laboratory	0	0	2	1	2	50	-	50
CS 23.255	General Purpose Programming laboratory	0	0	2	1	2	50	-	50
PB 25.201	Project Based Learning	0	0	2	1	-	-	50	50
SF 201	Personal Grooming, Fine Dining and Home Safety (Non Graded)	0	0	2	1	2	50		50
	Total	17	1	12	24				

Second Year -Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
UC 25.201	Management and Entrepreneurship	2	0	0	2	2	10	40	50
UE	University Elective-I	3	0	0	3	3	20		80
EC 23.202	Digital Electronics	3	0	0	3	3	10	40	50
EC 23.204	Integrated Circuits and Applications	3	0	0	3	3	10	40	50
CS 23.204	Database Management Systems	3	0	0	3	3	10	40	50
CS 23.202	Advanced Programming	3	0	0	3	3	10	40	50
EC 23.222	Integrated Circuits and Applications Laboratory	0	0	2	1	2	50	-	50
CS 23.254	Database Management Systems Laboratory	0	0	2	1	2	50	-	50
EC 23.224	Digital Electronics Laboratory	0	0	2	1	2	50	-	50
CS 23.252	Advanced Programming Laboratory	0	0	2	1	2	50	-	50
PB 25.202	Project Based Learning	0	0	2	1	-	-	50	50
SF 202	Social Grooming and Professional Skills (Non Graded)	0	0	2	1	2	50		50
	Total	17	0	10	22				

*Project Based Learning (PBL) will be conducted in the groups of 2-3 students.

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Third Year – Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P				MTE	ETE
EC 23.301	Microprocessor and Microcontroller	3	0	0	3	3	10	40	50
EC 23.303	Principles of Analog Communication	3	0	0	3	3	10	40	50
EC 23.305	Signal Processing and Applications	3	0	0	3	3	10	40	50
EC 23.337	Cybernetics and its applications	3	0	0	3	3	10	40	50
	Program Elective-1**	0	0	0	3		Based on MOOC exam Score		
EC 23.321	Analog Communication Laboratory	0	0	2	1	2	50	-	50
EC 23.323	Digital Signal Processing Laboratory	0	0	2	1	2	50	-	50
EC 23.325	Microprocessor and Microcontroller Laboratory	0	0	2	1	2	50	-	50
EC 23.329	Summer Internship Project-1***	0	0	0	2	-	100		
EC 23.331	Project-1	0	0	4	2		-	50	50
GE 25.301	Proficiency (Non-Credit, Non-Graded)	-	-	-	1		100		
	Total	15	0	12	22				

Third Year -Spring Semester								
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightag	
		L		P			CW	MTE
EE 23.303	Control System Engineering	3	0	0	3	3	10	40
EC 23.302	VLSI Design	3	0	0	3	3	10	40
CS 23.302	Artificial Intelligence and Machine Learning	3	0	0	3	3	10	40
EC 23.306	Digital Communication	3	0	0	3	3	10	40
EC 23.308	Antenna & Wave Propagation	3	0	0	3	3	10	40
EC 23.318	Technical Seminar	0	0	2	1			100
EC 23.322	VLSI Laboratory	0	0	2	1	2	50	-
EC 23.341	Artificial Intelligence and Machine Learning Laboratory	0	0	2	1	2	50	-
EC 23.324	Antenna Laboratory	0	0	2	1	2	50	-
EC 23.326	Digital Communication Laboratory	0	0	2	1	2	50	-
EC 23.328	Project-2	0	0	4	2		-	50
GE 25.302	Proficiency (Non-Credit, Non-Graded)	-	-	-	1			100
	Total	15	0	16	22			

**The course may be taken through MOOC. NPTEL/SWAYAM/Coursera will be the authorized platform for MOOC course. A minimum 8 week duration is required to earn 3 credits. After successful completion of this MOOC course, the student shall provide the successful completion status/certificate to the University (COE) through HOD/NPTEL/Coursera coordinator.

***Summer Internship Project-1 will be carried out during the summer vacation, specifically between the end of the second year and the start of the third year.

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Fourth Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P				MTE	ETE
UE	University Elective - II	3	0	0	3	3	20	-	80
	Program Elective-2	3	0	0	3	3	10	40	50
	Program Elective-3	3	0	0	3	3	10	40	50
EC 23.451	Capstone Project-1	0	0	4	2			50	50
EC 23.453	Summer Internship Project-2****	0	0	0	2		100		
	Total				**13**				

Fourth Year - Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P				MTE	ETE
	Program Elective-4	3	0	0	3	3	10	40	50
	Program Elective-5	3	0	0	3	3	-	50	50
EC 23.452	Capstone Project-2			12	6		100		
	Total				**12**				

List of Program Elective Options

Program Elective-1	
	MOOC
Program Elective-2	
CS 23.484	Big Data Analysis
CS 23.413	Distributed Databases
EC 23.457	Deep Learning: Principles and Practices
Program Elective-3	
EC 23.411	Transform Techniques
CS 23.431	Advanced Web Technologies
EC 23.461	Intelligent Robots and Drone Technology
Program Elective-4	
CS 23.493	Foundations and Applications of IoT
CS 23.495	Principles and Practices of Secure Computing
CS 23.465	Machine Learning using R
Program Elective-5	
CS 23.494	Software Defined Networking
EC 23.410	Adaptive Signal Processing
CS 23.464	Business Intelligence and its Application(Infosys)

****Summer Internship Project-2 will be carried out during the summer vacation, specifically between the end of the third year and the start of the fourth year.

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Credit Distribution across all Components								
Semester	**UC**	**UE**	**BS**	**ES**	**PC**	**PE**	**Project/SIP/Technical Seminar/PBL**	**Total**
First	2	0	10	11	00	00	1	24
Second	2	0	08	12	00	00	1	23
Third	0	0	04	12	07	00	1	24
Fourth	2	3	00	08	08	00	1	22
Fifth	0	0	00	00	15	03	4	22
Sixth	0	0	00	03	16	00	3	22
Seventh	0	3	00	00	00	06	4	13
Eighth	0	0	00	00	00	06	6	12
Total	8	6	22	48	46	15	17	**162**

UC	University Core
UE	University Elective
BS	Basic Science
ES	Engineering Science
PC	Program Core
PE	Program Elective / MOOC
Project/SIP	Project/Summer Internship

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UC 23.101 **Human Values and Professional Ethics** **Total Lectures: 26**
2-0-0-2

Objective: To create an awareness on professional ethics and human values, To instill moral and social values and loyalty and to appreciate the rights of others.

Pre-requisite:

1. **Introduction to Human Values:** Morals, Values and Ethics – Happiness & Prosperity Truth, Rights Conduct (Righteousness), Love, non-violence and peace, Humility and character. Core areas of ethics: Social ethics, Personal ethics Integrity and Trustworthiness, Honesty, Loyalty, Courage, Prudence, Confidence, Confidentiality. **[5]**
2. **Understand the Harmony:** Understanding the harmony as co-existing of self and body. Understanding myself, harmony in the family and society harmony in nature. **[4]**
3. **Professional Ethics:** Introduction, meaning of work ethics, professional ethics for Journalists, Physicians, Lawyers, Engineers and Accountants. Intellectual property Rights, scope of ethics, code of conduct, business values and inner consciousness, Ethics at the workplace cybercrime, plagiarism, misconduct, fraudulent use of institutional resources, etc. **[7]**
4. **Corporate Social Responsibility:** Evolution of Corporate Social Responsibility (CSR) in India, CSR models, CSR to different stakeholders, Corporate Social Responsibility Initiatives of Major Companies of India, Promoting value based governance in organization. Whistle blower policy. **[6]**
5. **Ethics and Environment:** Introduction to environmental Issues- Industry and Environmental Pollution, Ethics of Controlling environmental pollution – Impact of environmental pollution on human health – Rights, Duties and care in environmental protection - Sustainable development. **[4]**

Outcome: The students will understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories.

Text Books:
1. B.N Ghosh "Business Ethics and Corporate Governance", McGraw Hill Education, Chennai, 2016
2. John R Boatright, "Ethics And The Conduct Of Business", Pearson Education, New Delhi, 2013.

Reference Books:
1.Raju Ramachandran, "Professional Ethics: Changing Profession and Changing Ethics", LexisNexis, Butterworths, 2nd Edition 2014.
2.Andrew Crane and Dirk Matten, "Business Ethics", Oxford University Press, 2nd Edition, 2015.
3.S.K Mandal "Ethics in Business and Corporate Governance" McGraw Hill Education, New Delhi, 2013.
4.R. Subramanian "Professional Ethics", Oxford University Press, 2015.

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MA 23.101 **Mathematics I** **Total Lectures: 40**
3-1-0-4

Objective: To acquire fundamental knowledge of Mathematics and apply in engineering disciplines.

Pre-requisite:(10+2) Higher Secondary Mathematics

1. **Differential Calculus I:** Review of basic concepts, partial differentiation, different chain rules, second and higher order partial derivatives, Euler's theorem (with proof) on homogeneous functions and applications, Jacobians, properties of Jacobians. [07]
2. **Differential Calculus II:** Maxima and minima of functions of two variables, asymptotes (parallel and oblique), Tracing of simple Cartesian curves and standard polar curves. [07]
3. **Integral Calculus:** Basics of Beta and Gamma functions, Length of plane curves (Cartesian and polar), area bounded by the curves (Cartesian and polar), multiple integrals (double and triple), change of order of integration, physical interpretations and applications. [10]
4. **Matrix Theory**: Rank of matrix(elementary row transformations), linear dependence and independence of vectors, Solution of system of simultaneous linear equations, Eigen values, Eigen vectors of a matrix, Cayley-Hamilton theorem (without proof) and applications, diagonal and quadratic form of matrix.. [08]
5. **Three-dimensional Geometry:** Direction cosines and direction ratios of a straight line, equation of a plane, plane passing through intersections of two planes, equations of straight line, shortest distance between two skew lines, equation of a sphere, intersection of plane and sphere. [08]

Outcome: After completion of the course, students would be able to apply mathematical knowledge in engineering and solve curriculum problems.

Text Books:
1.Ramana B.V., Higher Engineering Mathematics, McGraw Hill Education, July, 2017.
2.Bali N. P. and Goyal Manish , A Text Book of Engineering Mathematics, Ninth Edition, Laxmi Publication, January 2016..

Reference Books:
1. Erwin Kreyszig Advanced Engineering Mathematics, 9th Edition, Reprint 2011.
2.Pal and Bhunia, Engineering Mathematics, Oxford University Press, 2015.
3.Dass and Verma, Higher Engineering Mathematics, S.Chand, 2019.

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CY 23.101 **Engineering Chemistry** **Total Lectures: 39**

3-0-0-3

Prerequisite(s): NIL

Objective(s):
- To purify the most valuable natural resource of the future-water.
- To understand one of the most versatile Engineering Materials: Polymers their preparation, properties and uses.
- To develop the basics of protecting engineering materials from the natural forces.
- To understand the present day up-to-date knowledge of the contemporary energy sources.
- To build up the basis of the future Engineering materials like superconductors, conducting organic polymers, Nano materials etc.

1. **Water treatment:** Hardness, types of hardness, degree of hardness and its estimation (EDTA methods). Numerical problems on degree of hardness. Boiler troubles: sludge and scale formation, Prevention of sludge and scale formation in boilers. Softening of hard water (Lime-Soda, Permutit, Ion Exchange and calgon methods). Numerical problems based on water treatment (Lime-Soda process). [8]

2. **Polymers and Phase Rule:** Industrial applications of Inorganic and organic polymers. Phase Rule and its application to water and Sulfur system. [8]

3. **Electrochemistry and Corrosion:** Electrochemical Changes, Electrochemical cell and its classifications (Galvanic cell, electrolytic cell). Types of electrodes. Origin of electrode potential, Electrochemical Series. Electromotive force, Nernst equation of electrode potential. [8]
Corrosion: Definition and its significance, Theories of corrosion, Mechanism of corrosion, types of corrosion, Corrosion control (Corrosion inhibitors, Cathodic protection - sacrificial anodic and impressed current cathodic protection).

4. **Fuels and Lubricants:** Introduction - Importance of fuels in Industries. Classifications of fuels, Comparison of solid, liquid & solid fuels, Calorific value of a fuel. Determination of calorific value by Bomb calorimeter. Refining and cracking of petroleum, knocking. Octane Number and Cetane Number. L.P.G., Coal gas and Producer gas. Lubricants: Introduction and Classification of Lubricants. Properties of Lubricants, Lubricant Oil, Grease, Emulsions. [9]

5. **New Engineering Materials:** Introduction: Superconductors, high and low temperature superconductors, organic electronic materials, Fullerenes and Nano materials, Industrial applications of fullerenes and Nano materials. [6]

Outcome(s): The student will be able to understand the basis of the future Engineering materials like of lubricants, superconductors, conducting polymers, Nano materials etc

Text Books:
1. Jain and Jain, "Engineering Chemistry," 16th Edition, Dhanpat Rai Publishing Company, 2015.
2. S.S. Dara, "A Text Book of Engineering Chemistry," 12th Edition, S. Chand & Company Limited, 2014.

Reference Books:
1. Peter Atkins, Julio de Paula, and James Keeler, "Atkins' Physical Chemistry" Eleventh Edition, Oxford University Press, 2017.
2. William D. Callister, "Materials Science and Engineering: An Introduction, Eighth Edition, John Wiley & Sons, Inc., 2010.

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EC 25.101 **Basics of Electronics Engineering** **Total Lectures: 40**

3-0-0-3

Prerequisite Basic Knowledge of Engineering and Applied Physics

Objective: To learn the fundamental principle and applicationsof electronics and communication engineering and devices.

1. **Introduction:** Introduction to electronic components and testing equipment's, Colour coding of resistors, types and functions of capacitors, basic concepts and uses of inductors. **[3]**

2. **Semiconductors**: Material and its properties, Formation of energy band diagram, Currents in semiconductors, Fermi-Dirac energy distribution, Types of semiconductors – Intrinsic and Extrinsic, Mass action law, Hall effect. **[7]**

3. **Diodes**: Introduction, Characteristic of ideal and real diode, Current components in diode, load characteristics, Breakdown in diode, Zener diode, Varactor diode, Tunnel diode, Clippers and Clampers, Rectifiers – Half and Full-wave rectifiers. **[10]**

4. **Transistors:** Introduction to pnp and npn transistors, current components, active, cutoff and saturation regions, CC, CB and CE configuration, Operating point, Biasing circuits, Bias Stability, Thermal runway and thermal stability. **[10]**

5. **Introduction to Signals and Communication Systems**: Definition, Classification of signals – Analog and Digital, Deterministic and Random signals, Power and Energy of signals, Bandwidth, Bit and Baud rate. Block representation of communication system, Modulation – Definition, Need of modulation, Types of modulation. **[10]**

Outcome: After completion of this course, students would be able to :

11. Distinguish between conductors, semiconductors and insulators based on energy band theory and classify different types of semiconductors.
12. Employ the concept of Energy Band Theory and Fermi Levels to explain the operating principle of semiconductors.
13. Demonstrate the operating principle and characteristics of p-n junction diodes, different diode circuits and Transistors.
14. Understand various types of communication signals and its characteristics parameters.
15. Understand the basic concepts of communication system and modulation techniques..

Text Books:

3.George Kennedy, Bernard Davis, "Electronics Communication Systems", Tata McGraw-Hill, 3rd Edition, 2007.

2. Behrouz Forouzan, "Data Communication and Networking", McGraw-Hill, 4th Edition, 2006.

Reference Books:

1. David A. Bell, "Electronics Devices and Circuits", PHI, 4th edition, 2008.

2. Wayne, Tomasi, "Advanced Electronic Communication Systems", PHI, 6th edition, 2013. 3. Robert L. Boylestad, Louis Nashelsky, "Electronics Devices and Circuits Theory", Prentice Hall, 10th Edition, 2009.

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CS 23.101 **Programming for Problem Solving** **Total Lectures: 40**

Credit: 3-1-0-4

Prerequisite(s): NIL

Objective(s):
1. To learn principles of programming by the structured native language 'C'.
2. To comprehend the rudiments, constructs, syntax, and statements with essentials of efficient compiling, running and debugging processes.

1.Introduction: The role of programming languages, programming paradigms, language description and syntax structure, basics of structured and object-oriented programming, functional programming, logic programming, concurrent programming, algorithm, flowchart. [5]

2.Fundamentals of 'C' language: Character set, variables data types constants, arithmetic,relational and logical operators, type conversion,increment,decrement, bitwise and assignment operators, conditional expressions, statements and blocks, if-else,switch, loops-do-while, while, for; break, continue and goto statements, labels. [10]

3.Functions, pointers and Arrays: Basics of functions, storage classes, scope rules, and header files, recursion and C preprocessor, arrays, pointers and addresses, types of pointers, pointers and arrays address arithmetic, character pointers and functions, pointer arrays, pointers to functions,function returning pointer, pointer to array, array of pointers, and multidimensional arrays, command line arguments, dynamic memory allocation-malloc(), calloc(), realloc(), free(). [13]

4.Structures and unions: Basics of structures and functions, arrays of structures, pointers to structures,passing structure to function, function returning structure,union, self-referential structures. [6]

5.I/O and File Processing: Concept of files, standard input and output, formatted output, file access in different modes, reading from and writing to a file, random access file operations. [6]

Outcome(s): Students would be able to apply learning and knowledge of C language analytically, critically and logically to solve mathematical, scientific and real-life problems in an efficient manner.

Text Books:
- Brain W. Kernighan and Dennis M. Ritchie, The C Programming Language, Pearson Education.
- Ravi Sethi &K.V. Viswanatha, Programming Languages-Concepts, and Constructs, Pearson Education.

Reference Books:
- Herbert Schildt, C: The Complete Reference, Fourth Edition, McGraw-Hill Education,
- E Balagurusamy, Programming in ANSI C, Tata McGraw - Hill Education,

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ME 23.111 **Computer Aided Engineering Drawing** **Total Hours: 26**
0-0-4-2

Objective:
- To improve the visualization skills.
- To enable the students with various concepts like dimensioning, conventions and standards related to working drawings, projections in order to become professionally efficient.
- To impart the knowledge on understanding and drawing of simple engineering products.

1. **Introduction to Computer Aided Sketching:** Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practice. Board Drawing vs. Computer- Aided Drawing. Introduction to Solid works Environments. Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP &LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, dimensioning, line conventions, material conventions and lettering. [8]
2. **Orthographic Projections** : Horizontal planes, Vertical planes, Front view, Top view, Side view, Projections, First and Third angle of projection, Projections of points, Principles of orthographic projections, Sketching of different views of given objects. Introduction to sketching in Solid works : 2-Dimenional Sketching, Sketching in Solid works, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. [12]
3. **Projections of Lines, Planes and Solids:** Lines inclined to both the principal planes, projection of Lamina inclined to both principal planes, Projections of solids: Axis inclined to both the reference planes and Intersection of solids. Introduction to part module in Solid works: Extrude, Revolve, Sweep, Hole, Filleting, and Chamfering features. [12]
4. **Sections of solids and sectional orthographic views:** Sectional orthographic projections - Full, Half, Partial, revolved and removed surfaces. Introduction to drawing module in Solid works: Standard 3 views, Auxiliary view, Section View, Projected view. [12]
5. **Isometric Projection:** Terminology, Isometric scale, Box method, Coordinate or offset method, Four-center method, isometric projection of arcs. Solid models practice using Solidworks part module. [8]

Outcomes:
1. Students will be able to improve their visualization skills so that they can apply these skills in developing new products.
2. Students will be able to know and understand the conventions and the methods of engineering drawing using Solid works.
3. Students will be able to prepare simple drawings of engineering products.

Text
1. N.D. Bhatt, "Engineering Drawing", Charotar Publishing House, 2013.

Books: 2.Prof. Sham Tickoo, Sandeep Prem Dass "Solid works 2013 for Engineers and Designers" Wiley Publication, 2013.

Reference Books: 1.Randy H. Shih, "Solid works 2013 and Engineering Graphics: An Integrated Approach", SDC Publications. 2013

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CY 23.111 **Chemistry Laboratory** **Total Hours:26**
0-0-2 - 1

Prerequisite(s): NIL

Objective(s): • To introduce students to water chemistry and purify the most valuable natural resource of the future-water.

•To understand one of the most versatile Engineering Materials: Polymers, lubricants, fuel and their properties and uses.

LIST OF EXPERIMENTS

Choice of 10-12 experiments from the following

1.To determine the temporary and permanent hardness in the given water sample by complex metric titration using EDTA as standard solution.
2.To determine the percentage of Available Chlorine in the given sample of Bleaching powder. Iodometrically.
3.To determine the alkalinity of water sample.
4.To prepare urea formaldehyde resin.
5.To determine the strength of given HCl solution by titrating it against NaOH solution using pH meter.
6.To determine the strength of given acid solution by titration it against sodium hydroxide solution using conductometer.
7.To determine molecular weight of a polymer using Ostwald viscometer.
8.Determination of viscosity of given lubricating oil by Redwood viscometer.
9.Determination of cloud and pour point of given lubricating oil.
10.Determination of the flash and fire point of given lubricating oil.
11.Determination of phase diagram of water system.
12.To determine the calorific value (HCV) of a sample of fuel.

Outcomes The students will learn to:

- Estimate the Hardness of water, alkalinity of water.
- Familiar with the important practical applications of electrochemistry, lubricants, solids, their properties and applications, and the polymer materials.

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EC 23.111 Electronics Laboratory 0-0-2-1

Pre-requisite: Basic Understanding of Engineering Physics and Electronics.

Objective:
- To gain practical knowledge by applying the experimental methods to correlate with the theory of Electronics Engineering.
- To apply the analytical techniques and graphical analysis to the experimental data.
- To enable the students to simulate and test the Electronics circuits using Multisim software.

Practical to be performed on Hardware:

1.Familiarity of Soldering/de-soldering process, Component identification, testing and their verification using multimeter.

2.To plot V-I characteristics of junction diode and Zener diode.

3.To design a half wave rectifier with and without filter circuit and find the ripple factor.

4.To design a full wave rectifier with and without filter circuit and find the ripple factor.

5.Study of clipper and clamper circuits and their implementation on breadboard.

6.To plot the characteristics of Transistor under Common Emitter configuration

Practical to be performed using MultiSim Software:

7.To verify Ohm's law and Kirchhoff's law.

8.To simulate half wave and full wave bridge rectifier.

9.To plot V-I characteristics of p-n junction diode.

10.To plot V-I characteristics of Zener diode

11.Study of clipper circuit and its implementation on Multisim.

Outcome: After performing the above experiments, student will be able to :
- Identify and describe basic electronic components used in circuits.
- Build and configure basic electronic circuits using breadboards.
- Analyze the voltage-current characteristics of p-n junction diodes, Zener diodes and Transistor.
- Develop clipper and clamper circuits to achieve desired voltage waveforms.
- Utilize Multisim software to simulate and validate circuit designs.

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CS 23.111 **Programming Laboratory** **Total Hours:26**
Credit: 0-0-2-1

Prerequisite(s): NIL

Objective(s):

- To make students familiar with syntax and structure of C-programming.
- To learn problem solving techniques using C programs implementation.

List of Practicals

1.Implement the logic of Data Types & Operators.
2.Implement the logic of Type Conversions.
3.Implement the logic of Arithmetic, Relational, and logical operators.
4.Implementation of Bitwise, unary, assignment operators.
5.Implementation of Increment and Decrement operators.
6.Implementation of Conditional operators.
7.Implement the logic of Increment and Decrement operators.
8.Implement programs in order to cover Control Structure, If-Else statements, Nested If-Else statements, Switch-case statement, Loops- For, While, Do-While, Break Continue, Go-To Statements, and Labels.
9.Implement programs in order to cover processing an array, passing arrays to functions, Multidimensional arrays.
10.Implement programs to cover all possible String operations.
11.Implement programs in order to cover Function prototypes and passing arguments to a function, Recursion.
12.Implement programs in order to cover Pointers declaration, operations on pointers, Array of pointers, pointers to arrays.
13.Implementation of structure and union programs.
14.Implement the use of Storage classes in C programming.
15.Implement programs for Reading and writing from/to a file.
16.Implement random access file operation.

Outcomes

On completion of this course student will be able to:

- Apply learning and knowledge of C language analytically, critically and logically to solve mathematical, scientific and real-life problems in an efficient manner

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CY 23.102 Environmental Sciences

Total Lectures: 26
2-0-0-2

Objective: • To teach the principal resources, renewable energy systems and biosphere. •To explore the environmental impact of various energy sources and also the effects of different types of pollutants.

Pre-requisite: Nil

1. **Basic concepts of Eenvironmental Studies:** Definition, scope and importance**,** [4] Multidisciplinary nature of environmental studies, Need for public awareness. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.
2. **Natural Resources:** Renewable and non-renewable resources. **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies. **Forest resources:** Use and over exploitation, deforestation, case studies. **Land resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification. **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, [6]
3. **Ecosystems & Biodiversity:** Concept and Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow and nutrient cycling in the ecosystem. Food chains, food webs and ecological pyramids. Biodiversity and its conservation: Introduction – Definition, genetic, species and ecosystem diversity. Threats to biodiversity: habitat loss, illicit poaching, man-wildlife conflicts. [5]
4. **Environmental Pollution:** Definition, cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear Radiation. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides. [6]
5. **Social Issues, Population and impacts of Environmental impacts:** Urban problems related to energy, Resettlement and rehabilitation of people, Global Climate Change, global warming, acid rain, ozone layer depletion. Wasteland reclamation. Population growth, variation among nations. Population explosion, Environment and human health. Human Rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies. Environment Protection Acts. [5]

Outcome: At the end of this course, students will demonstrate the ability to

- Evaluate local, regional and global environmental topics related to resource use and management
- Propose solutions to environmental problems related to resource use and management.

Text Books:
1. Erach Bharucha "Environmental Studies", University Grants Commission, 2004.
2. Anubha Kaushik, C P Kaushik "Perspectives In Environmental Studies" New Age International Publishers. 2018

Reference Books:
1. C. William, P. Saigo, B Woodworth, "Environmental Science: A Global Concern", Sixth Edition McGraw-Hill Higher Education, 2001.
2. Botkin, and Keller, "Environmental Science" Wily Publication, 2012.
3. R.T. Wright, D.F. Boorse, "Environmental Science" 11th Edition, PHI, 2010.

UC 23.102 **Pragmatic English Communication** **Total Lectures: 26**
2-0-0-2

Objective: This course aims to develop and enhance the linguistic and communicative competence of the students. The students will be exposed to various forms of personal and professional communication. The self-learning tasks designed will facilitate to enhance effective communication skills.

Pre-requisite: Basic knowledge of English grammar.

1. **Sentence Structure:** Elements of a sentence (Subject, verb, object, complement and adjunct) **Correct Usage of Language:** Tenses (Present, Past and Future, Modals (can, could, will, would, shall, should, may, might, must, ought to, need). [7]

2. **Listening and Reading Skills:** Developing effective listening and reading. **Writing Skills:** Theme (Paragraph) writing, Letter (formal letters) and application writing, report writing, résumé writing [6]

3. **Idioms and Phrasal Verbs:** Understanding idioms, collocations, introduction to phrasal [5]

4. **Common Errors:** How to avoid common sentence – structural errors, vocabulary and pronunciation [3]

5. **Technology-based Communication:** Effective e-mail messages; power-point presentation; enhancing editing skills using computer software. [5]

Outcome: The students will learn the essentials of English Grammar, analyze, identify and rectify the common errors in speech and writing. Student can read and write with ease and fluently, enrich vocabulary and enjoy reading and writing.

Text Books:
1. Wren & Martin: English Grammar & Composition, S. Chand & Co, Delhi (Latest edition)
2. Raman, M., & Singh, P. (2017). Business Communication (2nd edition.). New Delhi: Oxford University Press.

Reference Books:
1.Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited
2.Bonet, Diana. The Business of Listening: Third Edition. New Delhi: Viva Books, 2004.
3.Hornby A.S.: A Guide to patterns and usage, Oxford University Press, Delhi, 1954.
4.Lesikar, Raymond V and Marie E. Flatley. Basic Business Communication: Skills for Empowering the Internet Generation: Ninth Edition. New Delhi: Tata McGraw-Hill

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MA 23.102 **Mathematics II** **Total Lectures: 40**
3-1-0-4

Objective: To acquire fundamental knowledge of Mathematics and apply in engineering disciplines.

Pre-requisite: Mathematics I (MA 23.101)

1. **Computational Methods:** Calculus of finite differences, Forward, Backward and Shift operators and their relationship, Fundamental theorem of difference calculus (without proof), Factorial function, Interpolation schemes for equal intervals (Newton's forward and backward interpolation formulae), divided difference, interpolation for unequal intervals (Newton's divided difference and Lagrange interpolation formulae), Approximation of one real root of Algebraic and Transcendental equations by Newton-Raphson method.. [12]
2. **Ordinary Differential Equations I:** Definition, order and degree of differential equation, first order and first degree differential equations (variable separable, homogeneous, reducible of homogeneous, linear, Bernoulli and exact differential equations). [07]
3. **Ordinary Differential Equations II:** Linear differential equations of second order with constant and variable coefficients, general and particular solutions (complementary functions and particular integrals), and applications. [07]
4. **Partial Differential Equations:** Formation of partial differential equations, Lagrange's multipliers method for solution of first order differential equations, separation of variables for nonlinear differential equations(general and particular solutions) and applications. [06]
5. **Vector Calculus:** Vector and scalar point functions, conservative fields, gradient of scalar point functions, divergence and curl of vector point functions (Solenoidal and irrotational vectors), directional derivative of scalar point functions, line integral (work done), surface integral, volume integral, interpretations and applications. [08]

Outcome: After completion of the course, students would be able to apply mathematical knowledge in engineering and solve curriculum problems.

Text Books:

1. Ramana B.V., Higher Engineering Mathematics, McGraw Hill Education, July, 2017.
2. Bali N. P. and Goyal Manish , A Text Book of Engineering Mathematics, Ninth Edition, Laxmi Publication, January 2016.

Reference Books:

1. Erwin Kreyszig Advanced Engineering Mathematics, 9th Edition, Reprint 2011.
2. Pal and Bhunia, Engineering Mathematics, Oxford University Press, 2015.
3. Ram Babu, Engineering Mathematics, Pearson Education, First Edition, January 2009.

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PY 23.101 **Engineering Physics** **Total Lectures: 40**

3-0-0-3

Pre-requisite: Fundamental knowledge of Basic Physics

Objective:
1.To provide students with a basic understanding of the Physics that may be required by engineers in the course of their careers.
2.To enhance knowledge related to lasers and optical fiber and its different components to make it suitable for various purposes.
3.To introduce the learners to the basics of modern physics and Quantum Mechanics.

1. **Modern Physics**: Introduction to Black body radiation spectrum, Photo-electric effect, Compton effect. Wave particle Dualism. de Broglie hypothesis – de Broglie wavelength. Davisson and Germer Experiment. Matter waves and their Characteristic properties, Phase velocity, group velocity and **[8]** Particle velocity, Relation between phase velocity and group velocity, Relation between group velocity and particle velocity.

2. **Quantum Mechanics:** Heisenberg's uncertainty principle and its physical significance. Application of uncertainty principle (Non-existence of electron in the nucleus, explanation for decay and kinetic energy of electron in an atom). Wave function, Properties and physical significance of wave function, Probability density and Normalization of wave function. Setting up of one dimensional time independent Schrodinger wave equation. Eigen values and Eigen functions. Application of Schrodinger wave equation – Energy Eigen values for a free particle. Energy Eigen values and Eigen functions for a particle in a potential well of infinite depth. **[7]**

3. **Electrical Conductivity in Metals**: Free–electron concept. Classical free-electron theory-Assumptions. Drift velocity, Mean collision time and mean free path. Relaxation time. Expression for drift velocity. Expression for electrical conductivity in metals. Effect of impurity and temperature on electrical resistivity of metals. Quantum free-electron theory – Assumptions. Fermi – Dirac Statistics. Fermi-energy, Fermi factor. Density of states (No Derivation). Expression for electrical resistivity/ conductivity. Temperature dependence of resistivity of metals. Electron in a periodic potential, origin of the energy gap, band theory of solids, distinction of solids into metals, semi-conductors and insulators. **[8]**

4. **Dielectric & Magnetic Properties of Materials**: Dielectric constant and polarization of dielectric materials. Types of polarization. Equation for internal field in liquids and solids (one dimensional). Ferro and Piezo electricity. Frequency dependence of dielectric constant. Important applications of dielectric materials. Classification of dia, para and ferro-magnetic materials. Hysteresis in ferromagnetic materials. Soft and Hard magnetic materials. Applications. **[7]**

5. **Lasers and Optical Fibers**: Einstein's coefficients (expression for energy density). Requisites of a Laser system. Condition for laser action. Principle, Construction and working of CO_2 laser and semiconductor Laser. Applications of Laser – Laser welding, cutting and drilling. Propagation mechanism in optical fibers. Angle of acceptance. Numerical aperture. Types of optical fibers and modes of propagation. Attenuation. Applications–Block diagram discussion of point to point communication. **[10]**

Course Outcome:
After completion of this course, students will be able to :
1.Understand the experimental evidence supporting the de Broglie hypothesis and the wave-particle duality of matter.
2.Explain fundamentals of quantum mechanics and apply to one dimensional motion of particles.

3.Describe the band theory of solids.
4.Understand material properties to use in engineering applications and studies.
5.Illustrate the working of lasers and optical fibers.

Text Books: 1. S. O. Pillai, “Solid State Physics”, New Age International, Sixth Edition, 2009

2. V. Rajendran, “Engineering Physics,” TMH, Fifth Edition , 2013

Reference Book: 1.Arthur Beiser , “Concepts of Modern Physics" , McGraw-Hill Education, 2003

2.Stephen T. Thornton, “Modern Physics for Scientists and Engineers”,Cengage Learning, 4th ed.,2013

3.Halliday D., Resnick R. and Walker J., “Fundamentals of Physics”, Wiley Publications, 2008

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ME 25.101 **Applied Mechanics** **Total Lectures: 40**
3-0-0-3

Prerequisite Basic Mathematics and Physics

Objectives:
- This course will help the student to acquire knowledge of basic engineering mechanics concepts and enhance their ability to solve open ended engineering problems.
- To provide the student with a clear and thorough understanding of the theory and applications of engineering mechanics, covering both statics and dynamics.

1. Introduction: Idealization of Mechanics, concept of Rigid Body, External Forces, Laws of Mechanics. Force systems, Moment of force, Moment of a couple, Equivalent system, Free Body Diagram, Equations of equilibrium and their applications to various systems of forces. **[12]**

2. Distributed Forces and Moment Of Inertia: Centroid of Composite figures, Area Moment of Inertia, Mass Moment of Inertia, and Principle Moment of Inertia. **[7]**

3. Friction: Introduction of friction, Laws of friction, wedge, screw, belt friction. **[7]**

4. Tension, Compression and Shear: Normal stress and strain, Hooke's Law and Poisson's Ratio, Stress-Strain diagram, Shear stress and shear strain, **[9]**
Beams: Different support & load conditions, SFD and BMD of different beams with point and distributed load.

5. Kinematics of Particles: Introduction, Rectilinear motion, Plane curvilinear motion, Rectangular coordinates, Relative motion **[5]**
Kinetics of Particles: Introduction, Force, Mass and acceleration, Newton's second law of motion, Equation of motion and solution of problems, Work and Energy, Impulse and Momentum.

Outcome:
1 Evaluate forces in various frames of structural members
2 Understand and Apply the concept of drawing free body diagram
3 Apply the concept of friction in engineering applications
4 Calculate the centroid and moment of inertia in various sectional components and apply this to real life examples
5 Understand and evaluate for internal forces
6 Understand the importance of kinetics and kinematics in mechanics and apply the principles to various frames

Text Books:
1.Hibbeler, Gupta R. C., "Engineering Mechanics," Pearson India, Latest Edition.
2.Merian, J.L, Kraige, L.G., "Engineering Mechanics Vol I & II," Wiley India Latest edition.

Reference Books:
1.Timoshenko, S, Young, D.H, Rao, J.V, "Engineering Mechanics," 4th edition TMH, 2010.
2.Irving. H. Shames, "Engineering Mechanics," Prentice Hall Book Company.

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EE 25.101 **Basics of Electrical Engineering** **Total Lectures: 40**
3-0-0-3

Objective: This course facilitates the students to get a comprehensive exposure to various concepts and devices of electrical networks and engineering.

Pre-requisite: Nil

1. **DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation using: Mesh and Nodal method, Network Theorems - Superposition, Thevenin, Norton and Maximum power transfer Theorems. Star-Delta Conversion. [8]

2. **AC Circuits:** Basic terminologies, representation of sinusoidal waveforms, average, rms and peak values of a.c. quantities, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). [8]

3. **Three Phase A.C. Circuits:** Three phase supply, phase sequence, star connection, delta connection, relationship between phase and line quantities in 3-phase circuits, measurements of three phase power under balanced condition. [6]

4. **Transformers:** Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, Transformer testing: open circuit and short circuit test, losses in transformers, regulation and efficiency. Basics of auto-transformer and three-phase transformer connections. [10]

5. **Electrical Machines:** DC Machines – construction, functions of each part, working principle, EMF and torque equations, types of dc machines. Single Phase AC machines, AC machines – classification (Split phase machines, universal machines), construction, operating principles of ac machines. [8]

Outcome: At the end of this course, students will demonstrate the ability to

- To understand and analyse basic electric and magnetic circuits.
- To study the working principles of electrical machines.

Text Books:

1.Kothari, D. P., and I. J. Nagrath, "Theory and Problems of Basic Electrical Engineering," PHI Learning Pvt. Ltd., 1998.
2.Fitzgerald, Arthur Eugene, David E. Higginbotham, and Arvin Grabel, "Basic electrical engineering," McGraw-Hill Series in Electrical Engineering, Auckland: McGraw-Hill, 1981, 5th ed.(1981).

Reference Books:

1.H. Cotton, "Advanced Electrical Technology," CBS Publication. 1967.
2.Vincent Del Toro, "Electrical Engineering Fundamentals," 2nd Edition PHI Publication. 1972.
3.Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", PHI Publication, 1st Edition, 2007.

CS 23.102 **Object Oriented Programming through C++** **Total Lectures: 40**

Credit: 3-0-0-3

Prerequisite(s): Programming for problem Solving

Objective(s):

- To familiarize the students with basic concepts of object oriented Programming and developer tools.
- To present the syntax and semantics of the C++ Programming.

1.Object Oriented Programming: Basic concepts of object–oriented Programming, Structured versus object-oriented programming, merits and demerits of object oriented methodology. [6]

2.Beginning With C++: Preprocessor directives, variables, data types, constants, operators, scope resolution operator, memory management operators, decision and loop controls, arrays, strings, function, inline function. [6]

3.Classes And Objects: Class definition, structure versus class, access specifiers, accessing member functions within a class, data hiding, arrays within a class, static data and member functions, objects, friend functions and friend classes, constant member functions, pointers to members, constructors and destructor. [8]

4.Overloading and Exception Handling: Definition, unary operator overloading, binary operators overloading, overloading of new and delete operators, manipulation of string using operators, type conversion, overloading with friend functions, function overloading, error and exception handling. [8]

5.Inheritance and Overriding: Derived and base classes, type of inheritance, derived class constructors and destructor, overriding member functions, visibility modes public protected and private inheritance, virtual base classes, abstract classes, this pointer, virtual functions and pure virtual functions, static and dynamic bindings, I/O Streams and The Standard Library: Header files, I/O stream library, stream I/O for objects, File I/O [12]

Outcome(s): At the end of course, students have a good understanding about the concept of object-oriented programming using C++ and able to write and read C++ code for real world applications.

Text Books:

- HerbertSchildt,"C++:The Complete Reference", TMH
- Robert Lafore, "Object-Oriented Programming in C++", SAMS

Reference Books:

- Bjarne Stroustrup, "Programming-Principles and PracticeUsing C++",Addison- Wesley.
- E.Balagurusamy,"ObjectOriented Programming With C++",TMH

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PY 23.111 **Physics Laboratory** **0-0-2-1**

Objective:
1. To gain practical knowledge by applying the experimental methods to correlate withthe Physics theory.
2.To apply the analytical techniques and graphical analysis to the experimental data.

Pre-requisite: Nil

List of Experiments:

1. To study of material constant, temperature coefficient of current and planck's constant.

2. To determine the specific resistance of a given wire by using the Carey Foster's bridge.

3. To measure the numerical aperture of an optical fiber.

4. To measurement the cylindrical object of diameter with help of Screw gauge and Vernier caliper.

5. To study the variations of resistivity with temperature and hence determines the energyband gap of the given semiconductor with help of four probe method.

6. To convert a galvanometer into a voltmeter of a given range.

7. To convert a galvanometer into an ammeter of a given ranges.

8. To plot graph showing the variation of magnetic field with distance along the axis of a

Outcome:

1. Students will be convergent with operation of equipments and verify the principle of Physics by doing the experiments.

2. Understand the concepts and principles related to material constants, temperature coefficients, and Planck's constant.

3. Analyze the collected data to determine the specific Resistance using Carey Foster's Bridge.

4. Perform measurements and data analysis to determine the numerical aperture of the optical fiber accurately.

5. Gain hands-on experience in measuring and plotting the magnetic field variation along the axis of a circular coil carrying current.

6. Develop the ability to convert a galvanometer into an ammeter and voltmeter.

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EE 23.111 **Electrical Laboratory** **Total Hours: 26**

0-0-2-1

Objective: The objective is to provide a basic exposure of installation and operation of electrical equipment.

Prerequisite: Nil

Perform any ten of the list.

1. To Study of the various apparatus used in Electrical Engineering.
2. To perform residential house wiring using fuse, indicator, switch, Socket, plug and lamp.
3. To design a Stair case wiring for illuminating three lamps.
4. To conduct the open circuit tests on the given single phase transformer and to determine equivalent circuit parameters.
5. To conduct the short circuit tests on the given single phase transformer and to determine equivalent circuit parameters.
6. To construct a fluorescent tube and to measure voltage across tube rod, voltage across choke and current.
7. To conduct the polarity test on the given transformer.
8. To control the speed of DC machine by field current control method.
9. To control the speed of DC machine by Armature Voltage control method.
10. To measure three phase power by using two wattmeter methods.
11. To verify Superposition Theorem using resistive circuit.
12. To verify Thevenin's Theorem using resistive circuit.

Outcome: Students will be convergent with installation and operation of electrical equipment.

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CS 23.112 **Object Oriented Programming Laboratory** **Credit: 0-0-2-1**

Prerequisite CS 23.111 (Programming Laboratory)

Objective: The objective of this lab is to provide students with an understanding of the fundamental concepts in object oriented programming and to provide the skills needed for developing the software application.

1.Understand the basics of C++ library, variables, data input-output.

2.Implement class and object concepts

3.Implement the concept of polymorphism using function overloading.

4.Implement code to understand friend function and friend class

5.Program to understand different types of constructors and destructor.

6.Programs to understand the usage of constant data member and member function, static data member and member function in a class.

7.Implement different types of inheritance

8.Implement overriding and virtual function.

9.Implement Operator overloading concepts.

10.Write programs to understand function template and class template.

11.Write programs to understand exception handling techniques.

12.Write programs to understand file handling techniques.

Outcomes: Upon completion of the course students will have knowledge of the underlying the static member, friend function, operator overloading, exception handling, inheritance and polymorphism in object oriented programming application.

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ME 23.112 **Mechanical Workshop** **Total Hours:26**
0-0-2-1

Objectives:

1. Practice on manufacturing of components using workshop trades including fitting, carpentry, sheet metal and welding.
2. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping.
3. Study and practice on machine tools and their operations.

List of Jobs:

1. **Fitting Shop:** Prepare job that contain various fitting operation like filing, marking, measuring, cutting, drilling etc.
2. **Carpentry Shop:** Prepare job that contain various carpentry operations and making of carpentry joint (T joint).
3. **Sheet Metal Shop:** Prepare job that contain various sheet metal operations and making job from sheet (funnel, tray etc).
4. **Machine Shop:** Perform various operations like, turning, step turning, facing, chamfering, knurling etc. on Lathe.
5. **Welding Shop:** Prepare a weld bead using arc welding process.

Outcomes:

At the end of the course, the student will be able to:

1. To acquire skills in basic engineering practice.
2. To identify the hand tools and instruments.
3. To acquire measuring skills.
4. To provides the knowledge of job materials in various shops.
5. Students will be able to analyze the material on the basis of their properties and thus assigning different weight age to their use for technical purposes.

Text Books:

1. Hajara Chaudhary, Workshop Technology Vol I & II, Media Promoters and Publishers PVT. LTD, Mumbai.
2. B.S. Raghuvanshi, Workshop Technology, Dhanpat Rai & Sons. New Delhi.

Reference Books:

1. H S Bawa, Workshop Technology, TMH. New Delhi.

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MA 23.201 **Mathematics III** **TotalLectures:40**

3-1-0-4

Pre-requisite: Mathematics I and Mathematics II

Objective: To acquire fundamental knowledge of Linear programming, Numerical Methods, Probability, Statistics and Integral Transform and apply in engineering disciplines.

1. **Linear Programming:** Introduction to linear programming problems, Graphical solution, Simplex method, Artificial variable technique (Two phase method, Big –M method). [8]
2. **Numerical Methods:** Solution of system of equations (Gauss elimination and Gauss - Seidel methods); Solution of algebraic and transcendental equations (Bisection and Regula Falsi methods); Solution of ordinary differential equation (Euler's modified, Milne's predictor & corrector, Runge-Kutta method of orderfour). [8]
3. **Integral Transform:** Basics of Laplace transform and inverse Laplace transform; First and Second Shifting theorems; Convolution theorem (without proof); Solution of ordinary differential equations with initial conditions by Laplace transforms. [8]
4. **Probability Theory:** Recapitulation of basics of permutation, combination and probability theory; Law of addition and law of multiplication; Conditional probability; Total probability; Baye's theorem(withproof)andit'sapplications. [8]
5. **Correlation and Regression:** Conceptof least square technique, fitting of least square straight line and quadratic curve (Parabola)**,** correlations analysis, different types, Simple, partial and multiple correlations, correlation of bivariate frequency distribution. [8]

Outcome: After completion of the course, students would be able to apply the knowledge of linear programming, numerical methods, statistics, probability and integral transforms in engineering and solve curriculum problems.

TextBooks: 1. Ramana B.V., Higher Engineering Mathematics, TMH, 2016. 2. P.K. Gupta and D.S. Hira, Operations Research, S. Chand, 2019.

Reference Books:

1.Sastry S.S., Introductory Methods of Numerical Analysis, 5th Edition, Pearson.
2.Jain R.K. and S.R.K. Iyenger, Advanced Engineering Mathematics, Narosa Publishing House, 2003.

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CS 23.205 **General Purpose Programming** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CS 23.101 (Programming for Problem Solving)

Objective(s): Python is a general-purpose, versatile and popular programming language. It's great as a first language because it is concise and easy to read, and it is also a good language to have in any programmer's stack as it can be used for everything from software development and scientific applications.

1. **Introduction**: The basic elements of python, python syntax, python operators, basic input, branching programs, control structures, data types, strings, tuples, lists, sets, dictionaries, bytes, byte array and input iteration, Mutability with different types, ranges and iterators [7]
2. **Functions and Module**: Functions and scoping flow of execution, specifications, recursion, global variables, variable arguments, default arguments, system functions and parameters, input and output, modules , making your own module, importing modules, decorators, generators, command line argument. [7]
3. **Classes and Object-Oriented Programming**: Abstract data types and classes, class attribute, instances, object overhead, constructor, self, inheritance, encapsulation and information hiding, polymorphism, getter & setter, abstract class, duck typing, monkey patching, operator overloading, method overloading using multiple dispatch decorator. [8]
4. **Testing and Debugging**: Exceptions and assertions, types of testing – black-box and glass-box, debugging, handling exceptions, assertions. [6]
5. **Advance Python:** Regular expressions – REs and Python, plotting using matplotlib and Multithreaded Programming, GUI & event handling programming using Tkinter & pygame. Introduction to machine learning and deep learning [12]

Outcome(s): Upon completion of this course students will be
●Familiar with Python syntax.
●Able to use python to implement a given logic.

Text Books:
1.John V Guttag, Introduction to Computation and Programming using Python, Prentice Hall of India, 2nd Edition, 2013.
2. Martin C. Brown, Python: The Complete Reference, Mc Graw Hill, 2018

Reference Books:
1.Zed A. Shaw, Learn Python the hard way: a very simple introduction to the terrifyingly beautiful world of computers and code, 3rd edition, 2014.
2.Richard L. Halterman, Learning to Program with python, 2011.
3.Allen Downey, Think Python How to Think Like a Computer Scientist, Version 2.0.17, Green Tea Press Needham, Massachusetts, 2012.

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EC 23.201 **Electronic Devices and Circuits** **Total Lectures: 40**
3-0-0-3

Objective To acquire fundamental knowledge of operation, design and application of variousElectronic devices and circuits.

Pre-requisite Basic Electronics and Physics of electron.

1.	**Junction Diode:** Junction breakdown**,** Current components in a p-n diode, Quantitative analysis of p-n diode characteristics and equivalent circuit, diode resistance, interconnections of diodes, transition and diffusion capacitance.	[6]
2.	**Transistors**: Operation of transistor, transistor current components, transistor circuit configurations, transistor biasing schemes and operating point stabilization, hybrid-pi model of BJT, low and high frequency models of JFET.	[11]
3.	**Small Signal Amplifiers at Low Frequency:** Coupling schemes for multistage amplifiers, frequency response of coupled amplifier, RC coupled transistor amplifier, transformer coupled transistor amplifier, cascode circuits, Differential amplifier, Darlington amplifier.	[7]
4.	**Power Amplifiers:** Power amplifier circuits, class-A, class-B, class-AB, class-C, push pullamplifiers- class-A, class-B, Class- AB.	[10]
5.	**Oscillators:** Classification criterion for oscillation, tuned collector, Hartley, Colpitts, RC phase shift, Wien bridge and crystal oscillators.	[6]

Outcome: After completion of this course, students would be able to understand the working phenomena and applications of various electronic devices and circuits.

Text Books:
1. Robert L. Boylestad & Louis Nashelsky, Electronic Devices and Circuit Theory,Pearson Education, 11th Edition, 2013.
2. Thomas L. Floyd, Electronic Devices, Pearson Education, 10th Edition, 2018 .

Reference Books:
1. Bell, David A., Operational Amplifiers & Linear ICS, Prentice Hall of India, 3rdEdition, 2018.
2. J. Millman & C. C. Halkias, Electronic Devices and Circuits, McGraw Hill

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EC 23.205 **Principles of Electromagnetics** **Total Lectures: 40**
3-0-0-3

Objective: To develop the understanding of basics concepts of electromagnetic field theory and its applications.

Pre-requisite: Basic understanding of laws of Physics and Mathematics

1. **Introduction:** Transformation of a point and a vector in different coordinate systems, Differential length, area, volume Physical meaning of gradient, divergence and curl, Laplacian of a scalar, Divergence theorem, Stoke's theorem, review of electrostatic and magneto static fields. [5]

2. **Time Varying Fields and Maxwell's Equations:** Faraday's law of electromagnetic induction, Maxwell's equations in integral and differential form, potential functions, electromagnetic boundary conditions. [5]

3. **Electromagnetic Waves:** Introduction, Helmholtz wave equation, Wave equations and their solutions for free space, lossy dielectric, Lossless dielectrics and good conductor medium, Poynting vector and the flow of power. Reflection of plane wave at dielectric media and conducting surfaces for normal incidence. [15]

4. **Transmission lines:** Typesof transmissionlines,transmissionlineparameters,two conductor transmission line equations, input impedance, standing wave ratio and power of transmission lines,smith chart, transmission line impedance matching techniques. [5]

5. **Guiding Structures:** General wave behaviors along uniform guiding structure, rectangular andcircular wave guides, wave propagation in rectangular and cylindrical cavity resonators. [10]

Outcomes : After completion of the course, students would be able to:

- Recall fundamental concepts of electromagnetism, such as electric and magnetic fields, Gauss's Law, Ampere's Law, and Faraday's Law.
- Explain the relationship between electric and magnetic fields, including their interaction and the concept of electromagnetic induction.
- Interpret Maxwell's equations and their significance in describing electromagnetic phenomena.
- Evaluate the behavior of electromagnetic waves, including their propagation, reflection, and refraction.
- Definefundamentalconceptsrelatedtotransmissionlinesandwaveguides,suchas characteristic impedance, propagation constant, standing waves, and modes of propagation.

Text Books:
1 . Matthew N. O. Sadiku, Principles of Electromagnetics, Oxford University Press, 4th Edition,2015.
2. William H. Hayt: Engineering Electromagnetic, TMH, 8th Edition, 2013.

ReferenceBooks:

1.David J. Griffiths, Introduction to Electrodynamics (Third Edition); Pearson Education, 4th Edition, 2013.
2.M. L. Sisodia and G. S. Raghuvanshi, Microwave Circuits and Passive Devices, New Age Publication, 1987.

EE 23.203 **Network Analysis and Synthesis** **Total Lectures: 40**

Objective: **3-0-0-3** This course helps students in analyzing the A.C. & D.C. circuits and it also provides design exposure to circuit models for minor and major projects.

Pre-requisite:

1. **Network Theorems:** Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks. [10]
2. **Solution of First and Second Order Networks:** Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer. [8]
3. **Electrical Circuit Analysis Using Laplace Transforms:** Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances. [8]
4. **Two Port Network:** Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks. [6]
5. **Synthesis of Passive Network:** Hurwitz polynomials, positive real functions, elementary synthesis procedures, properties of LC immittance function, synthesis of LC driving point immittance, properties of RC driving point impedances, synthesis of RC impedances or RL admittances, properties of RL impedances and RC admittances, synthesis of RLC functions. [8]

Outcome: At the end of this course, students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state.
- Analyse two port circuit behaviors.

Text Books:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. A. Chakrabarti, “Circuit Theory (Analysis and Synthesis)”, Dhanpat Rai & Co. (PVT) Ltd., 2008.

Reference Books:

1. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
2. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
3. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.

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CS 23.203 **Data Structures** **Total Lectures: 40**
Credit:3-0-0-3

Prerequisite(s): CS 23.101 (Programming for Problem Solving)

Objective(s): • To provide knowledge of ways of structuring and operating on data, the nature of some fundamental problems, methods for addressing those problems, and to promote an analytical and empirical appreciation of the behavior of algorithms using data structures.

1.**Introduction:** Basic terminology, elementary data organization, algorithm, efficiency of an algorithm, time and space complexity, asymptotic notations, time-space trade-off, abstract data types. [4]

2.**Array & Linked list:** Definition, single and multidimensional arrays, representation of arrays: row major order and column major order, application of arrays, sparse matrices and their representations. Singly linked lists, doubly linked list, circular linked list, insertion, deletion, traversal, polynomial representation and addition, generalized linked list. [10]

3.**Searching & Sorting:** Sequential search, binary search, comparison and analysis, hash function, collision resolution strategies, insertion sort, selection sort, bubble sort, quick sort, merge sort, heap sort, radix sort.. [10]

4.**Stack& Queue:** Primitive stack operations: push and pop, array and linked list implementation of stack, application of stack: prefix and postfix expressions, evaluation of postfix expression, recursion, and tower of Hanoi problem. Queue operations, circular queues, array and linked list implementation of queues, dequeue and priority queue [8]

5.**Tree:** Binary trees, binary tree representation, tree traversal algorithms: inorder, preorder, and postorder, threaded binary trees, Huffman algorithm, binary search trees, AVL trees [8]

Outcome(s): On the successful completion of the course, the student will be able to:

- be knowledgeable of certain abstract data types (ADT)
- be able to make a critical assessment of different implementations of an ADT
- be familiar with a number of fundamental computational problems and be aware of real-world instances of those problems.

Text Books:

1. Lipschutz, "Data Structures" Schaum's Outline Series, TMH, Revised Edition Feb. 2014
2. Horowitz and Sahani, Fundamentals of Data Structures, University Press, 2nd Edition, 2008.

Reference Books:

1.Aaron M. Tenenbaum, Yedidyah Langsam, and Moshe J. Augenstein, Data Structures Using C and C++, PHI, 2nd Edition, 2012.
2.D. Samanta, Classic Data Structures, PHI, 2nd Edition, 2009.
3.Jean Paul Trembley and Paul G. Sorenson, An Introduction to Data Structures with applications, McGraw Hill, 2nd Edition, 2003.

CS 23.253 **Data Structures Laboratory** **Total Hours: 26**
Credit: 0-0-2-1

Objective(s):

- To develop skills to design and analyze simple linear and nonlinear data structures.
- To Strengthen the ability to identify and apply the suitable data structure for the given real world problem.
- To Gain knowledge in practical applications of data structures.

Prerequisite(s): (CS 23.111) Programming Laboratory

Contents:

1.Implement various operations on arrays.
2.Implement different operations on different types of link list.
3.Implement various searching algorithms.
4.Implement different sorting algorithm and realize their complexities.
5.Implement Queue and stacks with all the operations.
6.Implement Binary Tree.
7.Implement graphs.

Outcome(s): At the end of this course, the student will

- Be able to design and analyze the time and space efficiency of the data structure.
- Be capable to identity the appropriate data structure for given problem.
- Have practical knowledge on the application of data structures.

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EC 23.221 **Electronics Devices and Circuits Laboratory** **Total Hours: 26**
0-0-2-1

Objective: To acquire fundamental knowledge of operation, design and application of various Electronicdevices and circuits by doing the experiments.

Pre-requisite: Electronics Laboratory

1. To plot the diode characteristics and its dynamic resistance and cut-in Voltage.
2. Plot the characteristics of a Zener diode and find its dynamic resistance under reverse biased condition. Plot the Line-Regulation and Load-Regulation curve using Zener diode
3. To implement a diode clipper circuit which clips the positive peak of the input voltage (i) By 1V and (ii) negative peak by 1.5V? (For given sinusoidal input V_{pp}= $4V$, $1kH$)
4. To implement a diode clamper circuit which clamps the positive peak of the input voltage $1V$ and the negative peak of the input voltage 1.5V. (For given square wave input V_{pp}= $10V$, $1kHz$) 5. To plot the frequency response of a emitter follower.(For given sinusoidal input V_{pp}= $3V$, $1kH$z. 6. Design a Half Wave Rectifier circuit with and without capacitor filter, measure the rms and Dc values ofoutput voltage and calculate the ripple factor for given sinusoidal input V_{pp}= $10V$, $1kH$.
7. To plot the input and output characteristics of a transistor in CE Configuration.
8. Design a two stage RC coupled transistor amplifier and calculate the gain. (for given sinusoidal inputV_m= $200mV$, $1kHz$).
9. To plot the Transfer characteristics (forV_{DS}= $5V$)and Drain (for V_{GS}= $-1V$) characteristics of a JFET inCS Configuration.

Outcome: After completion of this lab course, students would be able to demonstrate the working phenomena and
applications of various electronic devices and circuits. Knowledge gained from this course would also beutilized to design different electronic circuits and devices.

EE 23.223 **Network Analysis and Synthesis Laboratory** **Total Hours:26**

0-0-2-1

Objective: This Lab course helps us to gain basic knowledge of principle, operation, application and design/verification of various Electrical components /devices/ circuits/theorems by conducting the experiments.

Prerequisite: Basic of Electrical Engineering

1. To study the series and parallel connected resistive circuits.
2. To study the equivalent star of a delta connected resistive circuit and also the equivalent delta of a star connected resistive circuit.
3. To verify the Kirchhoff's current Law and Kirchhoff's Voltage law.
4. To verify the superposition theorem using resistive circuit.
5. To verify the Reciprocity Theorem using resistive circuit.
6. To verify the Thevenin's Theorem using resistive circuit.
7. To verify of Norton's Theorem using resistive circuit.
8. To verify of Maximum Power Transfer Theorem using resistive circuit.
9. To determine Z-parameter, Y-parameter and ABCD parameter of a given Two-port network.
10. To design a zero PCB for a given circuit to verify the Thevenin's Theorem.
11. To find out the time- constant of RL-series circuit when connected to step function.
12. To find out the time constant of RC-series circuit when connected to step function.

Outcome: After completion of this lab course, students would be able to demonstrate the working phenomena and applications of various electrical components and circuits. Knowledge gained from this course would also be utilized in designing different electrical circuits/theorems and devices.

Reference Book: Lab Manual.

CS 23.255 **General Purpose Programming Laboratory** **Total Hours:26**
0-0-2-1

Prerequisite: (CS 23.111) Programming Laboratory

Objectives: The objective of this course is to:

- Become comfortable with Python programming, starting from basics of data types to deep learning.
- Provide the foundation of to explore any expansions of Python whether it is machine learning, deep learning, web development or gaming. It will also put focus to learn various skills to design object-oriented software.

Contents:

- Code different data types and operations on list, tuple, dictionaries, sets, String etc.
- Code basic programs like factorial, fibonacci etc. to understand functions and recursions.
- Implement different built-in functions in Python like eval, exec,lambda, map reduce, filter etc.
- Implement the concept of class, objects, inheritance and polymorphism.
- Implement constructor and self
- Code programs to implement exceptions and assertions
- Implement regular expressions
- Implement a small gaming application using Pygame
- Implement user interface and event handling using TKinter
- Code programs to implement the logic for machine and deep learning
- Implement multithreading

Outcomes: Upon completion of this course, students will be:

- Able to develop application in Python
- Able to develop scientific applications for machine learning
- Able to use python to implement a given logic.
- Able to use various Python IDE like Anaconda, Pycharm etc.

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UC25.201 **Management and Entrepreneurship** **Contact Hours: 26**
2-0-0-2

Objectives: This course introduces students to the principles of Entrepreneurship and Management practices. It acquaints students with the methods managers use to: assess the environment in which the organization operates; design, build, and implement the organization's capacity to serve; make decisions; and evaluate the efficacy of those decisions. It also provides students with a solid foundation in terms of the vital role played by entrepreneurs and entrepreneurship in the 21st century global economy.

1	**Introduction to Management**: Meaning and importance, Concept of industrial management, Levels of management, Management theories-classical, neo-classical and modern, Managerial roles (Mintzberg), Managerial competencies, Managers and environment.	**[5**
2	**Management Functions**: ***Planning*** – Concept, types, Strategic planning, Types of strategy, Decision making, Techniques for individual and group decision-making; ***Organizing*** – Concept,Design of organization structures, Departmentalization, Power and authority, Conflict and coordination; ***Staffing*** – Concept, Human resource planning, Recruitment and selection.	**[5**
3	**Contemporary Issues in Management**: Management challenges of the 21st Century, Factors reshaping and redesigning management purpose, Performance and reward perceptions, Internationalization, Digitalization, Entrepreneurship, Values and Ethics.	**[5]**
4	**Entrepreneurship**: Definition and concept of entrepreneurship, Entrepreneur Characteristics, Classification of Entrepreneurs, Role of Entrepreneurship in Economic Development, Start-ups.	**[5]**
5	**Idea Generation and Project Formulation**: Ideas in entrepreneurships, Sources of new ideas, Techniques for generating ideas, Guidelines for report preparation, Project appraisal techniques, EDP organizations - MDI, EDII, Industrial Sickness and Role of BIFR, Meaning of project, project identification, formulation, feasibility analysis.	**[6]**

Outcome Students will describe the various levels of management and applicability of management Principles, demonstrate various types of authority, delegation and decentralization in authority, demonstrate various types of leadership styles and identify the motivation techniques used by leaders, and discuss the impact of emerging issues in management.

Text Books

7.L.M. Parasad, "Principles & practice of management", Sultan Chand & Sons, New Delhi, (Latest edition).
8.Stephen P.Robbins "Organizational Behavior" Pearson Education, New Delhi (Latest edition).
9.Khanna, S. S., Entrepreneurial Development, S. Chand, New Delhi.

Reference Books

5.T.N. Chhabra, "Business Organization and Management", Sun India Publications. New Delhi.
6.P.C. Tulsian, and V. Pandey, "Business Organization & Management", Pearson Education, India.

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EC 23.202 **Digital Electronics** **Total Lectures: 40**
3-0-0-3

Objective: The aim of this course is to present the principles and techniques of combinational and sequential digital logic design and optimization at a gate level.
The use of transistors for building gates is also introduced.

Pre-requisite: Basics of Electronics Engineering.

1. **Number Systems and Boolean Algebra:** Introduction to number systems, weighted and non- weighted codes, 1's complement, 2's complement, complement arithmetic, Postulates and theorems of Boolean algebra, Boolean functions, canonical and standard form, simplification of Boolean function using Boolean laws and theorems. [5]
2. **Logic Gates and Simplification of Boolean Functions:** Basic Logic gates, Universal gates, K-map representation, incompletely specified functions, simplification realization with gates, Quine-McCluskey method. [5]
3. **Combinational Logic:** Analysis and design of combinational circuits, half adder and full adder, half subtractor and full subtractor, binary serial and parallel adder, BCD adder, binary multipliers, magnitude comparator, decoders, encoders, multiplexers, de-multiplexers. [10]
4. **Sequential Circuits:** Latches, flip-flops, triggering of the flip-flops, master-slave flip-flop, excitation tables, conversion of the flip-flops, analysis and design of clocked sequential circuits, shift registers, counters. [12]
5. **Programmable Logic & Introduction to Verilog HDL:** ROM, ASIC, PAL, PLA, FPGA, Verilog as HDL, An overview of VHDL, Role of VHDL in system design. [8]

Outcomes: Upon successful completion of this course, students should be able to:
1. Gain fundamental knowledge of the basic logic gates such as AND, OR, NAND NOR, EX-OR andtheir implementation in Logic Circuits.
2. Design multipliers, Combinational Circuits and registers.

Text Books: 1. M. M. Mano and M. D. Ciletti, Digital Design, Pearson Education, 4th Edition, 2009.
2. T. L. Floyd and R.P. Jain, Digital Fundamental, Pearson Education, 8th Edition, 2009.

References 1. V. K. Puri, Digital Electronics: Circuits and Systems, Tata McGraw-Hill, 4th Edition, 2001.
2. R. P. Jain, Modern Digital Electronics, Tata McGraw-Hill, 4th Ed, 2003.

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EC 23.204 **Integrated Circuits and Applications** **Total Lectures: 40**

Objective: **3-0-0-3** To acquire fundamental knowledge of Mathematics and apply in engineering disciplines.

Pre-requisite: Electronics Devices and Circuits

1. **Differential Amplifier:** Operational amplifier, bipolar and FET differential amplifiers, [4] constant current source, current mirror, level translator, block diagram of operational amplifier, frequency response and stability, operational amplifier parameters, offset compensation techniques.

2. **Application of Op-amp:** Inverting and non-inverting amplifiers, voltage follower, integrator and differentiator circuits, instrumentation amplifier, current to voltage converter and voltage to current converter, voltage to frequency conversion. [8]

3. **Oscillators and Active Filters:** Barkhausen's criteria, Quadrature, square wave, triangular wave,saw tooth wave and voltage controlled oscillator, Low pass, high pass, band pass and band reject filters. [8]

4. **ICs and Applications:** Clipping and clamping circuits, comparator, LM-311 comparator, Schmitt trigger, log and antilog amplifiers, half and full wave rectification, IC-8038, IC LF-398, IC-555. [10]

5. **Voltage Regulator and PLL:** Voltage regulator IC-723, switching regulators, regulator IC series 78xx, 79xx, building blocks of PLL, IC-565 and its applications, four-quadrant multiplier and its applications. [10]

Outcomes: After completion of the course, students would be able to apply mathematical knowledge in engineering and solve curriculum problems.

Text Books:

1. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, PHI, New Delhi, 3rd Edition.
2. B. P. Singh and Rekha Singh, Electronic Devices and Integrated Circuit", Pearson Education,2003.

Reference Books:

1. R. F. Coughlin and F. F. Driscoll, Operational Amplifiers & Integrated Circuits, Pearson Education, 5th Edition, 2001.
2. S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Pearson Education, 3rd Edition, 2003

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CS 23.204 **Database Management Systems** **Total Lectures: 40**

Credit:3-0-0-3

Prerequisite(s): CS 23.203 (Data Structures).

Objective(s):

- Understand the fundamental concepts of database management.
- Design and normalize databases, understand transaction processing control.
- Understand the basics of object concepts and object relations.
- Understand the role of the DBMS & RDBMS in the organization.

1. **Introduction to database systems:** database system concepts and architecture, data modeling using the Entity-relationship (ER) model. Mapping ER model to the relational model. Relational Data Model: relational model constraints, relational database schemas, update operations, dealing with constraint violations, relational algebra operations, and relational calculus. [10]
2. **Structured Query Language (SQL)**: SQL data definition and data types, specifying constraints, schema change statements, DDL, DML, basic queries, complex queries, update statements, views, Joins, Inbuilt-Functions of SQL. [6]
3. **Database Design:** Functional dependencies and normalization of relational databases, first normal form (1NF), 2NF, 3NF, Boyce-Codd normal form (BCNF), multivalued dependency, 4NF, join dependency, 5NF. [8]
4. **Transaction Processing:** Introduction - Transaction State, Transaction properties, Concurrent Executions, need for serializability, conflict v/s view serializability, testing for serializability, recoverable schedules, cascadeless schedules. Concurrency control techniques: two-phase locking protocol; concurrency control based on timestamp ordering. Database recovery techniques: recovery concepts, recovery techniques based on deferred and immediate update. [10]
5. **Database Security:** Database Security: Vulnerabilities in the database, authentication, SQL injections, encryptions & public key infrastructures, privacy issues, and preservation process. [6]

Outcome(s): After completion of the course, students will be able to:

- Analyze database models & entity-relationship models.
- Understand the architecture for database development.
- Design E-R diagrams,use Structured Query Language (SQL) with complex queries.
- Design and normalize the relations for any organization.
- Understand transaction processing control.

Text Books:

1.Ramez Elmasri & Shamkant B. Navathe, Fundamentals of Database Management Systems, 5th Edition, Pearson Education, 2013.

2. Raghu Ramakrishnan, Database Management Systems, Tata McGraw Hill, 3rd Edition, 2008.

Reference Books:

1.G.W. Hansen and J.V. Hansen, Database Management and Design, 2nd Edition, Prentice Hall India, 2000.

2.Korth and Silberschatz, Database System Concepts, 5th Edition, Tata McGraw Hill, 2006.

3.C.J. Date, Database Systems, Tata McGraw Hill, 2nd Edition, 2003.

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CS 23.202 **Advanced Programming** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CS 23.101(Programming for Problem Solving)

Objective(s):

- Cover issues related to the definition, creation and usage of classes, objects and methods.
- Discuss the principles of inheritance and polymorphism.
- Provide the foundation of good programming skills by discussing key issues of the design of object- oriented software, including programming design and documentation.

1. **Overview:** Introduction to OOP, OOP concepts, interactive Development Environments: Eclipse/Net Beans, basics of OOP, importance of Java Primitive datatypes, typecasting, arrays, operators and control structures, identifiers, constants and literals. [8]
2. **Classes and Inheritance:** Class fundamentals, objects, constructors, this keyword, garbage collection, the finalize()method, overloading methods, understanding static & final, exploring the string class. Inheritance basics, using super, multilevel hierarchy, constructor in hierarchy, method overriding, dynamic method dispatch, the object class, using abstract classes, interface, I/O with different types of streams(Character, byte and primitive data type), string handling with String and StringBuffer. [8]
3. **Package, and Exception Handling:** Packages, access protection, importing packages,interfaces,exception-handlingfundamentals,exceptiontypes,usingtry and catch, multiple catch clauses, nested try statements, throw, throws, finally, Java's built-in exceptions, user defined exception, assertions [8]
4. **GUI and Multithreaded Programming and JDBC:** Swing Introduction and GUI Widget, form design with swing, Graphics with swing, The Java thread model, the main thread, creating multiple threads, threads priorities, managing threads, thread class built-in functions. Connection to MySQL and SQL operations. [8]
5. **Java Collections:** Introduction, Types of Collections, Dynamic array, Linked list, Stack, table,TreeSet,AbstractList,Queue,AbstractSequentialList,LinkedHashSet,Priority queue, Double-ended queue with applications and operations. [8]

Outcome(s):

- Understand the concepts of OOP as well as the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.
- Identify classes, objects, members of a class and the relationships among them needed for a specific problem.
- Develop programs using the in-built JavaAPI and the Java standard class library. Become able to Implement Data Structure, Graphics and CURD operations in Java

Text Books: 1.Herbert Schildt, Java The Complete Reference, Herbert Schildt, 8thEdition, 2011. 2. Bert Bates and Kathy Sierra, Head First Java, O'Reilly,2005

Reference Books: 1.Allen B. Downey, Think Java:Howto ThinkLikeaComputer Scientist, 2011. 2.Paul Deitel, HarveyDeitel,JavaHowTo Program (EarlyObjects),10th Edition, 2014.
3.E. Balaguruswamy, Programing with Java A Primer, Tata Mc. Graw Hill, 2007.

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EC 23.222 **Integrated Circuits & Applications Laboratory** **Total Hours: 26**
0-0-2-1

Objective: This lab course develops skills for implementing and analyzing electronic circuits, with applications to electronics design. It is also designed to enhance problem solving ability through steadily increasing problem complexity.

Pre-requisite: Electronic Devices and Circuits

1. To measure the following parameters of IC-741-
(a)Slew rate (b) CMRR
2. Implement the circuits to show the application of op-amp
as-(a)Summing amplifier (inverting)
(b)Difference amplifier
(c)Algebraic adder
3. (a) Design an ideal inverting integrator to integrate a square wave of frequency, f ≥ 1KHz.
(b) Design a non-ideal non-inverting differentiator to differentiate a triangular wave of frequency, f ≥ 1KHz.
4. To plot the frequency response of - 1st order Low-Pass active filter
5. To plot the frequency response of - 1st order High-Pass active filter
6. Design the following circuit using IC 555 timer-
(a)Monostable Multivibrator to generate a pulse of 0.11 ms.
(b)Astable Multivibrator with 50% duty cycle.
7. Design op-amp based circuits to realize Wein Bridge oscillator.
8. To study application of IC 555 as-
(a)VCO (b) Schmitt-trigger circuit for square wave generator
9. 565.
10. Verify the line regulation and load regulation using IC 723.

Outcomes: Upon successful completion of this course, students should be able to:
- Design Band pass and Band Stop filters for the given specifications
- Design Oscillators and Multivibrators

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CS-23.254 **Data Base Management Systems Laboratory** **Total Hours: 26**
Credit: 0-0-2-1

Pre-requisites: CS 23.204 (Data Base Management Systems)

Objective: By the end of the practical sessions of this section, students will be able to:

- Create Databases using a user interface and SQL command.
- Create Integrity and constraints on databases.
- Write SQL queries.
- Provide a practical overview of advanced concepts like triggers, assertion, views, etc.

List of Experiments:

1.Creation of Databases
2.Implement various Integrity Constraints
3.SQL queries to implement DDL
4.Implement various queries to implement DML
5.Implement logics for PLSQL
6.Implement Triggers
7.Some examples of query

Outcomes: After undergoing this laboratory module, the students should be able to:

- Understand, appreciate and effectively explain the underlying concepts of database technologies.
- Design and implement a database schema for a given problem-domain.
- Populate and query a database using SQLDML/DDL commands.
- Declareandenforceintegrityconstraintsonadatabaseusingastate-of-the-artRDBMS.
- Programming PL/SQL including stored procedures, stored functions, cursors, packages.

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EC 23.224 **Digital Electronics Laboratory** **Total Hours: 26**
0-0-2-1

Objective: This lab course develops skills for implementing and analyzing digital electronic circuits, with applications to electronics design. It is also designed to enhance problem solving ability through steadily increasing problem complexity.

Pre-requisite: Basics of Electronics Engineering

1 To study the use of General Purpose Digital Trainer and familiarization with the digital IC Data-Books.

2 To study AND, OR. NOT, NAND, NOR, EX-OR gates and their specified experiments.

3 To set up a 4-bit Binary Counter (74LS93) to demonstrate its sequence of Counting.

4 To design and test 4-bit Adder and Subtractor circuits.

5 To compare the magnitude of two 4-bit Binary Numbers A and B.

6 Design a combinational circuit with 4 inputs and 4-outputs that converts a 4-bit Gray Code to an equivalent 4-bitBinary number.

7 Design and implement a BCD to Seven Segment Decoder / Driver.

8 To design and implement a 2 to 1 multiplexer.

9 To design and implement a 1:2 & 1:4 de multiplexer.

10 To investigate the operation of various flip flops SR, JK, T and D using gates and FF ICs.

11 To design and implement Adders and Subtractors using Verilog HDL

12 To design and implement Multiplexers/De-Multiplexers using Verilog HDL

13 To design and implement Filp-Flops using Verilog HDL

Outcome:
1. The background provided in this laboratory may effectively be utilized for the understanding ofadvanced courses such as VLSI Design and for the designing of complex circuitry.
2. Gain a hands-on experience in carrying out key operations needed to assemble circuits onbreadboard.
3. This subject is directly applicable to industrial IC design and provides a strong background for moreadvanced courses.
4. This lab will be useful in the designing of hardware projects using Verilog HDL

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CS 23.252 **Advanced Programming Laboratory** **Total Hours: 26**
Credit: 0-0-2-1

Prerequisite: (CS23.202) Java Programming and (CS 23.102) Object Oriented Programming through C++)

Objectives: The objective of this course is to:

- Become comfortable with object-oriented programming and learn to think in terms of objects.
- Provide the foundation of good programming skills by discussing key issues to the design of object-oriented software, including programming design patterns, documentation.

Contents:

1. Code different pattern to understand control structures
2. Code program like factorial, fibinocci etc. to understand functions and recursions.
3. To understand OOP implement an small application with getter and setter method
4. Implement various operators, this keyword and constructors
5. Code different usage of static keyword, polymorphism
6. Designing of Forms in Swing and Connection to database
7. Show different usage of String class using its inbuilt functions
8. Demonstrate Java Collections and Applications
9. Demonstrate exception handling using all its keywords
10. Demonstrate console I/O and File I/O
11. Implement multithreading using Runnable interface and Thread class

Outcomes: Upon completion of this course, students are able to:

- Understand the concepts of OOP as well as the purpose and usage principles of Inheritance, polymorphism, encapsulation and method overloading.
- Create Java application programs
- Use of development environment like Eclipse for collaborative programming/editing.

EC 23.301 **Microprocessor and Microcontroller** **Total Lectures: 40**
3-0-0-3

Objective: To develop an in-depth understanding of the operation of microprocessors and microcontrollers,machine language programming & interfacing techniques.

Pre-requisite: Digital electronics

1. **The 8086 Microprocessor Architecture :** Architecture, details of sub-blocks such as EU, [8] BIU; memory segmentation and physical address computations, pin diagram and description of various signals, minimum and maximum mode of operations, supporting chips viz. 8284, 8288 and memory mapping

2. **Programming of 8086:** Addressing modes of 8086, instruction set of 8086, assembly languageprogramming, counters and time delays, stack structure of 8086 and subroutine. [7]

3. **Interfacing of 8085 / 8086 with Programmable Chips:** Interfacing of 8255 Programmable peripheral interface, 8251 USART, 8253/8254 Programmable Interval Timer and Direct Memory Access Controller 8237/8257 DMA, 8259 Programmable Interrupt Controller. [8]

4. **Introduction to Microcontrollers, Architecture and Memory Interfacing:** Overview of the 8051 family, 8051 Microcontroller's Architecture, Pin configuration, Common memory types and Tradeoffs,External Memory interfacing. [7]

5. **Programming and Interfacing of 8051:** Addressing modes of 8051, instruction set of 8051, assembly language programming of 8051, stack structure of 8085, delays, and subroutines, Applications of interrupts, timer/counter and serial port, Components of Integrated Development Environment for software development, Interfacing of 8051 with sensors, ADC, DAC, Stepper Motor, Introduction to ARM processors. [10]

Outcomes: Upon completion of this course, the student will be able to:
1.The student will learn the internal organization of some popular microprocessors and microcontrollers.
2.The student will learn hardware and software interaction and integration and memory.

Text Books:
1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Application with the 8085,Penram International Publishing, 6th Edition, 2013.
2. M. A. Mazidi, The 8051 Microcontroller & Embedded Systems, Pearson Education, 2nd Edition,2006.

Reference Books:
1.I. Scott McKenzie and Raphael C.W. Phan, The 8051 Microcontroller, Pearson Education, 4th Edition, 2007.
2.D. V. Hall, Microprocessors and Interfacings; TMH, 3rd Edition, 2012.

EC 23.303 **Principles of Analog Communication** **Total Lectures: 40**
3-0-0-3

Objective: •To develop a fundamental understanding on communication systems with emphasis on analog modulation techniques.
•To appreciate the mathematical concepts that form the foundations of analog communication

Pre-requisite: Signals and Systems, Statistics and Probability Theory

1. **Linear Modulation Techniques:** Basic blocks of communication systems, Review of signals and systems, Linear Modulation, Time domain and frequency domain description of AM (DSB-FC), DSB-SC, SSB and VSB signals. Generation and detection of linear modulation techniques, Super-heterodyne receivers and design. [12]
2. **Angular Modulation Techniques:** Basic concepts, Frequency Modulation Spectrum Analysis of FM Wave,Generationanddetectionof narrowbandandwideband frequency modulation, Phase modulation, Commercial broadcasting systems. [8]
3. **Sources of Noise and their characterization:** Noise in Analog communication System. SNR calculations for synchronous detection of DSB and SSB and envelope detection of AM, Pre-emphasis and de-emphasis. Threshold effect in angle modulation. [8]
4. **MultiplexingandMultipleAccessTechniques:**FrequencydivisionMultiplexing, time divisionmultiplexing, multiple access techniques-TDMA, FDMA. [6]
5. **Sampling and Pulse Modulation:** Sampling theorem – ideal and natural sampling and reconstruction,Pulse-Amplitude Modulation, Pulse-Width Modulation. [6]

Outcome: Upon completion of this course, the student will be able to:
1. Apply the basic knowledge of signals and systems and understand the basics of communication system and analog modulation techniques.
2. Evaluate the communication system performance in the presence of noise and summarize the merits and demerits of all the conventional analog modulation system.

Text Books:
1.B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford university press, 4th Edition, 2009.
2.Taub and Schilling, Principles of Communication Systems, TMH, 4th Edition, 2013.

Reference Books:
1.Kennedy, Davis, Electronic Communication Systems, TMH, 6th Edition, 2017.
2.S. Haykins, Communication Systems, Wiley, 5th Edition, 2009.

EC 23.305 **Signal Processing and Applications** **Total Lectures: 4**

Objective: **03–1–0-4**

- To understand the fundamental characteristics of continuous- and discrete-time signals and systems in termsof both the time and transform domains and to develop the mathematical skills to solve problems involving convolution and sampling.

Pre-requisite: Mathematics I

1. **Representation and classification of Signals**: Signal classification - Continuous and discrete time, Periodic - aperiodic, even - odd, energy - power, Deterministic - random, real valued - complex exponential, sinusoidal, time scaling, time shifting, Sampling and discrete time processing of continuous-time signals, Concept of frequency in continuous-time and discrete-time signals. [6]
2. **Basics of Systems and Transformation**: Properties of systems – linearity, time invariant, causal, stable,inverse, static and dynamic, system impulse response, convolution, correlation, Transformation - Fourier series, continuous time and discrete time Fourier transform, z-transform, its properties, limitations and inverse transforms, pole – zero concept, computation of impulse response and transfer function using transforms. [6]
3. **Analysis of Continuous time and discrete time systems:** Block diagram representation, linear time-invariant (LTI) systems, interconnection of LTI Systems, discrete time systems and their types, systems with finite and infinite duration impulse response, recursive and non-recursive structures, system realizations in direct , transpose, cascade and parallel forms. [8]
4. **DFT, FFT and Wavelet Transform:** Discrete Fourier transform (DFT), linear convolution using DFT, efficient computation of the DFT - Fast Fourier transform (FFT) algorithms, radix-2 FFT algorithms, Wavelet Transform -continuous wavelet transform and Discrete wavelet transform. [10]
5. **Digital Filter Design:** Design of infinite Impulse Response (IIR) filter from analog filters - Bilinear and Impulse invariant transformation, Finite Impulse Response (FIR) filter - amplitude & phase responses, linear phase filters, transversal filters, windowing techniques, comparison between IIR and FIR filters. [10]

Outcome: After completion of the course, students will be able to

- Understand the process of sampling and spectral characteristics of periodic and aperiodic signals using Fourieranalysis and determine the response of LTI system using Fourier analysis convolution.

Text Books:

1.A.V. Oppenheim, A.S. Willsky and S.H. Nawab, Signals and Systems, PHI, 2nd Edition, 1997.
2.S. K. Mitra, Digital Signal Processing A Computer Based Approach, Tata McGraw-Hill, 4th Edition, 2013.

Reference Books:

1.Michel J. Robert, Fundamentals of Signals and Systems, MGH International Edition, 2008. 2.John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications,Pearson Education, 4th Edition, 2012.

EC 23.337 **Cybernetics and its Applications** **Total Lectures: 40**

3-0-0-3

Objectives: 1.Students will be able to understand the development of Cybernetics and its relationship to other disciplines.
2.Students will understand the use of cybernetics in artificial Intelligence.

Pre-requisites: Control System Engineering

1.	**Introduction**: Understanding of Cybernetics fundamentals, Definition and brief history of cybernetics, Cybernetics and systems thinking, Challenges in Cybernetics, Interdisciplinary nature of cybernetics, Applications of cybernetics in engineering.	[5]
2.	**Cybernetics System and Control Theory:** Basic concepts of cybernetics: systems, feedback, control, and information, Mathematical modeling of cybernetic systems, Analysis of the stability of control systems, Stability, transient, and steady-state responses are all types of feedback. The theory of optimal control and estimation..	[8]
3.	**Cybernetics and Artificial Intelligence:** Introduction to artificial intelligence, Neural networks, fuzzy systems, and genetic algorithms, Applications of cybernetics in artificial intelligence.	[10]
4.	**CyberneticsandRobotics:**IntroductiontoRobotics,Cyberneticsprinciplein Robotics, Robot Control and navigation, Applications of cybernetics in Robotics.	[10]
5.	**Cybernetics and System Science:** Introduction to system Engineering**,** Systems analysisanddesignmethodologies,Systemsoptimizationanddecision-making, Applications of cybernetics in engineering and technology.	[7]

Outcomes:

1.The ability to understand the practical uses of cybernetics in different fields.
2.Be able to realize the growth of Cybernetics in computing and communication 3.Be able to explore the potential impact of cybernetics on society and human behavior.

Text Books:

1.William Ross Ashby , “Introduction to Cybernetic”, Franklin Classics Trade Press, 2018, ISBN 9780353243262

Reference Books:

1.Norbert Wiener, “Cybernetics: or Control and Communication in the Animal and the Machine”, Second Edition, MIT Press, 2013, ISBN: 978-1610272001
2.Vanilla Beer, Allenna Leonard, Stafford Beer the Father of Management Cybernetics: Big Data Analysis including Cybernetic Glossary”, 1st Edition, Foundation Oroborus, 2019. ISBN: 9781073031214

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EC 23.321 **Analog Communication Laboratory** **Total Hours: 26**
0-0-2-1

Objective: The educational objectives of the Analog Communication Lab course are:

1. Graduates who desire to pursue an engineering career in Communication arena will be widely employed in positions they find appropriate and desirable.
2. Graduates who desire to pursue higher degrees will be successful in gaining admission andadvancing in programs they find appropriate and desirable.

Pre-requisite: Signals & systems

1. To Generate an AM signal and measure the depth of modulation using a CRO.
2. Implement an AM Modulator and demodulator circuits and verify its waveform and calculate its modulation index.
3. Implement FM generator circuit and observe variation with modulating signal.
4. Implement a circuit of Pulse Width Modulator with IC-555.
5. Implement a circuit of Pulse Amplitude Modulator with IC-555.
6. To observe the effect of pre-emphasis and de-emphasis on given input signal
7. Analyze the pulse amplitude modulation on multisim software.
8. Study of Time Division Multiplexing and demultiplexing (TDM- PAM) (ST 2102)
9. To understand the AM Signal modulation and demodulation. (MULTISIM)
10. To understand the FM Modulation and detection. (MULTISIM)

Outcome:

Ability to apply knowledge of mathematics, basic science, and engineering to solve problemsencompassing fundamental areas of Analog Communication.

EC 23.323 **Digital Signal Processing Laboratory** **Total Hours: 26**
0-0-2-1

Objective: The lab aims to introduce the mathematical approach to manipulate discrete time signals,which are useful to learn digital system.

Pre-requisite: Nil

1. **Using the MATLAB**

i) Generation of the basic signals such as unit impulse, unit step, unit ramp, exponential, sine and cosine etc.
ii) Study of linear convolution
iii) Study of impulse response of the causal LTI System
iv) Study of Fast Fourier Transform
v) Study of circular convolution
vi) Study of Finite Impulse Response filter
vii) Study of Infinite Impulse filter response filter
viii) Study of Wavelet Transform

2. **Using the TMS320C67XX Processor**

i) Wave generation
ii) Linear Convolution
iii) Circular Convolution
iv) DFT
v) Impulse Response of systems

Outcome:

1.Analyze discrete-time systems in both time & transform domain and also throughpole-zero placement.
2. Analyze discrete-time signals and systems using DFT and FFT 3.
Design and implement digital finite impulse response (FIR) filters. 4.
Design and implement digital infinite impulse response (IIR) filters.
5. Analyze discrete time signals in time and frequency domain.

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EC 23.325 **Microprocessor and Microcontroller Laboratory** **Total Hours: 26**

0-0-2-1

Objective: To introduce to students the basics of 8086 microprocessor, assembling language programmingand interfacing with various modules.

Pre-requisite: Assembly language programming

1 **[a]** Write a program for 8085 microprocessor to move a eight bit number in register A, B, C and D. Verifythe content of all the registers after execution of program.
Also find out the followings:
(i) Total number of bytes required for the program
(ii) Hex code of each instruction used in the program

[b] Load a eight bit number stored in memory location 4000H into register A. Now load the content of A in B and in memory location 5000H. Verify the contents of A, B and memory location 5000H.

2 **[a]** Write an assembly language program for 8086 microprocessor to find out the smallest number from a
series of five eight bit numbers and store it at memory location 2000H: 2000H

[b] Write an assembly language program for 8086 microprocessor to find out the largest number from a
series of five eight bit numbers and store it at memory location 2000H: 2000H

3 **[a]** Write a program to arrange the series of four eight bit numbers in ascending order.

[b] Write a program to arrange the series of four eight bit numbers in descending order.

4 Interface three LEDs with 8086 Kit to form traffic light control logic.

5 Interface a buzzer with 8086 microprocessor with the help of relay and write a program to control the
ON-OFF sound from the buzzer

6 Interface a DC motor with 8086 microprocessor and write a program to control its operation.

7 a)Introduction to Keil µVision Integrated Design Environment software.
b)Write an ALP for 8051 to move a block of five bytes stored from locations 30H to 40H of internalRAM.

8 a)Write an ALP for 8051 to move a block of five bytes stored from address 3000H of external datamemory to address 40H of internal RAM.
b)Write an ALP for 8051 to move a block of five bytes stored from address 40H of internal RAM toaddress 3000H of external data memory.

9 Three 8 bit numbers are stored at internal RAM locations 30H, 31H and 32H. Find out the largestnumber and store it at internal RAM location 40H.

10 Three 8 bit numbers are stored at internal RAM locations 30H, 31H and 32H. Find out the smallestnumber and store it at internal RAM location 40H.

Outcome: After the basic knowledge of microprocessor and microcontroller interfacing and their applications,the student will be able to:

1.Analyze and apply working of 8086.
2.Compare the various interface techniques. Analyze and apply the working of 8255, 8279,8259, 8251, 8257 ICs and design and develop the programs.
3.Learning the Communication Standards.

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EE 23.303 **Control System Engineering** **Total Lectures: 40**

3-0-0-3

Objective: The student gains the knowledge of the fundamental principles of analog and digital control system engineering, time response and frequency response analysis with its practical implementation. This course helps in understanding the design of Compensator and PID controller for the Automatic control of Industry.

Pre-requisite: Mathematics, Network Analysis & Synthesis

1. **Introduction:** Industrial control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of feedback. Block diagram reduction and signal flow graph representation of systems. [9]
2. **Time Domain Analysis:** Standard test signals, time response of 1st and 2nd order systems for standard test inputs, time domain design specifications, Steady state errors for unit step, unit ramp and unit parabolic inputs, Error constants. Concept of stability: conditions for stable system, relative and marginal stability, Routh-Hurwitz criterion. Root-Locus technique. Construction of Root-loci. [10]
3. **Frequency Domain Analysis:** Relationship between time and frequency response. Polar plots. Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. [9]
4. **Compensator and Controller:** Realization of basic compensators, cascade compensation in time domain and frequency domain, feedback compensation - Design of lag, lead, lag-lead series compensator (using Bode plot), P, PI and PID controllers in frequency domain. [8]
5. **State Variables:** Analysis of systems, state vector, state space, advantages of state space techniques, state space representation, State variable analysis and design. [4]

Outcome: At the end of this course, students will demonstrate the ability to

- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.
- Knowledge of stability analysis and improvement of stability for control system.
- Benefit the graduates who wish to work in core sector industry as most of the core sector is state-of-art control.

Text Books:
1. K. Ogata, "Modern Control Engineering," Pearson Education/Prentice Hall of India, 4th Edition, 2003.
2. I. J. Nagrath and M. Gopal, "Control System Engineering," New Age International Publishers, 2nd Edition, 2003.

Reference Books:
1. Syed Hasan Saeed, "Automatic Control Systems (with MATLAB Programs)," S.K. Kataria& Sons Publishers, 6th Edition, 2008.
2. Samarjit Ghosh, "Control Systems: Theory and Applications," Pearson Education, 2nd Edition, 2012.

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EC 23.302 **VLSI Design** **Total Lectures: 40**

3-0-0-3

Course Objective:

1.Graduates who desire to pursue an engineering career in VLSI Design arena will be widely employed in positions they find appropriate and desirable.

2.Graduates who desire to pursue higher degrees will be successful in gaining mission and advancing in programs they find appropriate and desirable.

Pre-requisites: Electronics Devices and Circuits, Digital Electronics.

1. **BasicVLSIDesignIssues:**ICdesigntechniques-hierarchicaldesign,design abstraction and computer-aided design [4]
2. **MOS Transistor Theory:** Current-voltage characteristics of MOSFETS, threshold voltage and body effect, MOSFET design equations, second order effects, MOSFET capacitances [8]
3. **NMOS and CMOS Inverter:** NMOS and CMOS inverters, W/L ratio for NMOS and CMOS inverters, $\beta\beta_{nn}/\beta\beta_{pp}$ratio, noise margin, NMOS and CMOS Voltage transfer Characteristics, CMOS delay and powerdissipation [8]
4. **MOS Inverter's Switching Characteristics and Stick Diagram:** Calculation of delay times, Inverter design with delay constraints, Stick diagrams, CMOS design style, design rules:lambda based design rules, layout design [6]
5. **VLSI Circuit Design Techniques & Compact Modeling:** Inverter equivalent of series and parallel MOS circuits, logic design with delay and power constraints, worst case design, complex logic design, Compact model Level 1, Level 2, Level 3. [14]

Course Outcome:

1.Ability to apply knowledge of mathematics, basic science, and engineering to solve problems encompassing fundamental areas of VLSI design.
2.Ability to apply in-depth knowledge of VLSI design principles, systems, and devices to the solution of real time problems.
3.Ability to design and evaluate a component or system to meet desired needs within the field of VLSI design.

Text Books:

1.Douglas A. Pucknell & Kamran Eshraghian, Basic VLSI Design, PHI, 3rd Edition, 2011.
2.Neil H.E. Weste, David Harris, Ayan Banerjee, CMOS VLSI Design, A Circuits and Systems Perspective,Pearson Education, 4th Edition, 2011.

Reference Books:

1.Jab M. Rabaey, Anantha Chandra Kasan, Borivoje Nikolic, Digital Integrated Circuits - A Design Perspective,PHI, 2nd Edition, 2012.
2.Y. P. Tsividis, Operation and Modelling of the MOS Transistor, McGraw-Hill, 2nd Edition, 2009.

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CS 23.302 **Artificial Intelligence and Machine Learning** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): (Programming for Problem Solving I), (Logic in Computer Science)

Objective(s):
- To understand the basic problem solving in Artificial Intelligence.
- To learn different blind as well as heuristic search strategies.
- To understand the various ways of knowledge representation in Artificial Intelligence.
- To know the concepts of machine learning.

1. **Overview of Artificial Intelligence:** Introduction to artificial intelligence and intelligent agents, brief history of artificial intelligence, related research fields, AI techniques, AI problems, applications and future of AI. [6]
2. **Problem Solving and Search Techniques:** Basics of problem solving, Problem representation paradigms, defining problem as a state space representation, uninformed search, depth first search, breadth first search, heuristic search, heuristic functions, generate and test, hill climbing, best first search, A* algorithm, problem reduction, AND/OR graph, AO* algorithm. [8]
3. **Knowledge Representation and Logic:** Representation and mappings, procedural versus declarative knowledge, approaches and issues in knowledge representation, first order logic, higher order logic, unification and resolution for performing logical inference, probabilistic logic. [8]
4. **GameTheory:** Minimaxsearch,alpha-betacutoffs,iterativedeepening, references on specific games. [8]
5. **Machine Learning:** Well posed learning problems, Components of learning, supervised learning, unsupervised learning, reinforcement learning, Designing a learning system, support vector machines, KNN, learning decision trees, association rule mining, Neural Network representation, perceptrons, Linear separability and adaline neural net. [10]

Outcome(s): On successful completion of this course, students will be able to
- Solve the basic problems and apply searching techniques used in Artificial Intelligence.
- To select knowledge representations to solve AI problems.
- Apply various machine learning techniques.

Text Books:
1. Rich E., and Knight K., Artificial Intelligence, Tata McGraw-Hill, 3rd edition, 2009.
2. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

Reference Books:
1. Patterson D. W., Introduction to Artificial Intelligence and Expert Systems, Prentice-Hall of India, 1st edition, 2015.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 5th edition, 2009.
3. Russell S., and Norvig P., Artificial Intelligence – A Modern Approach, Prentice-Hall of India, 3rd edition, 2014.

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EC 23.306 **Digital Communication** **Total Lectures: 40**

3-0-0-3

Objective: The objective of this course is to introduce the students to the basic concepts of digital communication. The aim of this course is to study the fundamental aspects of digital communication systems. The understanding of the fundamentals of digital communication by studying theory, numerical and implementation of circuits.

Pre-requisite: Basics of Communication Systems and Techniques.

1. **Model of a Communication System:** Introduction, advantages of digital communication over analogcommunication, probability theory random process and random variables. **[5]**
2. **Digital Communication Techniques:** uniform and non-uniform quantization techniques, PCM, DPCM, DM, and ADM, μ law compression standard. **[8]**
3. **Multiplexing:** Digital multiplexing hierarchy (AT&T and CCIT), Electrical representation of binary sequences, Bandwidth requirement of PCM. **[3]**
4. **Information Theory and Coding:** Channel capacity, Shannon capacity, source entropy, Shannon- Fano, Huffman coding, linear block codes and syndrome decoding, cyclic codes, BCH codes, convolution, Viterbi coding and decoding. **[12]**
5. **Digital Modulation Techniques:** Amplitude Shift Keying modulation, frequency Shift Keying modulation, Phase Shift Keying modulation, inter-symbol interference, CFSK & Sunde's FSK, matched filter and probability of error analysis. **[12]**

Outcome: After completion of the course, students will be able to

1. The students can understand the concepts of digital communication.
2. They acquire and apply the knowledge to implement the concepts for designing an efficientcommunication system.
3. They become able to identify, analyse and implement new ideas in digital communication systems forproposing alternate solutions.

Text Books:

1. B. P. Lathi, Modern Digital and Analog communication Systems, Oxford University Press, 4th Edition,2018.
2. Taub and Schilling, Principles of Communication Systems, TMH, 4th Edition, 2013.

Reference Books:

1. Kennedy, Davis, Electronic Communication Systems, TMH, 6th Edition, 2017.
2. S. Haykins, Communication Systems, Wiley, 5th Edition, 2009.

EC 23. 308 **Antenna and Wave Propagation** **Total Lectures: 40**
3-0-0-3

Course Objective: To impart knowledge on basics of antenna theory and to analyze and design a start of art antenna forwireless communications and RADAR.

Pre-requisite: Principles of Electromagnetics

1. **Introduction**:Basicpropertiesoftransmitting,andreceivingantenna,gain, bandwidth, and polarization,Effective aperture and Friss transmission formula. [4]
2. **Physical Concept of Radiation:** Retarded potentials hertzian dipole, antenna parameters, radiation pattern, gain, directivity, effective aperture, reciprocity and radiation from dipoles of arbitrary length. [6]
3. **Theory of Array Antenna: A**rrays of point sources, Endfire and Broadside arrays, Log-periodic, Yagi- uda arrays, Analysis of Rhombic antenna. Design of Rhombic Antennas, Loop Antenna: Radiation from small loop and its radiation resistance. Helical antenna: Normal and axial mode operation. Synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method. [10]
4. **Frequency Independent Antenna:** Slot, horn antenna, parabolic antenna, aperture antennas and microstrip antenna: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas. [8]
5. **Wave Propagation:** Propagation in free space. Propagation around the earth, surface wave propagation, structure of the ionosphere, Sky wave propagation- propagation of plane waves in ionized medium, Determination of critical frequency, MUF. Fading, troposphere propagation, Super refraction, antenna for aeronautical mobile systems, cell-site and mobile antenna, adaptive antennas. [12]

Course Outcome: After completion of the course, students will be able to

1.Select the appropriate portion of electromagnetic theory and its application to antennas. 2.Distinguish the receiving antennas from transmitting antennas, analyze and justify their characteristics.

3.Assess the need for antenna arrays and mathematically analyze the types of antenna arrays.

4.Distinguish primary from secondary antennas and analyze their characteristics by applying optics andacoustics principles.

5.Outline the factors involved in the propagation of radio waves using practical antennas.

Text Books:

1.C. A. Balanis, Antenna Theory and Design, John Wiley & Sons, 3rd Ed, 2005.

2.W. L. Stutzman, and G. A. Thiele, Antenna Theory and Design, John Wiley & Sons, 2nd Ed, 1998.

Reference Books:

1.R. E. Collin, Antennas and Radio Wave Propagation, Tata McGraw-Hill, 5th Edition, 2017.

2.K.D. Prasad, Antenna and Wave Propagation, Satya Prakashan, 3rd Edition, 2003

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EC 23.322 **VLSI Laboratory** **Total Hours: 26**
0-0-2-1

Course Objective: To introduce various aspects of VLSI circuits and their design.

Pre-requisite: Digital Electronics, Electronics Devices and Circuits

Using the Tanner EDA tools

1 Study the V-I characteristics of NMOS transistor

2 Study of different invertor designs
a) Resistive load inverter
b) NMOS load inverter
c) PMOS load inverter
CMOS inverter

3 Implement and verify the functionality for the following using CMOS technology
a) Two input NAND gate
b) Two input NOR gate

4 Implement and verify the functionality for a Boolean function using CMOStechnology.

5 Draw the layout for the following and verify its functionality.
a)CMOS inverter
b)two input NAND gate two input NOR gated)

6 Draw and verify the layout the following function

$$XX=(AAAA+DD+EEEE)'$$

7 Design a Full Adder cell using various configurations proposed in the literature and simulate to compare the performance using EDA tool.

8 Implementation of minor project based on VLSI

Course Outcome: Generalize the design techniques and analyze the characteristics of VLSI circuits such as area,speed and power dissipation

EC 23.341 Artificial Intelligence and Machine Learning Laboratory Total Hours: 26
0-0-2-1

Course Objective:

- Comprehend the fundamental ideas and principles of machine learning.
- Attain practical knowledge and abilities in implementing machine learning algorithms
- Comprehend the mathematical foundations behind machine learning algorithms.

Pre-requisite: Nil

1. Introduction to Python and MATLAB Programming.
2. Use a dataset to train a linear regression model and predict values by using Python and MATLAB Programming.
3. Use a dataset to train a logistic regression model and predict values by using Python and MATLAB Programming.
4. Employ the KNN algorithm to a dataset and categorize new data points by using Python and MATLAB Programming.
5. Employ the SVM to a dataset and categorize new data points by using Python and MATLAB Programming.
6. Construct a decision tree model and forecast outcomes for new instances by using Python and MATLAB Programming.
7. Execute and employ PCA to a dataset and visualize the decreased dimensionality by using Python and MATLAB Programming.

Course Outcome:

- Apply machine learning algorithms to resolve real-world problems.
- Implement and assess regression, classification, and clustering algorithms.
- Utilize feature engineering techniques to enhance model performance.

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EC 23.324 **Antenna Laboratory** **Lab Credits 0-0-2-1**

1 To Draw the radiation pattern and find the Front to back ratio, VSWR, half power beam width of following antennas using S 45 Antenna Set-up
(A) Dipole L/2 (B) Folded dipole L/2 (C) Yagi 5Element (D) Loop Square
(E) Quad Loop (F) Dipole 3/2L

2 To Draw the radiation patterns and Find the half power beam width and front to back ratio of following antennas using ATS-2003 kit.
(A)End Fire Antenna (B) Yagi- Uda- 3-Element (C) Dipole Antenna (D) Quad Antenna
(E) Square Loop

3 To Draw the radiation pattern and find the Front to back ratio, VSWR, half power beam width of following antenna using S-99 Antenna Set-up
(A)Yagi- Uda- 5- Element (B)Yagi- Uda- 7-Element (C) Log-Periodic (D) Broad side Array
(E) End Fire Array (F) Microstrip

4 To Draw the radiation pattern and find the antenna Test Wavelength, Near Field Boundary, Gain,HPBW, Directivity, BWFN, Antenna Resolution, Antenna Factor, Front to Back Ratio of following wired Antennas using RFL-AMS-A
(A) Helix Antenna (B) Log Periodic Antenna (C) Yagi UDA(5 Elements) (D) Wire monopole Antenna
(E) Rectangular Loop Antenna (F) VEE Antenna

5 To Draw the radiation pattern and find the antenna Test Wavelength, Near Field Boundary, Gain, HPBW, Directivity, BWFN, Antenna Resolution, Antenna Factor, Front to Back Ratio of E-Horn Aperture Antenna using RFL-AMS-A

6 To Draw the radiation pattern and find the antenna Test Wavelength, Near Field Boundary, Gain, HPBW, Directivity, BWFN, Antenna Resolution, Antenna Factor, Front to Back Ratio of Corner Reflector Antennas using RFL-AMS-A

7 To Draw the radiation pattern and find the antenna Test Wavelength, Near Field Boundary, Gain,HPBW, Directivity, BWFN, Antenna Resolution, Antenna Factor, Front to Back Ratio of following Array antennas using RFL-AMS-A
(A) Broad side Array (B) End Fire Antenna

8 To Draw the radiationpattern and find the antenna Test Wavelength, Near Field Boundary, Gain, HPBW, Directivity, BWFN, Antenna Resolution, Antenna Factor, Front to Back Ratio of following Planar Microstrip Antennas using RFL-AMS-A
(A) 2*1 Array Antenna (B) Insert Feed Antenna (C) TMSAAntenna (D) Angular ringAntenna
(E) CMSA

Outcome: After completion of the course, students would be able to:

- Gain hands-on experience with microwave test instruments such as vector network analyzers (VNAs), spectrum analyzers, power meters, and signal generators.
- Learn various measurement techniques used in microwave engineering, including impedance measurements, S-parameter measurements, power measurements, and frequency response measurements.

- Characterize the performance of microwave components through measurements of insertion loss, return loss, isolation, coupling, directivity, VSWR etc.
- Perform measurements of antenna parameters such as radiation patterns, gain, impedance matching, and bandwidth.

Text Book: Lab Manual

EC 23. 326 **Digital Communication Laboratory** **Total Hour:26**
0-0-2-1

Objective: The objectives of the Digital Communication laboratory are:

a)To allow the students to perform experiments that demonstrate the theory of digital communicationsystems that will be discussed in the lecture course.

b)To introduce the students to some of the electronic components that makes up digital communicationsystems.

Pre-requisite: Thebasicknowledgeofdifferentelectroniccomponentslikeresistors,capacitors, transformers, LEDsand devices like CRO, Power Supply, Function Generator, Multimeters.

List of Experiments

1.Study of FSK modulation and demodulation.

2.Measurement of Numerical Aperture of a Fiber Using Optical Fiber Trainer Kit & Measure the Bending Loss.

3.Study of DPSK Modulation and demodulation

4.Study of Cyclic redundancy check codes.

5.Study of Time Division Multiplexing and de-multiplexing (TDM- PAM).

6.Study of BPSK Modulation and demodulation

7.Study of MSK Modulation and demodulation

8.To generate the FM signal and demodulate it

9.FSK using Multisim software.

10.Generation of ASK signal using multisim software.

Outcome: The students will understand the basic facts and concepts of digital communication by performing experiments.

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CS 23.484 **Big Data Analysis** **Total Lectures: 40**
Credit:3-0-0-3

Objective(s):

- To Understand the Big Data Platform and its Use cases
- To Provide an overview of Apache Hadoop
- To Provide HDFS Concepts and Interfacing with HDFS
- To Understand Map Reduce Jobs
- To Provide hands on Hodoop Eco System
- To apply analytics on Structured, Unstructured Data.
- To Exposure to Data Analytics with R.

Prerequisite(s): Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment

1. INTRODUCTION TO BIG DATA AND HADOOP Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets. [10]
2. HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures. [8]
3. Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features. [5]
4. Hadoop Eco System Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS, NoSQL: What is it?, Where It is Used Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL [10]
5. Data Analytics with R Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR. [7]

Outcome(s): On the successful completion of the course, the student will be able to:

- Identify Big Data and its Business Implications.
- List the components of Hadoop and Hadoop Eco-System
- Manage Job Execution in Hadoop Environment
- Develop Big Data Solutions using Hadoop Eco System
- Analyze Infosphere BigInsights Big Data Recommendations.
- Apply Machine Learning Techniques using R.

Text Books:
1.Tom White " Hadoop: The Definitive Guide" Third Edit , O'reily Media, 2012.
2.Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books:
1.Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2.Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3.Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media

(2013), Oracle press.
4.Anand Rajaraman and Jef rey David Ulman, “Mining of Massive Datasets”, Cambridge University Press, 2012.

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CS 23.413 **Distributed Databases** **Total Lectures: 40**

Credit: 3-0-0-3

Prerequisite(s): CS 19.204 (Database Management System)

Objective(s):

- To build on the previous background of database systems by deepening the understanding of the theoretical and practical aspects of the database technologies, showing the need for distributed database technology.
- To introduce the concept and techniques of distributed database including principles, architectures, design, implementation and major domain of application.

1	**Overview:** Features of distributed versus centralized databases, levels of distributed transparency, types of data fragmentation, distributed database access primitives, integrity constraints in distributed databases.	[6]
2	**Distributed Database Design:** A framework for distributed database design, the design of database fragmentation, allocation of fragments, translation of global queries to fragment queries, parametric queries, a framework for query optimization.	[10]
3	**Management of Distributed Transactions:** A framework for transaction management, supporting atomicity of distributed transactions, concurrency control for distributed transactions, architectural aspects of distributed transactions.	[8]
4	**Concurrency Control:** Foundations of distributed concurrency control, distributed deadlocks, concurrency control based on timestamps, basic concepts of reliability, reliability and concurrency control, determining a constant view of the network, checkpoints and cold restart.	[8]
5	**Distributed Database Administration:** Catalog management in distributed databases, authorization and protection, SDD-1 a system for distributed databases, the R* project	[8]

Outcome(s): On successful completion of this course, students will be able to

- Identify the introductory distributed database concepts and its structures.
- Describe terms related to distributed object database design and management.
- Produce the transaction management and query processing techniques in DDBMS.
- Relate the importance and application of emerging database technology.

Text Books:

1. Stefano Ceri and Giuseppe Pelagatti, “Distributed Databases Principles and Systems”, McGraw-Hill, 2013

Reference Books:

1. M Tamar Ozsu and Patrick Valduriez, “Principles of Distributed Database Systems”, Pearson Education, 2011
2. Chanda Ray, “Distributed Database Systems”, Pearson Education, 2009

EC 23.457 **Deep Learning: Principles and Practices** **Total Lectures: 40**

3-0-0-3

Objectives: 1.To discuss basic neural network difficulties and main deep neural network frameworks
2.To solve real-world problems by using deep learning

Pre-requisites: Nil

1. **Introduction**: Artificial Neural Networks (ANN) - Functions in ANN – Activation function, Loss function - L1, L2 - Function approximation, classification / clustering problems - Applications. [6]
2. **Learning in Deep Networks:** Back propagation training, Learning the weights, Chain rule, Stochastic gradient descent, Sigmoid units and vanishing gradient, Rectified Linear Unit (ReLU) and its variants - Cross entropy for classification and activation, Batch learning. [8]
3. **Improving Deep Neural Networks:** Hyper-parameter tuning, Regularization -Dropouts, Minibatch gradient descent, Data Augmentation, Stratification, Generalization Gap – Under-fitting Vs Over-fitting - Optimization – Momentum, Learning rate schedules, AdaGrad, RMSProp and Adam optimization, Internal Co-variant and Batch Normalization, Initialization – weights, Bias [8]
4. **ConvolutionNeuralNetworks:**CNNOperations,Pooling,Basicarchitecture, Variants of the Basic Convolution Model – Advanced architectures: AlexNet, ResNet and others. [8]
5. **Recurrent and Recursive Neural Networks:** Recurrent Neural Networks -Bidirectional RNNs, Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders, The Challenge of Long-Term Dependencies, Echo State Networks, Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory. [10]

Outcomes:

1.Understand deep neural network terminologies and learning methodologies.
2.Indentify and apply the deep learning methods for the application.
3.Design custom deep-nets for human-intuitive applications.
4.Design of Test procedures to evaluate the model's efficiency.

Text Books:

1.Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017
2.Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017

Reference Books:

1.Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.
2.Neural Networks and Deep Learning, Michael Nielsen,, Determination Press.

EC 23.411 **Transform Techniques** **Total Lectures: 40**

3-0-0-3

Objective: 1.To provide broad understanding of the Transforms.
2.To make the student understand, applications of Continuous and Discrete wavelettransforms.

Prerequisite: Signal Processing and Applications

1.	**Transforms:** Walsh, Hadamard, Haar and Slant Transforms, DCT, DST, KLT,– definition,properties and applications.	[10]
2.	**Continuous Wavelet Transform (CWT):** Short comings of STFT, Need for wavelets, Wavelet Basis Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT- Tiling of time scale plane forCWT, Empirical Mode Decomposition.	[8]
3.	**Multi Rate Analysis:** Need for Scaling function – Multi Resolution Analysis, Two-Channel Filter Banks, Perfect Reconstruction Condition, Relationship between Filter Banks andWavelet Basis.	[8]
4.	**Discrete Wavelet Transform (DWT):** DWT, Structure of DWT Filter Banks, Daubechies Wavelet Function, Applications of DWT.	[8]
5.	**Special Topics:** Wavelet Packet Transform, Multidimensional Wavelets, Bi-orthogonalbasis- BSplines, Lifting Scheme of Wavelet Generation, Multi Wavelets.	[6]

Outcomes: Ability to apply in-depth knowledge of Transforms and wavelets to the solution of real time problems.

Text Books:
1. Raghuveer M. Rao and Ajit S. Bopardikar, Wavelet Transforms-Introduction theory and applications, Pearson Education, Asia, New Delhi, 2003.
2. Soman. K. P, Ramachandran. K.I, Insight into Wavelets from Theory to practice, Prentice HallIndia, First Edition, 2004.

References:
1. C. Sydney Burrus, Introduction to Wavelets and Wavelet Transforms, PHI, 1st Edition, 1997.
2. Stephen G. Mallat, A Wavelet Tour of Signal Processing, Academic Press, 2nd Edition, 2006.

EC 23.461 **Intelligent Robots and Drone Technology** **Total Lectures: 40**

3-0-0-3

Objectives:
1.Modeling dynamic systems, measuring and monitoring their performance, and making decisions
2.Designing and simulating a neural network
3.Apply AI that makes robots explore complex situations.
4.Develop intelligent controls for robotic systems that can hold and manipulate objects.

Pre-requisites: Nil

1.	**Introduction** Machine intelligence, History of Robotics, Types of Robots, Technical requirements for setting up Robot, Robot anatomy, architecture, Display devices, Software and Hardware setup.	[6]
2.	**Foundation for Robotics and AI:** The basic principle of robotics and AI, Sensing, Navigation, Planning, Uncertainty, Robot Control system and a decision making framework, Robot Kinematics and Path Planning, Artificial Personality: Emotion state machine, Creating a model of human behavior, Robot emotion engine, Human emotional model.	[8]
3.	**Concept for a Practical Robot Design Process:** A systems engineering based approach to robotics: Cleaning up the environment; Use cases: The problem Who, What, When and Where; Storyboards: Project goals, Decomposing hardware needs, breaking down software needs, writing a specification; Task Analysis, Teaching the Robot arm: Adaptive learning rate, Q-learning implementation, indexed states and actions, Genetic algorithms	[8]
4.	**Object Recognition Using Neural Networks and Supervised Learning:** Image recognition training and deployment process, Artificial neurons, convolution, convolutional neural network, Build the object detector.	[8]
5.	**Basic concepts of Drone:** Introduction to Drone, History of Drones, three terrains, anatomy of a Drone, Clothesline Racer, Radio-Controlled Blimp. Choosing an Airframe, Choosing Between Commercial Options, Maker Beam Airframe – Parts and Steps, Motors and Props, Outrunner Versus Inrunner, Brushed Versus Brushless, AC Versus DC, Prop Adapters, Steps for Attaching the Props and Motors.	[10]

Outcomes:
1.Understand the fundamentals of robotic intelligence
2.Design and modeling of machine vision neural network
3.Understand drone technology basics.
4.Solve real-world challenges with robots intelligence and drone technologies.

Text Books:
1.Francis X. Govers, Artificial Intelligence for Robotics, Packt Publishing, O'Reilly, 2018
2.Robin R Murphy, Introduction to AI Robotics, MIT Press, 2019

Reference Books:
1. J. Craig, Introduction to Robotics Mechanics and Control, Pearson, 2018.
2.H. Asada and J.-J. Slotine, Robot Analysis and Control, J. Wiley & Sons, 1986.
3.H. Choset, Principles of Robot Motion, MIT Press, 2005.

2.G. Long, Fundamentals of Robot Mechanics, Quintus-Hyperion, 2015

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CS 23.493 **Foundations and Applications of IoT** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CS 23.101 (Programming for Problem Solving)

Objective(s):
- To introduce the vision and impact of IoT.
- To understand IoT layered architecture and protocols
- To introduce hardware used to implement IoT applications.
- To understand the challenges that must be overcome by IoT technology.

1	**Introduction to Internet of Things:** Overview and Motivations, Evolution of IoT, Characteristics of IoT, IoT Layered Architecture, General Observations, ITU-T Views**,** Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.	[6]
2	**RFID:** Introduction, Principle of RFID, Components of an RFID system **EPCGlobal Architecture Framework:** EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things **Wireless Sensor Networks:** History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication, WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integrationapproaches.	[10]
3	**Machine-to-Machine Communications,** Difference between IoT and M2M, Interoperability in IoT,IoT Open source architecture (OIC)- OIC Architecture &Design principles- IoT Devices and deployment models. **Interfacing with Arduino:** Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino	[8]
4	**Working with Raspberry Pi:**Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Piwith basic peripherals, Implementation of IoT with Raspberry Pi, Implementation of IoT with Raspberry Pi, SDN for IoT, Data Handling and Analytics	[8]
5	**IoT Applications:**IoT applications for industry: Future Factory Concepts, Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring**.**	[8]

Outcome(s):
- Understand the vision of IoT from a global context.
- Understand the fundamental of IoT hardware.
- Understand the use of Devices, Gateways and Data Management in IoT.
- Build architecture in IoT.
- Analyze, design and develop parts of IoT solution.

Text Books:

1.Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2MCommunications”, ISBN: 978-1-118-47347-4, Willy Publications
2.Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Reference Books:

1.Parikshit N. Mahalle& Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).
2.Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
3.Peter Waher, "Learning Internet of Things", Packt Publishing Ltd, 2015.

4.Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

5.Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

6.Malcolm Frank, Paul Roehrig, Ben Pring,"What to Do When Machines Do Everything”, John Wiley & Sons, 2017

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EC 23.410 **Adaptive Signal Processing** **Total Lectures: 40**

3-0-0-3 Objective:

1.This course treats adaptive signal processing algorithms for extracting relevantinformation from noisy signals.
2.The emphasis is on recursive, model based estimation methods for time-varyingsystems.

Prerequisite: Signal Processing and Applications

1. **Introduction:** Definition and characteristics, general properties open and closed loopadaptation. [1]
2. **Adaptive Linear Combiner:** General description, input signal and Weight vectors, desired response and error performance function, gradient and minimum mean square. Theory of Adaptation with Stationary Signals: Input correlation matrix, Eigenvalues and eigenvectors of the correlation matrix, and their geometrical significance. Basic ideas of gradient search methods, gradient search by Newton's method and method of steepest descent, gradient component estimation by derivative measurement, Levinson Durbin's Algorithm - Lattice Derivation-Forward and backward prediction-Adaptive lattice structures. [12]
3. **Adaptive Algorithms:** Least mean square algorithm, convergence, learning curve noise in Weight vector misadjustment and performances of LMS algorithms, sequential regression algorithm, adaptive recursive LMS algorithm, random search algorithm. [10]
4. **Recursive Least Square Algorithm:** Preliminaries, matrix inversion lemma, exponentially weighted RLS algorithm, update recursion for the sum of weighted error squares, convergence analysis of RLS algorithm. [8]
5. **Adaptive Filter Structures:** Lattice structures, all poles and all zeroes versions, adaptive lattice predictor. Lattice LMS algorithms, and lattice SER algorithms, adaptive filters with orthogonal signals, DFT and lattice preprocessors. [9]

Outcomes:
1.Design and apply optimal minimum mean square estimators and in particular linear estimators. Tounderstand and compute their expected performance and verify it.
2.Design, implement and apply Wiener filters (FIR, non-causal, causal) and evaluate theirperformance.
3.Design, implement and apply LMS, RLS, and Kalman filters to given applications.

Text Books:
1. Widrow and Stearns, Adaptive Signal Processing, Pearson Education, 1999.
2. Simon Haykin, Adaptive Filter Theory, Pearson Education, 2008.

References:
1. Cowan & Grant, Adaptive Filters, Prentice Hall, 1985.
2. John R. Treichler, Theory and Design of Adaptive Filters, PHI, 1987.

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CS 23.465 **Machine Learning using R** **Total Lectures: 40**

Credit: 3-0-0-3

Prerequisite(s): Probability, Statistics, Introduction to computer programming, Linear Algebra

Objective(s): Understand and Appreciate why data science is gaining importance in today's business world.
Comprehend where data science can be applied in different scenarios across industry domains.
Understand the fundamentals of R language and its usage for statistical computing
Identify various data importing, manipulation, visualization techniques in R and perform exploratory data analysis
Recognize various machine learning techniques such as classification, regression etc. across several use cases

1. Unit I: Introduction to Data Science and Machine Learning Digital Data: [8]
Structured, Unstructured, Semi-structured data, what is Machine Learning? Why Machine Learning? Concept of Learning, Types of Machine Learning: Supervised Machine Learning, Unsupervised Machine Learning, Semi-supervised Machine Learning, Reinforcement Machine Learning, Industrial applications of Machine Learning across domains such as Healthcare, Finance, Retail etc.

2. Unit II: R Objects: CRAN introduction, Data Handling, Introduction to R, why R? [6]
Object, Vector, List, Factor, Matrix, Array, Data Frame, Manipulating Objects, Input/Output, R constructs, R Data Analytics packages.

3. UNIT III: Descriptive Statistics Central tendency and visualisation: [8]
RDispersion – variance, standard deviation, shape – skewness, kurtosis, percentiles, five point summary, boxplots, histograms, barplot, pie chart, scatter plot, two way tables, covariance, correlation, Chi-Square test for two way tables.

4. Unit IV: Unsupervised Learning – Clustering, what is Clustering? Applications of [8]
Clustering, Similarity measures, Partition based Clustering Techniques – K means clustering, k-medoid, Hierarchical clustering, Density based clustering, Cluster validation.

5. Unit V: Supervised Learning & Neural Networks: Regression, Classification, What [12]
is Regression? Simple Linear Regression, Multiple Linear Regression, What is Classification? Logistic Regression, Decision Tree, k-Nearest Neighbors, Support Vector Machine, Neural Networks**,** Activation functions, learning rate, Basics of Deep Learning Networks**.**

Outcome(s): At the end of this course, students will be able to:
1.Explain why, where, how and what Machine Learning is.
2.Recognize various Machine Learning Techniques.
3.Apply Machine Learning techniques such as classification, regression.
4.Explore advanced Machine Learning techniques like Support Vector Machines and Deep Learning.

Hardware / Software Requirements

Pentium P5, 3 GHz or higher
8 GB (or higher) RAM, 100 GB (or higher) HD
Windows 8 or 10 (or higher)
R and R Studio

Books:

1.Nina Zumel, John Mount, Manning Shelter Island, "Practical Data Science with R", Second Edition, Manning Publications, 2019.
2.J.Han, M Kamber, J Pei, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2011.
3.Pang-Ning Tan, Steinberg, Vipin Kumar, "Introduction to Data Mining", 2nd Edition, Pearson, 2019.
4.Gareth James, Daniela Witten,Trevor Hastie, Robert Tibshirani, "Introduction to Statistical Learning using R", 1st Edition, Springer, New York, NY, 2017.
5.Max Kuhn, Kjell Johnson, "Applied Predictive Modeling", 2nd Edition, Springer; 2018.

B.Tech Electronics and Communication Engineering (Specialization in Artificial Intelligence and Cybernetics)

Four Year Program
Academic Curriculum (2023-2027 Batch Onwards)

CS 23.494 **Software Defined Networking** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Nil

Objective(s):

- To explore the basics of SDN
- To discuss various types plane
- To list out various controllers
- To program a simple SDN

1	**Control and Data Planes**: Introduction, evolution vs revolution, the control plane, data plane, moving information between planes, distributed control planes, convergence time, load balancing, creating the MPLS overlay, centralized control planes, logical vs literal, ATM.LANE, route servers.	[8]
2	**SDN Controllers:** Wire protocol, replication, FAWG, hybrid approaches, SDN controllers, VMware, Nicira, OpenFlow, Mininet, NOX/POX, Trema, Ryu, L3VPN, RSPV-TE problem statement, bin-packing, deadlock, Plexxi, Cisco OnePK.	[8]
3	**Network Programmability:** The management interface, the application-network divide, NETCONF and NETMOD, SNMP, modern programmatic interface, XMPP, JSON, I2RS, OpenStack, CloudStack, Puppet, virtual multitenant data center, SDN solution for data center networks.	[8]
4	**Network Function Virtualization**: Virtualization and data plane I/O, services engineered path, service locations and chaining, NFV at ETSI, non-ETSI NFV work, network topology, LLDP, BGP-TE/LS, ALTO, I2RS topology.	[8]
5	**Building an SDN framework:** Build code first, ask questions later, the Juniper SDN framework, IETF SDN framework, open daylight controller/framework, use cases for bandwidth scheduling, manipulation, data center overlays, big data, NFV, and traffic monitoring.	[8]

Outcome(s): On successful completion the students will be able to:

- Describe the key benefits of SDN
- Describe the data plane
- Configure an SDN friendly network emulator
- Program a simple SDN for a given task using a low-level approach and high-level approach
- Evaluate a sample SDNs performance and reliability

Text Books:

1.Ken Gray, Thomas D Nadeau, “SDN: Software Defined Networks”, O’Reilly, 2013.

Reference Books:

1.Paul Goransson, Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, First edition, 2014.
2.Vishal Shukla, “Introduction to Software Defined Networking – OpenFlow&VxLAN”, Createspace, 2013
3.Patricia A Morreale, James M. Anderson, “Software Defined Networking: Design and Deployment”, CRC Press, 2014

B.Tech Electronics and Communication Engineering (Specialization in Artificial Intelligence and Cybernetics)

Four Year Program
Academic Curriculum (2023-2027 Batch Onwards)

CS 23.495 **Principles and Practices of Secure Computing** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Nil

Objective(s):
- To understand the technical realization and security of data and computers.
- To understand the industry security standards, regulatory mandates, audit policies and compliance requirements for cloud-based infrastructures.

1	**Authentication, Access Control and Cryptography:** Identification vs. authentication, authentication based on phrases, biometrics and tokens, multifactor authentication, access control, access policies, role-based access control, problems addressed by encryption, trust and certification, digital signatures.	[8]
2	**Programs and Programming:** Unintentional programming oversights, malicious code – malware, countermeasures, browser attacks, web attacks targeting users, obtaining user or website data, email attacks.	[8]
3	**Operating Systems and Network Security:** Security in operating systems, security in design of operating system, rootkit, threats to network communications, wireless network security, denial of service, distributed denial of service, cryptography in network security, network management.	[10]
4	**Database Security:** Introduction to databases, security requirements of databases, reliability and integrity, database disclosure, data mining and big data.	[6]
5	**Cloud Security:** Cloud computing concepts, risk analysis in cloud computing, cloud security tools and techniques, cloud identity management, securing IaaS, privacy principles and policies.	[8]

Outcome(s): On successful completion the students will be able to:

- Define terms related to computer, data and network security.
- Analyze the offered system and point to the potential safety problems.
- Choose and appropriate engineering approach to solving the security problems in various domains.

Text Books:
1. Charles P Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, "Security in Computing", 5th edition, Prentice Hall, 2015.
2. Tim Mather, SubraKumaraswamy and ShahedLatif, "Cloud Security and Privacy" An Enterprise Perspective on Risk and Compliance", O'Reilly, 2009

Reference Books:
1. David Salomon, "Foundations of Computer Security", Springer, 2006
2. Chuck Easttom, "Computer Security Fundamentals", 2nd edition, Pearson Education, 2012