Curriculum Components

Component	Courses	Credits
1. University Core (3 Courses)	1. UC 23.101 : Human Values & Professional Ethics (2) 2. UC 23.102 : Pragmatic English Communication (2) 3. UC 25.201 : Management and Entrepreneurship (2)	06
2. University Elective (2 Courses)	1. University Elective-I (3) 2. University Elective-II (3)	06
3. Basic Science (9 Courses)	1. MA 23.101 : Mathematics I (4) 2. CY 23.101 : Engineering Chemistry (3) 3. CY 23.111 : Chemistry Laboratory (1) 4. CY 23.102 : Environmental Sciences (2) 5. MA 23.102 : Mathematics II (4) 6. PY 23.101 : Engineering Physics (3) 7. PY 23.111 : Physics Laboratory (1) 8. MA 23.201 : Mathematics-III (4) 9. EE 23.308 : Electrical and Electronics Engineering Materials (3)	25
4. Engineering Science (11 Courses)	1. ME 25.101 : Applied Mechanics (3) 2. EC 25.101 : Basics of Electronics Engineering (3) 3. ME 23.111 : Computer Aided Engineering Drawing (2) 4. EC 23.111 : Electronics Laboratory (1) 5. EE 25.101 : Basics of Electrical Engineering (3) 6. CS 23.101 : Programming for Problem Solving I (3) 7. EE 23.111 : Electrical Laboratory (1) 8. CS 23.111 : Programming Laboratory I (2) 9. ME 23.112 : Mechanical Workshop (1) 10. CS 23.205 : General Purpose Programming (3) 11. CS 23.255 : General Purpose Programming Laboratory (1)	23
5. Program Core (28 Courses)	1. EE 23.201 : Electrical Machines-I (3) 2. EE 23.203 : Network Analysis and Synthesis (3) 3. EC 23.201 : Electronic Devices and Circuits (3) 4. EE 23.221 : Electrical Machines-I Laboratory (1) 5. EE 23.223 : Network Analysis and Synthesis Laboratory (1) 6. EC 23.221 : Electronic Devices and Circuits Laboratory (1) 7. EE 23.202 : Electrical Machines-II (4) 8. EE 23.204 : Electrical Measurement and Instrumentation (3) 9. EE 23.206 : Electromagnetic Fields (3) 10. EC 23.202 : Digital Electronics (3) 11. EE 23.222 : Electrical Machines-II Laboratory (1) 12. EE 23.224 : Electrical Measurement and Instrumentation Laboratory (1) 13. EE 23.226 : Electrical Simulation Laboratory (2) 14. EE 23.228 : Electrical Estimation and Costing Laboratory (1) 15. EE 23.301 : Transmission and Distribution (3) 16. EE 23.303 : Control System Engineering (3) 17. EE 23.305 : Power Plant Engineering (3) 18. EE 23.307 : Renewable Energy Technology (3) 19. EC 23.301 : Microprocessor and Microcontroller (3) 20. EE 23.321 : Power System-I Laboratory (1) 21. EE 23.323 : Control System Laboratory (1) 22. EE 23.302 : Power System Analysis and Design (3) 23. EE 23.304 : Power Electronics (3)	64

	24. EE 23.306 : Power System Protection (3) 25. EE 23.310 : Utilization of Electrical Energy and Traction System (3) 26. EE 23.316 : Electrical Machine Design (3) 27. EE 23.322: Power System-II Laboratory (1) 28. EE 23.324: Power Electronics Laboratory (1)	
6. Program Elective / MOOCs (5 Courses)	1. MOOC (3) 2. EE 23.401: Electric Drives and Control (3) 3. EE 23.403: Nonlinear Control system (3) 4. EE 23.405: Robotic Engineering (3) 5. EE 23.407: High Voltage Engineering (3) 6. EE 23.409: Smart Grid (3) 7. EE 23.411: Industrial Automation and Control (3) 8. EE 23.402: Solar PV Technology (3) 9. EE 23.404: Power Electronics in Renewable Energy Technology (3) 10. EE 23.406: PLC and Automation (3) 11. EE 23.408: Wind Energy System (3) 12. EE 23.410: Energy Storage Systems (3) 13. EE 23.412: Advanced Electric Drives (3)	15
7. Project / Summer Internship Project / Colloquium / PBL (11 Courses)	1. PB 25.101 : Project Based Learning (1) 2. PB 25.102 : Project Based Learning (1) 3. PB 25.201 : Project Based Learning (1) 4. PB 25.202 : Project Based Learning (1) 5. EE 23.331 : Summer Internship Project-1 (2) 6. EE 23.333: Project-1 (2) 7. EE 23.332 : Project-2 (2) 8. EE 23.334 : Colloquium (1) 9. EE 23.431 : Summer Internship Project-2 (2) 10. EE 23.433 : Capstone Project-1(2) 11. EE 23.432 : Capstone Project-2 (6)	21
8. Proficiency (Non-Credit / Non-Graded) * (6 Courses)	1. SF 101: Personal Grooming and Fine Dinning 2. SF 102: Social Grooming, Home Décor and Business Communication 3. SF 201: Personal Grooming Fine Dining and Home Safety 4. SF 202: Social Grooming and Professional Skills 5. GF 25.301: Proficiency (Non Credit, Non Grade) 6. GF 25.302: Proficiency (Non Credit, Non Grade)	00
Total	**75 Courses**	**160**

First Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
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
ME 25.101	Applied Mechanics	3	0	0	3	3	10	40	50
EC 25.101	Basics of Electronics Engineering	3	0	0	3	3	10	40	50
ME 23.111	Computer Aided Engineering Drawing	0	0	4	2	2	50		50
CY 23.111	Chemistry Laboratory	0	0	2	1	2	50		50
EC 23.111	Electronics Laboratory	0	0	2	1	2	50		50
CY 23.102	Environmental Sciences	2	0	0	2	3	10	40	50
SF 101	Personal Grooming and Fine Dinning (Non Grade)	0	0	2	1	2	50		50
PB 25.101	Project Based Learning	0	0	2	1		50		50
	Total	16	1	12	**22**				

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
EE 25.101	Basics of Electrical Engineering	3	0	0	3	3	10	40	50
CS 23.101	Programming for Problem Solving	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 23.111	Programming Laboratory	0	0	4	2	2	50		50
ME 23.112	Mechanical Workshop	0	0	2	1	2	50		50
SF 102	Social Grooming, Home Décor and Business Communication (Non Grade)	0	0	2	1	2	50		50
PB 25.102	Project Based Learning	0	0	2	1		50		50
	Total	14	1	14	**21**				

Project Based Learning (PBL) in Group of 3-5 Students, it must be a software project (for EE students only).

Second Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
MA 23.201	Mathematics-III	3	1	0	4	3	10	40	50
EE 23.201	Electrical Machines-I	3	0	0	3	3	10	40	50
EE 23.203	Network Analysis and Synthesis	3	0	0	3	3	10	40	50
EC 23.201	Electronic Devices and Circuits	3	0	0	3	3	10	40	50
CS 23.205	General Purpose Programming	3	0	0	3	3	10	40	50
EE 23.221	Electrical Machines-I Laboratory	0	0	2	1	2	50		50
EE 23.223	Network Analysis and Synthesis Laboratory	0	0	2	1	2	50		50
EC 23.221	Electronic Devices and Circuits Laboratory	0	0	2	1	2	50		50
CS 23.255	General Purpose Programming Laboratory	0	0	2	1	2	50		50
SF 201	Personal Grooming Fine Dining and Home Safety (Non Grade)	0	0	2	1	2	50		50
PB 25.201	Project Based Learning	0	0	2	1		50		50
	Total	15	1	12	**21**				

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	3	10	40	50
UE	University Elective-I	3	0	0	3	3	20		80
EE 23.202	Electrical Machines-II	3	1	0	4	3	10	40	50
EE 23.204	Electrical Measurement and Instrumentation	3	0	0	3	3	10	40	50
EE 23.206	Electromagnetic Fields	3	0	0	3	3	10	40	50
EC 23.202	Digital Electronics	3	0	0	3	3	10	40	50
EE 23.222	Electrical Machines-II Laboratory	0	0	2	1	2	50		50
EE 23.224	Electrical Measurement and Instrumentation Laboratory	0	0	2	1	2	50		50
EE 23.226	Electrical Simulation Laboratory	0	0	4	2	2	50		50
EE 23.228	Electrical Estimation and Costing Laboratory	0	0	2	1	2	50		50
SF 202	Social Grooming and Professional Skills (Non Grade)	0	0	2	1	2	50		50
PB 25.202	Project Based Learning	0	0	2	1		50		50
	Total	17	1	14	**24**				

Project Based Learning (PBL) in Group of 3-5 Students, it must be a software project (for EE students only).

Third Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration	Weightage		
		L	T	P			CW	MTE	ETE
EE 23.301	Transmission and Distribution	3	0	0	3	3	10	40	50
EE 23.303	Control System Engineering	3	0	0	3	3	10	40	50
EE 23.305	Power Plant Engineering	3	0	0	3	3	10	40	50
EE 23.307	Renewable Energy Technology	3	0	0	3	3	10	40	50
EC 23.301	Microprocessor and Microcontroller	3	0	0	3	3	10	40	50
	Program Elective-1 *	0	0	0	3	-	Based on MOOC Exam Score		
EE 23.321	Power System-I Laboratory	0	0	2	1	2	50		50
EE 23.323	Control System Laboratory	0	0	2	1	2	50		50
EE 23.331	Summer Internship Project-1**	0	0	0	2	-	100		
EE 23.333	Project-1	0	0	4	2	-	50	-	50
GE 25.301	Proficiency (Non Credit, Non Grade)	-	-	-	1		100		
	Total	15	0	08	**24**				

Third Year -Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
EE 23.302	Power System Analysis and Design	3	0	0	3	3	10	40	50
EE 23.304	Power Electronics	3	0	0	3	3	10	40	50
EE 23.306	Power System Protection	3	0	0	3	3	10	40	50
EE 23.308	Electrical and Electronics Engineering Materials	3	0	0	3	3	10	40	50
EE 23.310	Utilization of Electrical Energy and Traction System	3	0	0	3	3	10	40	50
EE 23.316	Electrical Machine Design	3	0	0	3	3	10	40	50
EE 23.334	Colloquium	0	0	2	1		100		
EE 23.322	Power System-II Laboratory	0	0	2	1	2	50		50
EE 23.324	Power Electronics Laboratory	0	0	2	1	2	50		50
EE 23.332	Project-2	0	0	4	2		50	-	50
GE 25.302	Proficiency (Non Credit, Non Grade)	-	-	-	1		100		
	Total	18	0	10	**23**				

*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. The course code of MOOC courses will be same as the course code given in NPTEL Certificate.

Proficiency (Non-Credit/Non Grade) shall be measured through level of participation in skill development programs i.e., sports, Yoga, Life skills, Music, Fine Arts or decided by Departmental academic Committee.

Fourth Year - Autumn Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	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
EE 23.431	Summer Internship Project-2**	0	0	0	2	-	100		
EE 23.433	Capstone Project-1	0	0	4	2	-	100		
	Total	9	0	4	**13**				

Fourth Year -Spring Semester									
Course Code	Course Title	Contact Hours Per Week			Credits	ETE Duration (Hours)	Weightage		
		L	T	P			CW	MTE	ETE
	Program Elective-4	3	0	0	3	3	10	40	50
	Program Elective-5	3	0	0	3	3	10	40	50
EE 23.432	Capstone Project-2	0	0	4	6	-	100		
	Total	6	0	4	**12**				

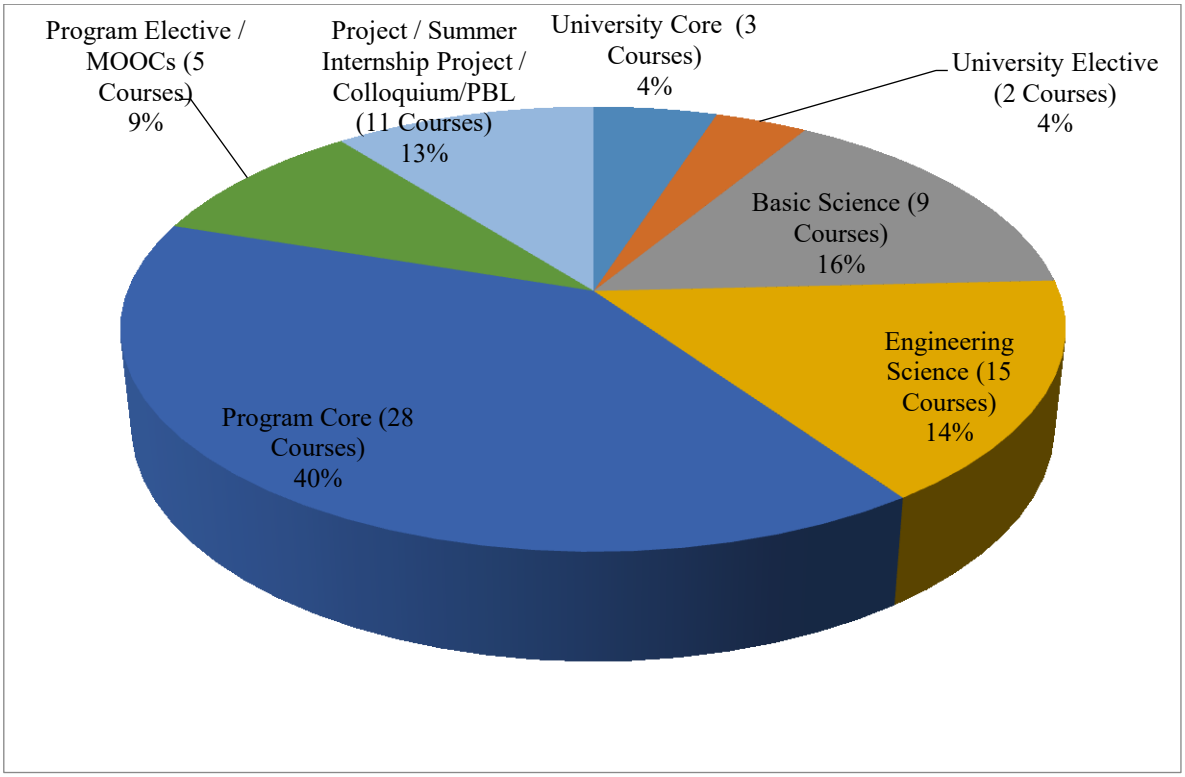
**Summer Internship-1 & 2 must be performed in an industry between summer vacation of end of second year and start of fourth year.

Credit Distribution across all Components								
Semester	UC	UE	BS	ES	PC	PE	PR	Total
First	2	0	10	9	0	0	1	22
Second	2	0	8	10	0	0	1	21
Third	0	0	4	4	12	0	1	21
Fourth	2	3	0	0	18	0	1	24
Fifth	0	0	0	0	17	3	4	24
Sixth	0	0	3	0	17	0	3	23
Seventh	0	3	0	0	0	6	4	13
Eight	0	0	0	0	0	6	6	12
Total	6	6	25	23	64	15	21	160

Acronym	
UC	University Core
UE	University Elective
BS	Basic Science
ES	Engineering Science
PC	Program Core
PE	Program Elective / MOOCs
PR	Project/Summer Internship /Colloquium/PBL

List of Program Elective Options

Code	Program Elective-1
	MOOC
Code	**Program Elective-2**
EE 23.401	Electric Drives and Control
EE 23.403	Nonlinear Control system
EE 23.405	Robotic Engineering
Code	**Program Elective-3**
EE 23.407	High Voltage Engineering
EE 23.409	Smart Grid
EE 23.411	Industrial Automation and Control
Code	**Program Elective-4**
EE 23.402	Solar PV Technology
EE 23.404	Power Electronics in Renewable Energy Technology
EE 23.406	PLC and Automation
Code	**Program Elective-5**
EE 23.408	Wind Energy System
EE 23.410	Energy Storage Systems
EE 23.412	Advanced Electric Drives



MA 23.201 **Mathematics-III** **Total Lectures: 40**
3-1-0-4

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

Pre-requisite: Basic of Electrical Engineering

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 order four). [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 (with proof) and it's applications. [8]
5. **Correlation and Regression:** Concept of 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.

Text Books:

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.

EE 23.201 **Electrical Machines-I** **Total Lectures: 40**

3-0-0-3

Objective: This course facilitates the students to get a comprehensive exposure to the working principles, construction details and performance of D.C. machines and Transformer.

Pre-requisite: Basic of Electrical Engineering

1. **Basic Concepts of Electrical Machines:** Introduction, Electromagnetic Induction, Flux linkage, Statistically and Dynamically induced emf, Classification and Description of electrical machines, Generator and Motor principles, Leakage flux, Losses and Efficiency, Rating and Loss Dissipation, Electrical and Mechanical degrees, Heating and Cooling of electrical machines. [8]
2. **Introduction to D.C. Machines:** Constructional parts of D.C. machines and their function, Principle of operation, Armature winding: Lap and Wave, Simplex and Duplex, Method of excitation, Classification, Derivation of emf and torque equations, Process of Commutation, Armature Reaction, Inter poles, Compensating winding and equalizer rings. [6]
3. **D.C. Generators:** Operating characteristics: Magnetization, Internal and External characteristics, Critical resistance and critical speed, Process of building up of voltage, Causes of failure of voltage build-up and remedies, Parallel operation of D.C. generators, Applications. [7]
4. **D.C. Motors:** Basic equation for voltage, Power, Torque and Speed, Condition for maximum power, Operating characteristics: Torque-current, Speed-current and Torque-speed characteristics. Comparison, Starters, Speed control methods, testing of D.C. machines: Swinburne, Hopkinson's and Series field tests. Calculation of efficiency, Applications. [7]
5. **Transformers:** Principle, Construction and Operation of single-phase transformers, equivalent circuit, Phasor diagram, Voltage regulation, Losses and Efficiency Testing - Open circuit and Short circuit tests, Polarity test, Back-to-Back test, Separation of hysteresis and eddy current losses. Three-phase transformer - Construction, Types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - Construction, Principle, Applications and Comparison with two winding transformer, Three-winding transformers. Cooling of transformers. [12]

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

- Understand the concepts of magnetic circuits.
- Understand the operation of D.C. machines.
- Analyse the differences in operation of different D.C. machine configurations.
- Analyse single phase and three phase transformers circuit.

Text Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

Reference Books:

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

EE 23.203 **Network Analysis and Synthesis** **Total Lectures: 40**
3-0-0-3

Objective: 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: Basic of Electrical Engineering

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.

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.

CS 23.205 **Total Lectures: 40**

General Purpose Programming

Credit: 3-0-0-3

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.

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

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.

EE 23.221 **Electrical Machines-I Laboratory** **Total Hours:26**
0-0-2-1

Objective: The objective of the Electrical Machine Lab is to provide an exposure of operation of D.C. machines and transformers and give them experimental skill. It also aims to understand the generation of D.C. voltages by using shunt generator and study their performance. It also enables the students to understand the working principles of D.C. motors and their load characteristics and methods of speed control. It also enables students to test and performance of D.C. machines and transformers.

Prerequisite: Electrical Lab

1. To conduct the open circuit and short circuit tests on the given single phase transformer and to pre-determine (i) equivalent circuit parameters (ii) voltage regulation and (iii) efficiency.
2. To connect the given three, single phase transformers as three phase bank in (i) star-star (ii) star-delta (iii) delta-delta and (iv) delta-star configurations.
3. To perform the no-load test on the given D.C. shunt motor to study its speed variation by (i) field control method and (ii) armature voltage control method.
4. To obtain the open citcuit characteristics of a separately excited D.C. generator at rated speed and to determine (i) critical field resistance at rated speed (ii) critical speed (iii) voltage built up by the generator at rated speed and (iv) to plot the O.C.C. at different speeds.
5. To conduct the load test on the given D.C. shunt generator and its internal and external characteristics.
6. To determine the no load losses and hence to predetermine the efficiency, at any desired load, of the d.c. machine running. (i) as a motor and (ii) as a generator
7. To conduct the polarity test on the given transformer and to operate two single phase transformers in parallel to share a common load.
8. To determine the efficiency of two identical D.C. shunt machines by Hopkinson's regenerative test.
9. To conduct the back-to-back test on the given two, identical single phase transformers and to pre-determine (i) equivalent circuit parameters (ii) voltage regulation and (iii) efficiency.
10. To connect the given two, single phase transformers in Scott connection so as to
    (i) Show that the secondary voltages are at right angles to each other
    (ii) Supply two phase load from three-phase supply.
11. To conduct:
    (i) Field's test on two similar mechanically coupled series machines.
    (ii) Compute efficiency at different outputs.

    Plot the following curves for the motor efficiency, torque and speed v/s output.
12. To determine the no load stray losses of a given D.C. shunt machine and to separate the mechanical losses from iron losses.

Outcome: Students will be convergent with transformer and D.C. machines and their testing and performance aspects.

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.

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 Electronic devices 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 $V_{pp} = 3V$, $1kH$.
6. Design a Half Wave Rectifier circuit with and without capacitor filter, measure the rms and Dc values of output 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 input $V_{pp} = 200mV, 1kHz$).
9. To plot the Transfer characteristics (for $V_{DS} = 5V$) and Drain (for $V_{GS} = -1V$) characteristics of a JFET in CS 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 be utilized to design different electronic circuits and devices.

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

Objective: 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.

Prerequisite: Programming Laboratory-I

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

Outcome: 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.

UC 25.201 **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

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

Reference Books

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

EE 23.202 **Electrical Machines-II** **Total Lectures: 40**

3-1-0-4

Objective: This course facilitates the students to get a comprehensive exposure to the working principles, construction and performance of 1-ϕ, 3-ϕ induction and synchronous machines.

Pre-requisite: Electrical Machine-I

1. **Fundamentals of AC Machine Windings:** Physical Arrangement of windings in Stator and Cylindrical rotor; Slots for windings; Single turn coil - active portion and overhang; Full-pitch Coils, Concentrated Winding, Distributed Winding, Winding axis, 3D visualization of the above winding types, Air-gap MMF Distribution with Fixed Current through winding - Concentrated and Distributed, Sinusoidally Distributed Winding, Winding Distribution Factor. [8]
2. **Pulsating and Revolving Magnetic Fields:** Constant Magnetic Field, Pulsating Magnetic Field - Alternating Current in Windings with Spatial Displacement, Magnetic Field produced by a Single Winding - Fixed Current and Alternating Current Pulsating Fields produced by spatially Displaced Windings, Windings Spatially shifted by 90 degrees, Addition of Pulsating Magnetic Fields, Three Windings Spatially Shifted by 120 degrees (Carrying Three-phase Balanced Currents), Revolving Magnetic Field. [4]
3. **Induction Machines:** Construction, Types (Squirrel Cage and Slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent Circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on Torque Speed Characteristics (Variation of Rotor and Stator Resistances, Stator Voltage, Frequency). Methods of Starting, Braking and Speed Control for Induction Motors. Generator Operation. Self-Excitation. Doubly-Fed Induction Machines. [12]
4. **Single Phase Induction Motors:** Constructional Features Double Revolving Field Theory, Equivalent Circuit, Determination of Parameters. Split-phase Starting Methods and Applications. [6]
5. **Synchronous Machines:** Constructional Features, Cylindrical Rotor Synchronous Machine - Generated EMF, Equivalent Circuit and Phasor Diagram, Armature Reaction, Synchronous Impedance, Voltage Regulation. Operating Characteristics of Synchronous Machines, V and inverted V-Curves. Salient Pole Machine – Two Reaction Theory, Analysis of Phasor Diagram, Power Angle Characteristics. Parallel Operation of Alternators - Synchronization and Load Division. [10]

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

- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines.
- Analyse performance characteristics of ac machines.

Text Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Reference Books:

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
4. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

EE 23.204 **Electrical Measurement and Instrumentation** **Total Lectures: 40**
3-0-0-3

Objective: To make students conversant with concepts of smart measurement and various electrical and electronics instruments, transducers and bridges.

Pre-requisite: Basic of Electrical Engineering, Basic of Electronics Engineering

1. **Concepts of Measurements:** Introduction, accuracy and precision, repeatability, errors in measurement, sources of errors, types of errors, statistical analysis of measurement data, graphical representation of measurement, data as distributions, Gaussian graph and precision indices. [8]
2. **Analog Instruments:** Types of operating torques in an analog instrument, Moving coil, moving iron, electrodynamic and induction instruments-construction, operation, torque equation and errors. Shunts and multipliers. Applications of instruments for measurement of single-phase power and single-phase energy. Errors in wattmeter and energy meter and their compensation and adjustment. [12]
   Electronic Instruments for Measuring Basic Parameters: Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, Q meter, Digital measurement of Time and Frequency, Signal Analyzers- Wave Analyzers, Harmonic Distortion Analyzers and Spectrum Analyzers.
3. **Bridge:** DC bridges for measurement of resistance Wheatstone bridges, Kelvin's double bridges and AC bridges for measurement of L, R, C & M, Maxwell's bridges, Anderson's bridges and Wein bridge. [5]
4. **Transducers:** Classification, Types and Characteristics of transducers: Measurement of physical quantities: temperature, pressure, flow, stain, displacement: commonly used transducers: resistive potentiometer, strain gauge, RTD, thermistors, thermocouples, capacitive, inductive, piezo-electric, hall-effect and ultrasonic transducers [8]
5. **Sensors and Actuators:** Terminology, Principles, Characteristics and Classifications, Applications: Automotive Sensors, Home Appliance Sensors, Aerospace Sensors, Sensors for manufacturing and environmental monitoring, Pneumatic, hydraulic, mechanical and electrical actuators, Types of Control Valves, Types of Motion, Electrical Actuation Systems. [7]
   Internet of Things: Introduction to IOT: Sensors, Actuators, Smart Objects, Basics of IOT networking. IOT Architecture and Design.

Outcome: Students will be able to understand electrical and electronic measuring devices and instrumentation like bridges, transducers, CRO etc.

Text Books:

1. J. B. Gupta, “Electrical Measurements and Measuring Instruments”, S. K. Kataria & Sons, Reprint Edition, 2012.
2. A.K.Sawhney, “A Course in Electrical and Electronic Measurements & Instrumentation”, Dhanpat Rai and Co., 2005.

Reference Books:

1. Albert D. Helfrick, Wiliam D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, PHI Learning Private Limited, 2011.
2. Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley, “Electrical and Electronics Measurements And Instrumentatio”, McGraw-Hill Education, 1st Edition, 2013.
3. F.W. Golding and Widdis, Electrical Measurements and Measuring Instruments, 5th Edition, 2010.

EE 23.206 **Electromagnetic Fields** **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, Conversion of a vector from one coordinate system to another. Divergence theorem, Stoke's theorem, reviews of electro-static and magneto-static fields. [6]
2. **Static Electric Field:** Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Conductors, Dielectrics and Capacitance: Current and current density, Ohm's Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Solution and Application of Laplace and Poisson's equations. [9]
3. **Static Magnetic Fields:** Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors. Magnetic Forces, Materials and Inductance: Force on a moving charge, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits. [9]
4. **Time Varying Fields and Maxwell's Equations:** Faraday's law of electromagnetic induction, Displacement current, Point form of Maxwell's equation, Maxwell's equations in integral and differential form, potential functions, electromagnetic boundary conditions. [8]
5. **Electromagnetic Waves:** Derivation of wave equations and their solutions for free space, uniform plane waves, Maxwell's equation in phasor form, wave equation in phasor form, plane waves in free space and in a homogenous material, wave equation for a conducting medium, plane waves in lossy dielectrics, propagation in good conductors, Skin effect. Poynting theorem. [8]

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

- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyze time varying electric and magnetic fields.
- To understand Maxwell's equation in different forms and different media.

Text Books:

1. Matthew N. O. Sadiku, "Principles of Electromagnetics", Oxford University Press, 4th Edition, 2009.
2. William H. Hayt, "Engineering Electromagnetic", McGraw Hill, 8th Edition, 2001

Reference Books:

1. David J. Griffiths, "Introduction to Electrodynamics", Pearson New International Education, 3rd Edition, 2004.
2. M.L. Sisodia and G. S. Raghuvanshi, "Microwave Circuits and Passive Devices", New Age Publication, 3rd Edition, 2009.

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: Basic 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.

EE 23.222 **Electrical Machines-II Laboratory** **Total Hours:26**

0-0-2-1

Objective: The objective of the Electrical Machines-II Lab is to provide an exposure of operation of different types of A.C. motor and generator and give them experimental skill. It also aims to understand the generation of A.C. voltages by synchronous generator and induction generator and study their performance. It also enables the students to understand their testing, load characteristics and methods of speed control.

Pre-requisite: Electrical Machines

1. To conduct no-load test and blocked rotor test on three-phase Squirrel cage Induction motor and to draw the circle diagram.
2. To perform load test on three-phase Squirrel cage Induction Motor.
3. To obtain the equivalent circuit of a single-phase induction motor by no-load test and blocked rotor test.
4. To determine the regulation of a three-phase alternator at full load condition by ZPF method.
5. To determine the regulation of a three-phase alternator at full load condition by ASA method.
6. To conduct load test on single phase induction motor and to draw the performance characteristics.
7. To determine the regulation of a three-phase alternator by EMF and MMF method.
8. To conduct the parallel operation/synchronization of an alternator with bus bar by Synchroscope.
9. To perform the starting of Induction motor automatically by Start-delta starter.
10. To plot V and inverted V-curves of three phase synchronous motor.
11. To conduct the experiment for separation of no-load losses of three-phase induction motor.

Outcome: Students will be convergent with transformer, A.C. machines and their testing and performance aspects.

EE 23.224 Electrical Measurement and Instrumentation Laboratory Total Hours:26
0-0-2-1

Objective: The aim of this Measurements and Instrumentation Laboratory is to reinforce the students with an adequate work experience in the measurement of different quantities and also the expertise in handling the instruments involved. It also helps to train the students in the measurement of displacement, resistance, inductance, frequency and angle etc., and to give exposure to AC, DC bridges and transient measurement.

Pre-requisite: Basic Electrical and Electronics

1. To measure unknown resistance using Wheat stone bridge.
2. To measure unknown inductance, capacitance and resistance using Maxwell bridge.
3. To Measure unknown frequency and capacitance using Wein's bridge.
4. To study the working of Q meter and measure Q of coils.
5. Study of Input-Output characteristics of LVDT.
6. Measurement of phase difference between LVDT secondary.
7. Study of Strain measurement using strain gauges and cantilever assembly.
8. To determine the Sensitivity of Strain gauge Trainer.
9. To study the Characteristics of IC temperature sensor (LM 335).
10. To study the Characteristics of Platinum RTD (Temperature sensor).
11. To study the Characteristics of NTC Thermistor.
12. Determining Linear Range of operation (Strain Gauge).
13. To measure unknown inductance, capacitance and resistance using Anderson bridge.
14. To study the loading effect of a PMMC type voltmeter and hence to observe the change in percentage error in its full scale reading when it is used to find out the voltage across different load resistances.
15. To measure very low unknown resistance using Kelvin's Double bridge.

Outcome: The student will be able to:(Knowledge based):

- identify electronics/ electrical instruments, their use, peculiar errors associated with the instruments and how to minimize such errors
- explain the industrial and laboratory applications of such instruments
- service and maintain such instruments in case of damage or misuse,
- understand the basic design techniques of electronic equipment (Skills) The students will
- use various laboratory instruments like cathode ray oscilloscope, function generators, dismantle and recouple serviceable parts of some other selected instruments without damaging them.
- be well grounded in their knowledge about various types of transducers, their applications and how they can be used for design purposes.

EE 23.226 **Electrical Simulation Laboratory** **Total Hours:26**

0-0-4-2

Objective: To make the students exposure about the use and applications of MATLAB and ETAP software in electrical engineering.

Pre-requisite: Basic of Electrical Engineering

1. Basic MATLAB desktop, help Browser, types of files, basic commands.
2. Introduction to SIMULINK, creating and simulating a SIMULINK model.
3. Plotting of single phase voltage waveform using MATLAB through programming techniques.
4. Simulink model to generate sine and cosine waveforms.
5. Response of RL and RC circuits and its transient study using MATLAB.
6. Response of RLC circuit and its transient study using MATLAB.
7. Introduction to basics of Electrical Transients Analyzer Program (ETAP).
8. Construction of single line diagram of an electrical network using ETAP Software.
9. Modeling and analysis of single line diagram of an inductive load using ETAP Software.
10. Modeling and analysis of single line diagram of a capacitive load using ETAP Software.

Outcome: Upon completion of this course, the student will be able to:

- Develop computer based program for electrical circuits in power system.
- Develop computer based models for power system components.
- Design, simulate and analyze circuits using simulation packages.

EE 23.228 **Electrical Estimation and Costing Laboratory** **Total Hours:26**
0-0-2-1

Objective:

- Emphasize the estimating and costing aspects of all electrical equipment, installation and designs to analyze the cost availability.
- Exposure to design and estimation of wiring, design of overhead and underground distribution lines, substations and illuminations design.

Pre-requisite: Basic of Electrical Engineering

1. To study the various Indian electricity rules (IER) as per standard of Central Electricity Regulatory Commission (CERC).
2. To carryout wiring diagram of residential building, Educational institute and Industry. Giving selection of appropriate wiring, list materials and accessories for given project.
3. To study the design consideration of Panel Boards.
4. To study the design consideration of various electrical systems:
   i. 3 phase four wire distribution systems.
   ii. To study the design consideration of different types of earthing schemes.
5. To estimate the cost of industrial installation (Work shop, agriculture, flour mill etc.).
6. To estimate the cost of overhead service connection (Single phase and three phase).
7. To estimate the cost of underground service connection (single phase and three phase).
8. To estimate the cost of overhead, 440 V, 3-phase, 4 wire or 3 wire distribution line.
9. To estimate the cost of underground, distribution line.
10. To estimate the cost of any one electrical appliance.
11. To estimate the cost of repairs and maintenance of any one domestic appliance.
12. To study various types of light sources and lighting schemes.

Outcome: Upon completion of this course, the student will be able to:

- Develop computer based program for electrical circuits in power system.
- Develop computer based models for power system components.
- Design, simulate and analyze circuits using simulation packages.

EE 23.301 **Transmission and Distribution** **Total Lectures: 40**

3-0-0-3

Objective:
1. To learn the fundamentals designing of power system that meets specific need.
2. To understand the factors affecting Insulators and also in Under Ground cables.
3. To calculate the various parameters in Distribution System.

Pre-requisite: Network Analysis and Synthesis

1. **Introduction:** Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids. Effect of Transmission voltage, Load factor, diversity factor, plant capacity factor, plant utilization factor, different types of tariffs, per unit quantities and its advantages. Impedance and Reactance Diagram. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. [5]
2. **Parameter and Performance of Transmission Line:** Parameter: Configuration, Type of conductors, Resistance of line, Skin & Proximity Effects, Calculation of Inductance and capacitance of single phase, three phase, Single circuit and double circuit transmission lines. Performance: Representation of short, medium and long transmission lines, Ferranti effect, SIL, Tuned Power Line, Power flow through transmission lines. [12]
3. **Insulator, Corona and Underground Cables:** Overhead lines insulators type of insulators and their applications Potential distribution over a string of insulators, Methods of Equalizing the potential, Phenomenon of Corona, Corona Loss, Factors affecting Corona, Methods of reducing corona. Types of Insulation for Cable, Sheath, Armour and Covering, Classification of cables, Effective Conductor Resistance, Inductive Reactance, Capacitance of single phase and three phase cables, Grading of Cables, Problems with Underground cables. [12]
4. **Mechanical Design of Transmission Lines:** Catenary curve, Calculation of sag and Tension, Effects of wind and ice Loadings, Sag Templates, Vibration dampers. [5]
5. **Distribution:** Comparison of various distribution systems, type of primary and secondary distribution systems, choice of transmission voltage, Kelvin's law, limitation of Kelvin's law. Necessity of neutral grounding, various methods of neutral grounding. [6]

Outcome: At the end of this course, students will demonstrate the ability to
- Understand the concepts of power systems components, generation of over-voltages and insulation coordination.
- Understand the concepts of Mechanical, electrical design of overhead lines and performance of transmission lines.
- Evaluate fault currents for different types of faults.

Text Books:
1. Wadhwa C. L. "Electrical Power Systems Electronics", New Age International Publishers, 4th Edition, 2011.
2. Gupta, B. R., "Power System Analysis and Design" S. Chand and Co., Ltd, 2nd Edition, 2005.

Reference Books:
1. Grainger J. J. and William D. Stevenson Jr., "Power System Analysis", McGraw Hill, 3rd Edition, 2005.
2. Abhijit Chakrabarti and SunitaHalder, "Power System Analysis: Operation and Control", Prentice Hall of India, 2nd Edition, 2008.

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-III, 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.

EE 23.305 **Power Plant Engineering** **Total Lectures: 40**

3-0-0-3

Objective: This course facilitates the students to understand the basic functioning of generation and design/economics consideration of various power plants.

Pre-requisite: Elements of Electrical Engineering, Power System-I

1. **Introduction:** Energy sources and their availability, Principle types of power plants, Their special features and applications, Present status and future trends. Economic aspects in power Generation: Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load duration curves, Connected load, maximum load, Peak load, base load and peak load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant, different types of tariffs, power factor improvements. [10]
2. **Thermal and Nuclear Power Plant: Thermal Power Plant:** General developing trends, Essentials, Plant layout, Coal storage, Preparation, Handling, Feeding and burning, Ash handling, Dust collection, High pressure boilers and steam turbines, Their main components like super heaters, Economizers, Pre-heaters etc., Fuel efficiency/heat balance. **Nuclear Power Plant:** Nuclear fuels, Nuclear energy, Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect. [12]
3. **Hydro Electric Power Plants:** Classifications, Plant layout, various components, Types of turbines, Pumped storage, hydro-electric plants, advantages and disadvantages. Environmental aspects for selecting the sites and locations of hydro power stations. [6]
4. **Gas Turbine Power Plants:** Schematic arrangement, advantages and disadvantages of Gas turbine power plant. Open cycle and Closed cycle gas turbine power plant, Combined cycle power plant, Comparison of various power plants. [6]
5. **Renewable Energy Power Plants:** Introduction to different Renewable Energy Sources and their availability. Block diagram, Plant layout and various Components of solar power plants. On grid and off grid solar power plants. Block diagram, Plant layout and various Components of wind power plants. [6]

Outcome: The students shall develop an insightful knowledge to apply the basic laws and operating principles in various power plants.

Text Books:

1. Deshpande, M.V., “Power Plant Engineering”, McGraw Hill, 4th Edition 2004.
2. Gupta B. R., “Generation of Electrical Energy”, S. Chand Publications, 14th Edition, 2011.

Reference Books:

1. Wood A.J. & Wallenberg B.F, “Power Generation and Control”, John Wiley & Sons, 2nd Edition, 2012.
2. P.K Nag “Power Plant Engineering”, McGraw Hill publications, 2nd Edition, 2008.
3. Arora S.C &Domkundawar S, “A course in Power Plant Engineering”, Dhanpat Rai, 2nd Edition, 2002.

EE 23.307 **Renewable Energy Technology** **Total Lectures: 40**

3-0-0-3

Objective:
- To provide knowledge, understanding and application oriented skills on solar, wind, ocean, biomass, wave, tidal, ocean, geothermal and other energy sources and relevant technologies towards their effective utilization for meeting energy demand.
- To develop clear understanding of these technologies to be able to select an appropriate type of plant for given energy requirements.

Prerequisite: Nil

1. **Solar and Wind Energy:** Solar radiation, Measurements of solar radiation and sunshine, Solar thermal collectors, Flat plate and concentrating collectors, Fundamentals of photo voltaic conversion, applications. Wind data and energy estimation, Wind energy Conversion Systems, Wind energy generators and performance, applications. [10]
2. **Biomass Energy:** Biomass resources and their classification, Biomass production for Energy farming, Direct combustion for heat, Pyrolysis, Thermo chemical process, Anaerobic digestion, Digester sizing, waste and residues, vegetable oils and biodiesels, Applications of Biogas-Social and environmental aspects. [7]
3. **Wave and Tidal Energy:** Concept of energy and power from waves, Wave characteristics, period and wave velocities, Different wave energy conversion devices (Tapchan, oscillating water column type); Principles of tidal power generation, components of power plant, Single and two basin systems, Estimation of energy, Maximum and minimum power ranges. [8]
4. **Ocean and Geothermal Energy:** OTEC Principle, Lambert's law of absorption, Open cycle and closed cycle, Heat exchanger calculations (elementary treatment), Major problems and operational experience, Classification of geothermal resource, Fundamentals of geophysics, Availability and estimation of thermal power, Extraction techniques. [7]
5. **Hydrogen and Fuel Cell:** The Hydrogen economy, Advantages of hydrogen as an energy carrier, Components of the hydrogen economy, Generation of hydrogen, Transport and storage of hydrogen: physical and chemical, Fuel Cells, classification of fuel cells, power generation and economics. [8]

Outcome: Upon successful completion of this course, students should be able to:
- Gaining appropriate knowledge on principles of operation, construction and working and technological advances in solar photovoltaics, solar thermal, wind, ocean, tidal, geothermal and other systems.
- Ability to design and describe the challenges and problems with different types renewable energy technologies.

Text Books:
1. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd, 2nd Edition, 2006.
2. G.N.TiwariandM.K.Ghosal, "Renewable Energy Resources Basic Principles and Applications", Narosa Publishing House, New Delhi, 1st Edition, 2005.

Reference Books:
1. Sukhatme, "S.P., "Solar Energy", McGraw Hill, 3rd Edition, 2008.
2. LivinOniciu, "Fuel cell", Abacus press, 5th Edition, 1976.

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.

Prerequisite: Digital electronics

1. **The 8086 Microprocessor Architecture :** Architecture, details of sub-blocks such as EU, 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. [8]
2. **Programming of 8086:** Addressing modes of 8086, instruction set of 8086, assembly language programming, 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]

Outcome: Upon completion of this course, the student will be able to:

- The student will learn the internal organization of some popular microprocessors and microcontrollers.
- 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.

EE 23.321 **Power System-I Laboratory** **Total Hours: 26**

0-0-2-1

Objective:
- To make the students aware about the use and applications of MATLAB and ETAP software in electrical engineering.
- Study of circuit characteristics using MATLAB & ETAP. It also gives practical exposure to the usage of different power circuits with different condition.

Pre-requisite: Basic electrical engineering and Network analysis.

1. Plotting of three phase voltage waveforms using MATLAB through programming techniques.
2. Plot of daily load curve for the given data using MATLAB.
3. Calculation of Transmission Line Parameters and verify using MATLAB.
4. Determine the positive sequence line parameters L and C per phase per kilometre of a three phase single circuit transmission lines for different conductor arrangements.
5. Determination of Receiving end quantities and the line performance of a medium/long transmission line using MATLAB.
6. Study and operation of various ETAP modules Viz. load flow, short circuit and harmonics.
7. Construction of single line diagram of a power system using ETAP Software.
8. Modeling of power distribution network using ETAP Software.
9. Determination of Receiving end quantities and the line performance of a medium/long transmission line using ETAP Software.
10. Harmonic Analysis of Hybrid and Renewable Generation Networks.

Outcome: Upon completion of this course, the student will be able to:
- Develop computer programs for electrical circuits and power system.
- Develop computer models for power system components.
- Design, simulate and analyze circuits using simulation packages.

EE 23.323 **Control System Laboratory** **Total Hours: 26**
0-0-2-1

Objective: This laboratory course facilitates the students to get a comprehensive exposure to various techniques/principles and applications of control systems for real life implementation like temperature control of oven, position control of DC/AC servomotor, synchro devices as a control transformer, robotic control systems etc.

Pre-requisite: Nil

Perform any ten of the list.

1. To study the performance of various types of controllers (P, PI, PID) in order to control the temperature of an oven.
2. To study the performance analysis of PC based analogue and digital motor control system (DCMC) with second order feedback system behavior.
3. To study the characteristics of a Synchro Transmitter Receiver pair and use these as torque-synchro and angular error detector.
4. To study the performance characteristics of angular position error detector (AC&DC excitation) using two Potentiometers.
5. Using Nyquist Stability technique, find the stability of negative feedback control system whose open loop transfer function is given by $G(s)\,H(s) = 10/[(s+1)(s+2)(s+3)]$ Also verifies the MATLAB results/stability with theoretical method after plotting on graph sheets.
6. To study the performance characteristics of an AC servo motor angular position control system and analysis of transient characteristics with gain Variation.
7. To study the performance characteristics of a DC servo motor angular position control system and analysis of transient characteristics with gain Variation and additional tachometer feedback.
8. To study the Characteristics of an A.C. Servo Motor and determine its transfer function.
9. Plot the Root locus diagram for investigating the stability for the system whose open loop transfer function given by $G(s)\,H(s) = K/[s(s+4)(S+5)]$. Using MATLAB Code, verify the results with Conventional method.
10. To study and design the pc based universal robotic system as snake.
11. Draw the bode plot for the transfer function $G(s) = 50/[s(1+0.25s)(1+0.1s)]$.
    From the graph, determine:
    1. Gain and Phase Crossover Frequency
    2. Gain Margin and Phase Margin
    3. Stability of the system

    Also, verify the MATLAB results with theoretical value.
12. Obtain the state space, pole-zero and residue pole form of the control system whose transfer function is given by.

Outcome: The students shall develop an insightful knowledge on various techniques and concepts of analysis & design of control system for different applications like temperature control of oven, position control of DC/AC servomotor, synchro devices, Robotic control systems etc.

EE 23.302 **Power System Analysis and Design** **Total Lectures: 40**

3-0-0-3

Objective:
- To know the necessity of load flow in a regulated system.
- To examine the need of various analysis like fault analysis, short circuit analysis stability analysis, steady state and transient analysis.

Pre-requisite: Power System-I

1. **Load Flow Studies:** Bus admittance(Y bus) and Impedance (Z bus) matrices and their formation. Power flow in a transmission system, bus classification, Load flow equations and solution techniques-Gauss iterative method, Gauss-Seidel method, Newton-Raphson method, comparison of load flow solution techniques. [9]
2. **Fault Calculation and Network:** Symmetrical fault, Significance of Positive, Negative and Zero Sequence Components, Fault calculation, Sequence Networks, Unsymmetrical fault analysis – Single Line to Ground faults, Line to Line fault, Double line to Ground fault. [9]
3. **Power System Stability:** Steady state stability and transient stability- stability problem, rotor dynamics and swing equation, power angle equation and diagram, equal area criterion and its application, critical clearing angle, fault clearing time, factors influencing transient stability, methods of improving stability. [8]
4. **Economic Load Dispatch:** Station performance and operating characteristics, Incremental rate theory, optimal Load distribution within generating station and between various generating stations in a region, Transmission loss equation, Calculation of losses and Generation scheduling and dispatch. [8]
5. **Power System Control:** Load Frequency Control: Load Frequency Problems, Speed Governing System, Reasons for Limits on Frequency. Excitation systems, Automatic Voltage Regulators, SCADA and Computer control. [6]

Outcome: After the completion of the course, the students will be able to:
- Apply the load flow application to various power system problems like minimization of transmission line losses and minimization of the total fuel cost.
- Analyze the economic dispatch problem in thermal power plant.
- Design a power system solution based on the problem requirements and realistic constraint.

Text Books:
1. Grainger, J. J. and William D. Stevenson Jr., “Power System Analysis”, McGraw Hill, 4th Edition, 2005.
2. Wadhwa. C. L. “Electrical Power Systems Electronics”, New Age International Publishers, 3rd Edition, 2011.

Reference Books:
1. Ashfaq Husain, “Electrical Power Systems”, CBS Publishers and Distributors, 4th Edition, 1996.
2. Abhijit Chakrabarti, Sunita Halder “Power System Analysis: Operation and Control”, Prentice Hall of India, 2nd Edition, 2008.

EE 23.304 **Power Electronics** **Total Lectures: 40**

3-0-0-3

Objective:
- To introduce to students the theory and applications of power electronics systems for high efficiency, renewable and energy saving conversion systems
- To prepare students to know the characteristics of different power electronics switches, drivers and selection of components for different applications
- To develop students with an understanding of the switching behavior and design of power electronics circuits such as DC/DC, AC/DC, DC/AC and AC/AC converters

Prerequisite: Network Analysis and Synthesis, Basics of Electronics Engineering

1. **Introduction to Power Devices:** Review of power semiconductor devices, SCR, Static and dynamic characteristics, Turn-on and Turn-off methods and circuits, Ratings and protection of SCRs, Series and parallel operation of thyristor, Other members of thyristor family. [8]
2. **Controlled AC to DC Converter:** Principle of phase control, 1-ϕ (Single phase) half wave circuit with different types of loads, 1-ϕ and 3-ϕ semi converter and full converter bridge circuits, 1-ϕ dual converters and their operation with circulating and non-circulating currents. [10]
3. **Controlled AC to AC Converter:** AC Voltage Controllers - Types of 1-ϕ voltage controllers, 1-ϕ voltage controller with R and RL type of loads, gate pulse requirements to trigger the SCRs of ac voltage controllers. Cycloconverters - Principles of operation, 1-ϕ to 1-ϕ step up and step down cycloconverters. 3-ϕ to 1-ϕ cycloconverter. [10]
4. **Controlled DC to DC Converter:** Introduction to dc chopper, Principle of chopper operation, Control strategies, Types of choppers and its operation. [5]
5. **Controlled DC to AC Converter:** Introduction to inverter, 1-ϕ VSI: half bridge and full bridge inverters. 3-ϕ bridge inverters with 180 degree and 120 degree modes of operation, Series and parallel inverters, Introduction to current source inverters. [7]

Outcome: After the completion of the course, the students will be able to:
- Understand the principle of operation of commonly employed power electronic converters.
- Capable of analyzing non-linear circuits with several power electronic switches.
- Take up advanced courses in Power Electronics and its application areas.

Text Books:
1. Rashid, M., "Power Electronics", Prentice Hall of India Private Limited, 4th Edition,2006.
2. P.S. Bimbhra, "Power Electronics," Khanna publishers, 5th edition, 2012.

Reference Books:
1. Mohan,N., Undel, T.M. and Robbins, W. P., "Power Electronics: Converter Applications and Design," John Wiley and Sons, 3rd Edition, 2007.
2. Jain,A., "Power Electronics and its Applications," Penram International Publishing (India) Pvt. Ltd., 4th Edition, 2008.
3. Dubey, G.K., Doradla, S.R., Joshi, A. and Sinha, R.N.K., "Thyristoried Power Controllers," New Age International (P) Limited, Publishers, 2nd Edition, 2004.

EE 23.306 **Power System Protection** **Total Lectures: 40**

3-0-0-3

Objective: This course facilitates the students to get a comprehensive exposure to the working principles of various power system protection equipment and its simulation-Modeling schemes.

Pre-requisite: Power System-I

1. **Introduction and Components of a Protection System:** Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers. [4]
2. **Faults and Over-Current Protection:** Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination. [8]
3. **Equipment Protection Schemes:** Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes. [8]
4. **Digital Protection:** Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues. [8]
5. **Modeling and Simulation of Protection Schemes and system protection:** CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing. Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems. [12]

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

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of wide-area measurements.

Text Books:

1. J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India, 2010.

Reference Books:

1. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 1988.
2. A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 2008.
3. D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.

EE 23.308 **Electrical and Electronics Engineering Materials** **Total Lectures: 40**

3-0-0-3

Objective:

- Use the fundamental science and engineering principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials.
- Use their knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials.
- Use lifelong learning skills to develop knowledge and skills, to pursue new areas of expertise, careers and to take advantage of professional development opportunities.

Pre-requisite: Nil

1. **Introduction**: Engineering properties of material. Structure, properties and performance, types of materials. Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect. [6]
2. **Dielectric Properties of Insulators in Static and Alternating Fields:** Types of Polarizations**,** static dielectric constant of gases and solids, properties of ferroelectrics materials. Spontaneous polarization, Piezoelectricity, Frequency dependence of Electronic and Ionic Polarizability, complex dielectric constant of non-dipolar solids, dielectric relaxation, dielectric losses. [10]
3. **Magnetic Properties and Superconductivity:** Magnetization of matter, Classification of Magnetic Materials, Ferromagnetic Origin, Curie-Weiss Law, Soft and Hard Magnetic Materials, Superconductivity and its origin, Zero resistance and Meissner Effect, critical current density. [10]
4. **Conductivity of Metals**: ohm's law and the relaxation time of electrons, relaxation time, collision time and mean free path, electron scattering and resistivity of metals, thermal conductivity of metals. [8]
5. **Semiconductor Materials:** Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, Trends in materials used in Electrical Equipment. [6]

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

- Learn the basics of materials used in electrical engineering.
- Realize the dielectric properties of insulators in static and alternating fields.
- Importance of magnetic properties and superconductivity.
- Behavior of conductivity of metals and classifications of semiconductor materials.

Text Books:

1. AdrianusJ. Dekker, "Electrical Engineering Materials" Prentice Hall India Learning Publishers, 1970.
2. Solymar, "Electrical Properties of Materials" 8th Edition, Oxford University Press-New Delhi, 2012.

Reference Books:

1. T. K. Basak, "Electrical Engineering Materials" New Age International Private Limited Publisher, 2010.
2. C. S. Indulkar, S. Thiruvengadan, "An Introduction to Electrical Engineering Materials", Revised Edition, S. Chand & Company Pvt. Ltd, 2008.

EE 23.310 Utilization of Electrical Energy and Traction System Total Lectures: 40

3-0-0-3

Objective: This Course provides an introduction to the principles of electrical drives and their applications in daily life. It deals with the fundamentals of illumination and its classification and provides knowledge on electrical traction systems.

Pre-requisite: Electrical Machines, Power System-I

1. **Electric Drives:** Electrical drives & Mechanical drives, Concept of electrical drives, Basic features of industrial drives, review of operating and starting characteristics of different types of electric motors for various drives. [5]
2. **Electric Heating and Welding:** Methods of electric heating, types of electric heating, constructional details and performance of resistance heating furnace. Dielectric heating, AC and DC Welding, Resistance and Arc Welding. Electric Beam Welding, Laser Welding. Typical construction of electrical welding AC and DC set. [10]
3. **Illumination and Electrolysis:** Production of light by different methods, terms used, laws of illumination, Different Artificial light sources, their construction and operating principles, Design of lighting schemes and equipment used for indoor, industrial and flood lighting. Laws of Electrolysis, Process voltage, current, energy, efficiency, Applications of electrolysis. [9]
4. **Refrigeration and Air conditioning:** Refrigeration system, Domestic refrigeration, Air conditioner, Comfort Air conditioning, Effective temperature. [9]
5. **Electric Traction:** Introduction to Indian railways system, Electric Locomotive Classes, Various types of Traction system, single phase feeding arrangement prevalent in India. Substation. Arrangements, Different Types of Catenary construction and line insulation, Span and dropper design Calculations. [7]

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

- Describe the methods of electric heating, types of Electric welding and the principle of Electro deposition, laws of electrolysis and its applications
- Explain the laws of illumination and explain the principle of refrigeration and air-conditioning.
- Describe the salient features of traction drive.

Text Books:

1. J.B. Gupta, 'Utilization of Electric Power and Electric Traction', Kataria & Sons publishers, Delhi, IX Edtion, 2004.
2. C.L. Wadhwa, 'Generation, Distribution and Utilization of electrical Energy', New Age International (P) Limited Publishers, 3rd Edition, 2010.

Reference Books:

1. H. Partab, ' Modern Electric Traction' Dhanpat Rai & Sons.
2. G.K. Dubey, 'Fundamentals of Electric Drives' Narosa Publishing House.

EE 23.316 **Electrical Machine Design** **Total Lectures: 40**
3-0-0-3

Objective: To provide knowledge of design aspects of various dc machines, ac machines and transformers.

Pre-requisite: Electrical Machines

1. **Fundamentals of Electrical Machine Design:** Standard specification of frame size, conductors and insulation, Magnetization and loss curves, Choice of specific loadings Heating and cooling of electrical machines. [6]
2. **D.C Machines:** Construction details, output equation, main dimensions, Choice of specific loadings, choice of number of poles, armature design, design of field poles and field coils ,design of commutator and brushes. [8]
3. **Transformers:** Construction details of core and shell type transformers, output rating of single phase and three phase transformers, optimum design of transformers, design of yoke, core and winding for core and shell type transformers, equivalent circuit parameters from design data and design of tank and cooling tubes of transformers. [10]
4. **A.C. Machines:** Construction details of A.C. machines, output equation, main dimensions, Choice of specific loadings, design of stator, design of squirrel cage and slip ring rotor equivalent circuit parameter from design data, Short circuit ratio, design of rotor of cylindrical pole and salient pole machines. [10]
5. **Computer Aided Design:** Need for computer aided design, Analysis method, Synthesis method, Introduction to analysis of Electric machine parameters using FEM. [6]

Outcome: After completion of the course, students would be able to apply the knowledge of magnetism in the design of transformer and rotating electrical machines.

Text Books:

1. A.K.Sawhney, ‘A course in Electrical Machine Design’, DhanpatRai and sons, New Delhi, (Latest Edition).
2. S K Sen, ‘Principles of Electrical Machine Design with Computer Programme’,Oxford and IBH publishing Co. Pvt Ltd., New Delhi, 1987

Reference Books:

1. R.K Agarwal, ’Principles of Electrical Machine Design’, S.K.Katariasons , New Delhi, 2002.
2. V.N. Mittle and A.Mittle, ‘Design of Electrical Machines’ , Standard Publications and Distributors, Delhi, 2002.

EE 23.322 **Power System-II Laboratory** **Total Hours: 26**
0-0-2-1

Objective: To enhance the model building, advanced analyzing and problem solving skills of the students in the area of power system, power electronics and control through computer programming and simulation.

Pre-requisite: Power System-I

1. To study and testing the operation Gas actuated Buchholz Relay.
2. To study and testing of IDMT type Over current Relay with different and time setting & draw characteristics.
3. To study and testing of under voltage relay with different voltage setting multiplier & plot IDMT characteristics.
4. To study and testing of under frequency relay with IDMT characteristics.
5. To study and testing of microcontroller based Earth Fault relay with IDMT and DMT mode.
6. To study and testing the operating characteristics of percentage-biased differential relays and plot the characteristics of percentage biased differential relay for 30%, 40%, & 20%.
7. Simulation of load Flow analysis and related problems using Newton-Raphson and Fast-Decoupled methods using MATLAB.
8. Simulation and study of various power quality events like voltage sag, harmonics and transients etc.
9. Developing a simple simulation models for harmonic filter in power system distribution lines.
10. Simulation of various faults and short circuit analysis for a given power system.
11. Draw I-V and P-V characteristics of PV panel by variable resistive load and find out maximum power point by FF (fill factor) calculation.
12. Simulation of transient and small signal stability analysis: single-machine Infinite Bus System using SIMULINK.
13. Transient Stability Analysis of Multi-machine Power Systems using MATLAB.

Outcome: Upon completion of the course students will be able to

- Develop computer programs for advanced power system studies.
- Develop computer models for power system components.
- Simulate and visualize the real time phenomenon.

EE 23.324 **Power Electronics Laboratory** **Total Hours: 26**

0-0-2-1

Objective: To enable the students to develop hands on experience in analyzing, designing and carrying out experiments on various electrical networks by using power electronic components. It aims to familiarize the switching devices, power converters and its applications in various systems for power control.

Pre-requisite: Network Analysis and Synthesis, Basics of Electronics Engineering

Perform any ten of the list.

1. To obtain the V-I characteristic of an SCR and to find out it's latching and holding currents.
2. To obtain the Drain and Transfer Characteristic of a MOSFET.
3. To obtain the V-I characteristic of TRIAC.
4. Study of SCR (i) Resistor Triggering circuit (ii) Resistor Capacitor Triggering circuit for Half wave rectifier.
5. Study of SCR (i) Resistor Triggering circuit (ii) Resistor Capacitor Triggering circuit for Full wave rectifier.
6. Study of Step-Up Chopper with (i) resistive load (ii) resistive, inductive load.
7. Study of Step Down Chopper with (i) resistive load and (ii) resistive – inductive load.
8. To study the forced commutation process of an SCR.
9. Study of Single Phase Bridge Inverter with
   i. Resistive-Capacitive load
   ii. Inductive-Capacitive load
   iii. Resistive, Inductive and Capacitive load.
10. To write and execute a program (i.e. STL and Ladder Logic) for SIEMEN make P.L.C to flash a light at regular intervals of time.
11. To simulate a program for a PLC controller to control the traffic lights using 'BRYTONIC' software.
12. To design and develop a simulation schematic for the performance analysis of Half wave rectifier with different loads, using MATLAB SIMULINK toolbox.
13. To design and develop a simulation schematic for the performance analysis of Full wave rectifier with different loads, using MATLAB SIMULINK toolbox.

Outcome: Upon completion of this course, the student will be able to:

- Understand the characteristics of various switching devices and appreciate its applications in various electrical networks/systems.
- Analyze and design the operation of power switching converters.
- Develop practical control circuits for various real time applications.
- Analyze and prepare the technical report on the experiments carried out.

EE 23.401 **Electrical Drives and Control** **Total Lectures: 40**
3-0-0-3

Objective: This course facilitates the students to get a comprehensive exposure to the working principles, characteristics details, control and performance of Electrical Drives.

Pre-requisite: Electrical Machines, Control System Engineering, Power Electronics

1. **DC Motor Characteristics and Chopper fed DC Drive:** Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited DC motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation. Review of DC chopper and duty ratio control, chopper fed DC motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in DC motor and chopper, efficiency of DC drive, smooth starting. [10]
2. **Multi-quadrant DC Drive:** Review of motoring and generating modes operation of a separately excited DC machine, four quadrant operation of DC machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed DC drive, regenerative braking. [6]
3. **Closed-loop Control of DC Drive:** Control structure of DC drive, inner current loop and outer speed loop, dynamic model of DC motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function for controller design, current controller specification and design, speed controller specification and design. [6]
4. **Induction Motor Characteristics:** Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with applied voltage, applied frequency and applied voltage and frequency. Typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation. [6]
5. **Scalar Control or Constant V/f Control of Induction Motor and Control of Slip Ring Induction Motor:** Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation. Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. [12]

*Assignments based on numerical tutorials are required to be submitted.

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

- Understand the characteristics of DC motors and induction motors.
- Understand the principles of speed-control of DC motors and induction motors.
- Understand the power electronic converters used for DC motor and induction motor speed control.

Text Books:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.

Reference Books:

1. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
2. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.
3. Leonhard, Werner. Control of electrical drives. Springer Science & Business Media, 2001.

EE 23.402 **Solar PV Technology** **Total Lectures: 40**
3-0-0-3

Objective: This course facilitates the students to attain a broad comprehension of solar photovoltaic systems used for various applications.

Pre-requisite: Basic of Electrical Engineering

1. **Photovoltaic basics:** [7]
Structure and working of Solar Cells - Types, Electrical properties and Behaviour of Solar Cells - Cell properties and design - PV Cell Interconnection and Module Fabrication - PV Modules and arrays - Basics of Load Estimation.

2. **Stand alonepv systems:** [8]
Schematics, Components, Batteries, Charge Conditioners - Balance of system components for DC and/or AC Applications - Typical applications for lighting, water pumping etc.

3. **Grid connected pv systems:** [8]
Schematics, Components , Charge Conditioners, Interface Components - Balance of system Components - PV System in Buildings

4. **Hybrid systems:** [8]
Solar, Biomass, Wind, Diesel Hybrid systems - Comparison and selection criteria for a given application.

5. **Design of pv systems:** [9]
Radiation and load data - Design of System Components for different PV Applications - Sizing and Reliability - Simple Case Studies.

*Assignments based on numerical tutorials are required to be submitted.

Outcome: At the end of this course, students will demonstrate the ability to
- To explain basics of solar photovoltaic systems.
- To know in depth of its types and design of various PV-interconnected systems.

Text Books:
1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, Wiley-Interscience, ISBN 0-471-28060-7.
2. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications, PHI Learning Pvt. Ltd., 2011.

Reference Books:
1. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008.
2. Nelson, J The Physics of Solar Cells. Imperial College Press, 2003. Thomas Markvart, Solar Electricit, John Wiley and Sons, 2001.
3. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish (Editors), Applied Photovoltaics, Earthscan, 2008.

EE 23.403 **Nonlinear Control System** **Total Lectures: 40**
3-0-0-3

Objective: This graduate course will cover fundamentals of nonlinear systems analysis and control.

Pre-requisite: Linear dynamical systems, differential equations, and linear algebra

1. **Introduction:** Examples – violin strings, heart rhythms, double pendulum, van der Pol oscillator. Existence and uniqueness of solutions [6]
2. **Analysis:** Linearization through Taylors series, Hartman-Grobmann Theorem, local stability. Multiple equilibria, limit cycles, bifurcations. [9]
3. **Second-order systems and Input-output analysis and stability:** Phase plane techniques, Poincare-Bendixson Theorem. Small gain theorem, passivity, describing functions [9]
4. **Mathematical background and Lyapunov stability theory:** Contraction mapping theorem, homeomorphisms, norms. Basic stability and instability theorems. Uniform stability, asymptotic stability, exponential stability. LaSalles Theorem, indirect method. [8]
5. **Feedback linearization, Sliding mode control and Gain scheduling:** Input-output linearization, full-state linearization, stabilization, tracking. Zero dynamics, MIMO systems, non-minimum phase systems, singularities. Sliding surfaces, differential inclusions, solutions in the sense of Filippov. Controller and scheduling design [8]

*Assignments based on numerical tutorials are required to be submitted.

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

- Understand the concepts of stability for linear and non-linear systems.
- Approach and understand non-linear control literature.
- Analyze simple non-linear systems to determine system stability.
- Synthesize control methods to achieve the desired performance of practical non-linear systems.

Text Books:

1. S. Sastry, Nonlinear Systems: Analysis, Stability, and Control, Springer 1999.
2. H. Khalil, Nonlinear Systems, Prentice Hall, 2002.

Reference Books:

1. Slotine, J.-J. E and Li, W. Applied Nonlinear Control. Englewood Cliffs, NJ: Prentice Hall, 1991.
2. H. J. Marquez, Nonlinear Control Systems: Analysis and Design, John Wiley Interscience, 2003.
3. J. E. Gibson Nonlinear Automatic Control, McGraw-Hill,1963

EE 23.404 **Power Electronics in Renewable Energy Technology** **Total Lectures: 40**

3-0-0-3

Objective: This course facilitates the students to develop the competency of maintaining renewable energy equipment using power electronic devices and circuits. The purpose of power electronic interface is to regulate the voltage, frequency, and power to make energy useable as per requirement.

Pre-requisite: Power Electronics.

1. **Introduction:** Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) – Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems: operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area. [8]

2. **Electrical machines for renewable energy conversion:** Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG. [8]

3. **Power converters:** Solar: Block diagram of solar photo voltaic system: line commutated converters (inversion- mode) – Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing. Wind: 3-Φ AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters. [8]

4. **Analysis of wind and PV systems:** Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system. [8]

5. **Hybrid renewable energy systems:** Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV- Maximum Power Point Tracking (MPPT). [8]

*Assignments based on numerical tutorials are required to be submitted.

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

- Identify renewable energy sources for generation of power.
- Maintain PE devices in PV power system.
- Maintain PE devices in Wind power system.
- Maintain PE devices in power system of power generation from solid waste.
- Maintain PE devices in hybrid power system of renewable energy.

Text Books:

1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009
2. Ned Mohan, Tore M. Undel and William P. Robbins, “Power Electronics: Converters, Applications and Design”, Third Edition, John Wiley & Sons, 2007

Reference Books:

1. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
2. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi.

EE 23.405 **Robotic Engineering** **Total Lectures: 40**
3-0-0-3

Objective: This course facilitates to enlighten the students about the fundamentals of robotic systems.

Pre-requisite: NIL

1. **Introduction:** Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems, Hydraulic, Pneumatic and Electric system. [8]

2. **End effectors and robot controls:** Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control. [8]

3. **Robot transformations and sensors:** Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors. [8]

4. **Robot cell design and applications:** Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications. Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. [8]

5. **Micro/Nano robotics system:** Micro/Nano robotics system overview-Scaling effect-Top down and bottom up approach- Actuators of Micro/Nano robotics system-Nano robot communication techniques-Fabrication of micro/nano grippers-Wall climbing micro robot working principles-Biomimetic robot-Swarm robot-Nano robot in targeted drug delivery system. [8]

*Assignments based on numerical tutorials are required to be submitted.

Outcome: At the end of this course, students will able to understand

- The basics of robot, end effectors and robot controls.
- Robot Transformations, Sensors, robot cell design and its applications.
- Micro/Nano robotic systems

Text Books:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning., 2009.

Reference Books:

1. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
2. P.A. Janaki Raman, Robotics and Image Processing An Introduction, Tata Mc Graw Hill Publishing company Ltd., 1995.

EE 23.406 **PLC and Automation** **Total Lectures: 40**

3-0-0-3

Objective: This course facilitates the students to get a comprehensive exposure to the Industries Automation techniques and the importance of PLC, SCADA and robots in automation.

Pre-requisite: Elements of Electrical Engineering, Digital Electronics, Electrical Measurement and Instrumentation.

1. **Introduction:** Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus. [9]

2. **Automation components:** Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control. [7]

3. **Computer aided measurement and control systems:** Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation. [9]

4. **Programmable logic controllers:** Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries. [7]

5. **Distributed Control System:** Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS. [8]

*Assignments based on numerical tutorials are required to be submitted.

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

- Understand various automation components and systems
- Explain architecture of industrial automation system and fundamentals of process control
- Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.
- Use programmable logic controllers and IOTs for industrial automation
- Draw block diagram of SCADA and integrate SCADA with PLC systems

Text Books:

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies.
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI/

Reference Books:

1. Chemical Process Control,An Introduction to Theory and Practice, George Stephanopoulos,Prentice Hall India, 2012
2. Electric Motor Drives, Modelling,Analysis and Control, R.Krishnan,Prentice Hall India, 2002
3. Hydraulic Control Systems, Herbert E. Merritt, Wiley, 1991

EE 23.407 **High Voltage Engineering** **Total Lectures: 40**
3-0-0-3

Objective: To provide an in-depth understanding the principle of High Voltage (HV) generation, various measurement methods, testing aspects of HV electrical apparatus and HV laboratories facilities.

Pre-requisite: Power System-I, Power System-II

1. **Breakdown in Gases, liquid and solid Insulating materials:** Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge. Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials. [12]
2. **Generation of High Voltages:** Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators. [7]
3. **Measurements of High Voltages and Currents:** Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements. [7]
4. **Lightning and Switching Over-voltages:** Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers. [7]
5. **High Voltage Testing of Electrical Apparatus and High Voltage Laboratories:** Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs. [7]

*Assignments based on numerical tutorials are required to be submitted.

Outcome: At the end of the course, the student will demonstrate

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

Text Books:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.

Reference Books:

1. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.

EE 23.408 **Wind Energy System** **Total Lectures: 40**
3-0-0-3

Objective: This course provides an overview of the wind turbine as a system, including the influence of the wind resource and external factors that impact the wind energy enterprise.

Pre-requisite: Basic of Electrical Engineering

1. **History:** early wind power, technical development, influence of society and science. **Winds:** physical background, energy content, variation in time and in space, geographical resource distribution, influence of terrain, measurement methods, statistical analysis. [7]

2. **Turbines:** free flow, principles of drag and lift, aerodynamics, design of turbine blades, horizontal and vertical axis wind turbines, Betz' and Glauert's turbine theories, the BEM method. [9]
Mechanics: static and dynamic loads (oscillations), rotor dynamics, solid mechanics, mechanical modelling, aeroelasticity.

3. **Electric generation:** synchronous/ asynchronous generators, winding/ permanent magnetised generators, constant/ variable speed, transformers, power electronics, power converters. [8]

4. **Design:** horizontal and vertical axis wind turbines, blades, control mechanisms, drive train, tower, nacelle, foundation, choice of materials, manufacture, adaptation to different climates [8]
Control: control targets, system modelling, control strategies (pitch and stall regulation), hardware.
Systems: wind power parks, transports, erection, grid connection, operation, maintenance.

5. **Economy:** financing, investment, costs during the life time of a wind turbine, value of wind energy, business and market overview. [8]
Society: environmental issues, law, forms of government support, technical aspects of environment. Small scale wind power: technology, economy, paths of development.

*Assignments based on numerical tutorials are required to be submitted.

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

- calculate and analyze wind resource and energy production for a wind turbine from wind speed distribution, wind shear and power curve
- Analyze wind turbine components and compare various design configurations.
- compute performance characteristics of the main components of the wind turbine.

Text Books:

1. Freris L.L., Wind Energy Conversion Systems, Prentice Hall 1990.
2. Spera D.A., Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, ASME Press, NY 1994.

Reference Books:

1. Johnson, G.L., Wind Energy Systems, Prentice Hall, 1985.
2. Manwell, James F.; McGovan, Jon G.; Rogers, Anthony L.**Wind energy explained : theory, design and application** ed.: Chichester: Wiley, 2009.
3. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.

EE 23.409 **Smart Grid** **Total Lectures: 40**
3-0-0-3

Objective:
- This course aims to equip the students to understand the change in electricity power business from conventional sectors to smart grid sectors.
- To understand and analyze the basic architecture of smart grid and functions of its various components like renewables generation, measurement and communication system etc.

Pre-requisite: Basic of Electrical Engineering

1. **The Traditional Power Generation and Transmission System**: Introduction, Power System reliability and quality, Voltage profile of power system, Power transfer Through radial feeder, Power system stability and control, Protection system, SCADA System. [8]
2. **Smart Grid:** Introduction, Characteristics of Smart Grid, Traditional Grid Versus Smart Grid, Evolution of Smart Grid, Components of Smart Grid, The Environmental Impacts of Smart Grid, Technologies Required for Smart Grid. [8]
3. **Renewable Energy Integration:** Introduction, Solar Energy, Wind Energy, Distributed Energy Resources Integration Challenges, Forecasting and Scheduling, Impacts of Renewable Energy into the Grid. [8]
4. **Smart Grid Communications and Measurement Technology:** Communication, Measurement and Monitoring Technologies, Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMU) ,Smart Appliances, Advanced Metering Infrastructure (AMI),Communication Protocols. [8]
5. **Smart Meter:** Details Description of Smart Meter, Benefits of Smart Meter, Technical Configurations of Smart Meter, Components of Smart Meter Network in Distribution System, and Characteristics of smart meters. [8]

*Assignments based on numerical tutorials are required to be submitted.

Outcome: At the end of this course, students will demonstrate the ability to
- Understand the difference between conventional grid and smart grid.
- Understand the integration necessity and challenges of renewable in conventional grid system.
- Understand the operation of communication and measurement technology in modern grid context.

Text Books:
1. Momoh James., “Smart Grid Fundamentals of Design and Analysis”, John Wiley &Sons, Inc., Hoboken, New Jersey, 4th Edition, 2012.
2. Bollen, Math and Hassan F, “Integration of Distributed Generation in the Power System”, IEEE press, 2011.

Reference Books:
1. Shawkat Ali A. B. M., “Smart Grids Opportunities, Developments and Trends”, Springer Verlag, London, 4th Edition, 2013.
2. Chowdhury S., Crossley P. “Microgrids and Active Distribution Networks” The Institution of Engineering and Technology, UK, 3rd Edition, 2009.
3. James Momoh, Smart Grid: Fundamentals of Design and Analysis, IEEE Computer Society Press (2012).

EE 23.410 **Energy Storage Systems** **Total Lectures: 40**
3-0-0-3

Objective:
- To enable the student to understand the need for energy storage, devices and technologies available and their applications

Pre-requisite: Basic of Electrical Engineering

1. **Electrical Energy Storage Technologies:** Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable. [8]

2. **Needs for Electrical Energy Storage:** Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy. [8]

3. **Features of Energy Storage System:** Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H_2),Synthetic natural gas (SNG). [8]

4. **Types of Electrical Energy Storage Systems:** Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies. [8]

5. **Applications:** Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems . [8]

*Assignments based on numerical tutorials are required to be submitted.

Outcome: After completion of this course, the student will be able to
- analyze the characteristics of energy from various sources and need for storage
- classify various types of energy storage and various devices used for the purpose
- Identify various real time applications.

Text Books:
1. James M. Eyer, Joseph J. Iannucci and Garth P. Core, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Books:
1. Jim Eyer, Garth Core, “Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report”, Sandia National Laboratories, Feb 2010.
2. Rahn C. D. and Wang C., “Battery Systems Engineering” First Edition, Wiley, 2013.
3. Moseley P. T., and Garche J., “Electrochemical Energy Storage for Renewable Sources and Grid Balancing”, Elsevier Science, 2014.

EE 23.411 **Industrial Automation and Control** **Total Lectures: 40**
3-0-0-3

Objective: This course facilitates the students to get a comprehensive exposure to the working principles of actuators, sensors, different type of controllers and industrial communication in the field of industrial automation system.

Pre-requisite: Basic of Electrical Engineering

1. **Overview:** Structure & components Industrial Automation systems. Architectural levels of Industrial controls. [8]
2. **Actuators & sensors:** Servomotors, Stepper motors, Process I/O systems. Local & remote I/O systems. [8]
3. **Controllers:** Different types of controllers, Single loop and Multiloop controllers and their tunning, Direct controllers and their tunning, Direct Digital Controllers, Software implementation of Multiloop Controllers. Distributed Control Systems. [8]
4. **Supervisory Controllers:** Functionally of Supervisory Control Level, Process Optimization, Recipe Management Material. Tracking. Man-machine interfaces. [8]
5. **Industrial Communication Systems:** Characteristic features of industrial networks. Low level networks and their features, Field bus architecture. Performance aspects of Industrial Automation Systems. [8]

*Assignments based on numerical tutorials are required to be submitted.

Outcome: The students shall develop an insightful knowledge on actuators, sensors, different controllers and tuning of different controllers used in industries.

Text Books:
1. Terry Bartlet, Industrial Control Electronics Devices, Systems & Applications, Thomson Delmar Learning, 3rd Edition, 2006.
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, PHI New Delhi, 5th Edition, 2009.

Reference Books:
1. John G. Webster, The Measurement Instrumentation and Sensors Handbook, Springer Science & Business Media, 1999.
2. Richard Zurawski, Industrial Communication Technology Handbook, CRC Press, 2nd Edition, 2017.

EE 23.412 **Advanced Electric Drives** **Total Lectures: 40**
3-0-0-3

Objective: This course aims to equip the students to understanding the advance electric drive system and their controls.

Pre-requisite: Electrical Drives and Control

1. **Power Converters for AC Drives :** [10]
PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, different topologies, SVM for three level inverter, diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices, control of CSI, H-bridge as a 4-Q drive.

2. **Induction Motor and Synchronous Motor Drives:** [12]
Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control, v/f control, vector control, direct torque and flux control (DTC), modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

3. **Permanent magnet motor drives:** [6]
Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, speed and torque control in BLDC and PMSM.

4. **Switched reluctance motor drives:** [6]
Evolution of switched reluctance motors, various topologies for SRM drives, comparison, closed loop speed and torque control of SRM.

5. **DSP based motion control:** [6]
Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

*Assignments based on numerical tutorials are required to be submitted.

Outcome: At the end of this course, students will demonstrate the ability to
- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for AC motor drives
- Understand the implementation of the control strategies using digital signal processors.

Text Books:
1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.

Reference Books:
1. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003.
2. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.
3. Boldea, Ion, and Syed A. Nasar. Electric drives. CRC press, 2016.

MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY

The Bhagavad-Gita

Pre-requisite(s): Basic interest in Indian culture. Sanskrit verses in *Devanagari* script as well as in transliteration forms are provided for further references only; knowledge of Sanskrit is not required as the medium of instruction is English, however it may be an added advantage. Familiarity with the *Devanagari* script may be useful at times.

Course Objectives: The primary aim of the Bhagavad-Gita Course is to make the glorious 'Gita way of life' accessible to anyone who yearns for it, or is just curious to know more in a convenient yet effective manner. It provides a holistic, insightful coverage of the entire text in a lucid and simple style without compromising on the salient features of this priceless knowledge. Providing inputs in the modern context for continuous improvement it becomes a practical manual to live a transformed life of goodness and greatness. The course seeks to help students negotiate the text independently without referring to the traditional commentaries so as to enable them to experience the richness of the text and its philosophy.

Evaluation Process: The evaluation pattern would have following two components:

1. Internal component of 20 marks, which can be assessed in one of the following ways at the discretion of course coordinator
    a. Assignment
    b. Written test
    c. Presentation
    d. Viva
    e. Model preparation
    f. Practical assignment
2. An end term examination of 80 marks.

Course Description:

BG 111	**The Bhagavad-Gita**	**3-0-0-3**
Introduction: Background of the Mahabharata War, Author (Vedavyasa), Background of the Bhagavad-Gita: knowledge given in the battlefield of life, The role of Gita in our life, Overview of the chapters, The Distress of Arjuna		[03]
Cognitive and Emotive Apparatus: Hierarchy of senses, *manas, buddhi* and *ātman*- III.42, XV.7 Role of the ātman-XV.7, XV.9 Mind as a product of prakṛti VII.4 Properties of three modes and their impact on the mind-XIII. 5-6; XIV.5-8, 11-13; XIV.17		[08]

Controlling the Mind: Confusion and conflict: Nature of conflict I.1; IV.16; I.45; II.6 Causal factors-Ignorance-II.41; *Indriya*-II.60, Mind-II.67; *Rajoguṇa*-III.36-39; XVI.21; Weakness of mind- II.3; IV.5 Means of controlling the mind: Meditation–difficulties –VI.34-35; procedure VI.11-14 Balanced life- III.8; VI.16-17 Diet control- XVII. 8-10 Physical and mental discipline – XVII. 14-19, VI. 36.	[09]
Means of Conflict Resolution: Importance of knowledge – II. 52 ; IV.38-39; IV.42 Clarity of *buddhi* – XVIII.30-32 Process of decision making – XVIII.63 Control over senses – II.59, 64 Surrender of doer-ship –XVIII .13-16; V.8-9 Desirelessness- II.48; II.55 Putting others before self – III.25	[10]
Self Management through Devotion: Surrender of ego – II.7 ; IX.27; VIII.7; XI.55 ; II.47 Abandoning frivolous debates – VII.21, IV.11; IX.26 Acquisition of moral qualities - XII.11; XII.13-19 **Conclusion:** Arjuna's realization, Lasting property, Total victory- XVIII.73,78	[09]

Text Book:

Srimad Bhagavadgita(with English Translation and Transliteration, Code 1411), Gita Press, Gorakhpur

Reference Books:

1. Shrimadbhagavadgitarahasya or Karmayogashastra: The Hindu Philosophy of Life, Ethics, and Religion (Original Sanskrit Stanzas with English Translation), Balgangadhar Tilak & Balchandra

Sitaram Sukthankar, J.S. Tilak & S.S. Tilak
2. Shrimadbhagavadgita-Tattvavivechani (English Commentary by Jayadayal Goyandaka), Gita Press, Gorakhpur
3. Shrimadbhagavadgita:A Guide to Daily Living (English Translation and notes by Pushpa Anand), Arpana Publications
4. Shrimadbhagavadgita:The Blessed Lord's Song Paramananda, The Vedanta Centre
5. The Art of Man Making (114 short talks on the Bhagavadgita), Chinmayananda, Central Chinmay Mission Trust, Mumbai
6. Essays on the Gita, Shri Aurobindo, Shri Aurobindo Ashram, Pondicherry
7. Managing One-Self (Shrimadbhagavadgita: Theory & Practice), Panchamukhi V.R., Panchamukhi Indological Research Centre, New Delhi & Amar Granth Publications, Delhi
8. Science of Bhagavadgita (A Study of Ancient Wisdom through Modern Science),Virajeshwar, Himalayan Books, Connaught Place, New Delhi
9. Shrimadbhagavadgita through the Eyes of a Scientist, Manhas M.S., B.R. Publishing Corporation, Delhi

Mody University

Open Elective in English for all Undergraduate Programmes

Paper Code: EL 100 **Credits: 3-0-0-3**
Paper Name: Essential English

Contents:

Reading Comprehension [11]
To develop skills such as vocabulary building, efficient reading and note-taking.
Poetry

1. Milton: On His Blindness
2. Shakespeare: Let Me Not to the Marriage of true minds
3. Wordsworth: The Solitary Reaper
4. William Butler Yeats: A Prayer to my daughter
5. Browning: My Last Duchess
6. Nissim Ezekiel: Night of the Scorpion

Prose

(1) Francis Bacon: Of Studies
(2) R.K. Narayan: Engine trouble
(3) O. Henry : The Gift of the Magi
(4) Oscar Wilde : The Nightingale and the Rose

Grammar and Usage [16]
Tenses and their different forms (present, past and future), their uses and sequences of tenses. Articles, auxiliaries and modals, Preposition, Rules of conversion form direct to indirect speech, expressions of time and place, questions in indirect speech, commands, requests and advice in indirect speech. Spotting the errors in spelling, tenses, prepositions, articles and how to avoid them.

Business Letter Writing [6]
Layout of formal letters, difference between British and American pattern of letter writing and different types of letters (Job application letter, invitation letter, letter of request)
Idioms and Phrasal Verbs: Understanding idioms, collocations, introduction to phrasal verbs, verb and preposition/ adverb combination, usage of idioms and phrasal verbs.
Vocabulary Building: One word for many, Synonyms and Antonyms, words commonly mis-spelt and mis-pronounced. [6]

Text Books:

1. Jain, Jasbir (ed): Strings of Gold, Delhi, Macmillan Ltd. (1994/ Latest Edition).
2. Lockitt, C. H (ed): The Art of the Essayist, Delhi, Longman Group Ltd. (Latest Edition).
3. Murphy and Reynold: Essentials of English grammar, Cambridge University Press, 4th printing 2007.

References:
1. Andrea J. Rutherford: Basic Communication Skills for Technology; Pearson Education, New Delhi, 2nd edition, 2002.
2. R.C. Sharma and Krishna Mohan: Business Correspondence and Report Writing; Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd edition, 1999.
3. R.P. Bhatnagar: English for Competitive Examinations; Macmillan India Ltd., 5th edition, 1998.
4. T.Balasubarmaniam: A Textbook of English Phonetics for Indian Students; Macmillan India Ltd., 15th edition, 2001.
5. Sharon J. Gerson and Steven M. Gerson: Technical Writing; Pearson Education Asia, New Delhi, 3rd edition, 2001.
6. A.J. Thomson and A.V. Martinet: A Practical English Grammar; Oxford University Press, New Delhi, 4th edition, 1986.

MODY UNIVERSITY

OPEN ELECTIVE CBCS COURSE

Course Code: **3-0-0-3**
ET-18.101 **E-Government Processes and Technologies**

Total Lectures: 39

Objectives:

- Support the government departments, in terms of leading or being part of team responsible for, e-Governance project Conceptualization and design .
- Support the government departments in effectively planning and managing various phases of e-Governance project development and implementation
- Leverage the strengths of private sector in e-Governance initiatives through effective procurement approach and manage service delivery throughout project Lifecycle
- Application of learning and good practices in e-Governance projects implementation to minimise the learning curve and to maximise the benefits for the department

1. **Roadmap to e-Government:** Vision and mission of e-government, government to e-government transformation, selection, planning and management of projects, parameters for success and measure of projects, relationship and citizen participation in e-government. [5]
2. **e-Gov 2.0:** Introduction, e-Gov 1.0 v/s e-Gov 2.0, e-Gov 2.0 financial and technology models. [5]
3. **Multiple Standards in ICT and Change Management:** Purpose and rationale for multiple standards, areas having multiple standards, rationale for single standard, introduction to change management, model of change management. [6]
4. **Government Data Centres and Utility Computing :** Elements and complexity of GDCs, virtualization and consolidation of GDCs, architecture of a GDC, utility computing concepts and areas, technical and regulatory issues in utility computing. [7]
5. **Secured Government Information System Architecture:** Introduction, architectural types, processes, security requirements and policies, steps in designing security architecture. [8]
6. **Case Studies of few e-Government Projects:** National Citizen Identity System, land records, urban development management system, e-agriculture, e-procurement, RTO, e-mitra etc. [8]

(The contents in this unit are subject to change as per the evolution and progression of novel e-governance projects).

Outcomes: Will have the understanding and knowledge of the following:

- Better access to information and quality services for citizens
- Simplicity, efficiency and accountability in the government
- Expanded reach of governance
- Enabling Environment for Promoting Economic development
- Enhancing Transparency and Accountability:

- Improving Service Delivery:
- Improving Public Administration

Text Books:

1. Jaijit Bhattacharya, "e-Gov 2.0", 1st edition, Tata McGraw Hill.

2. C.S.R. Prabhu, "e-Governance: Concepts and Case Studies", 2nd edition, PHI.

Reference Books:

1 J. Satyanarayana," e-Government: The Science of the Possible", PHI.

2 Bidisha Chaudhuri, "E-Governance in India: Interlocking Politics, Technology and Culture", 1st edition, Routledge.

MODY UNIVERSITY

Course Code: **3-0-0-3**
ET-18.102 **Web Designing and Mobile App Development** **Total Lectures:40**

OPEN ELECTIVE CBCS COURSE

Objectives: On completion of this course, a student will be familiar with client server architecture and able to develop a web application using java technologies. Students will gain the skills and project-based experience needed for entry into web application and development careers.

1. Concept of Internet A brief Introduction to the Internet: Computer Networks, Internet, URL (Uniform Resource Locator), Internet Service Provider, Intranet, Extranet, Virtual Private Network. Application of Internet: World Wide Web, Search Engines, News groups, Electronic Mail, Web Portal, Chat, Video Conferencing, FTP, Remote Login, E-Commerce, E-Learning, EGovernance, E-Banking. [9]

2. Static Web Page Development Basics of HTML: What is Internet Language?, Understanding HTML, Create a Web page, Linking to other Web Pages, Publishing HTML Pages, Text Alignment and Lists, Text Formatting Fonts Control, Email Links and link within a Page, Creating a Table, Creating HTML Forms, Creating Web Page Graphics, Putting Graphics on a Web Page, Custom Backgrounds and Colors, Creating Animated Graphics. [9]

3. Dynamic Web page Development Cascading Style Sheet: CSS, Defining Style with HTML Tags, Features of Style Sheet, Style Properties, Style Classes, External Style Sheet. [8]

4. JavaScript Introduction to JavaScript: Writing First Java Script, External JavaScript, Variables: Rules for variable names, Declaring the variable, Assign a value to a variable, Scope of variable, Using Operators, Control Statements, JavaScript loops, JavaScript Functions: Defining a Function, Returning value from function, User define function. [9]

5. Android: Introduction to android OS, Versions of Android, Introduction to Android Studio, Different GUI Elements of Android Programming, WebView, Convert any Website to android apk. [5]

Outcomes:

- Students are able to develop a dynamic webpage by the use of java script and DHTML.
- Students will be able to write a well formed / valid XML document.
- Students will be able to connect a java program to a DBMS and perform insert, update and delete operations on DBMS table.
- Students will be able to write a server side java application called Servlet to catch form data sent from client, process it and store it on database.
- Students will be able to write a server side java application called JSP to catch form data sent from client and store it on database.

Text Books:

1. Teach Yourself HTML 4 in 24 Hours By Dick Oliver (Tech media) 4th edition
2. The Complete Reference JavaScript By Thomas Powell & Fritz Schneider 2nd Edition.
3. Jerome (J.F) DiMarzio “Android A programmer’s Guide” Tata McGraw-Hill 2010 Edition.

Reference Books :

1. HTML, DHTML, JavaScript, Perl CGI By Ivan Bayross(BPB) 3rd Edition
2. CSS By Kynn Bartlett(Pearson Education)2nd Edition
3. Introduction to Internet & HTML Scripting By Bhaumik Shroff Books India Publication 3rd Edition.

MODY UNIVERSITY

OPEN ELECTIVE CBCS COURSE

Course Code: **ET 18.103**

Application of Electronics in Everyday Life

3-0-0-3
Total Lectures: 40

Objective: To develop the understanding of Electronics used in daily life as well as understand the principle and working of various instruments used in health care, IoT and communication sector.

1. **ELECTRONICS COMPONENTS:** Resistor and its color code, Capacitor, Inductor, PN diode, Photo Diode, LDR, LED, Zener diode, Varactor diode. **[4]**

2. **ELECTRONICS IN COMMUNICATION:** Telegraph, Telex, Mobile Phone, Optical Fiber, Transmission Line, Waveguides, Satellite Communication, RADAR, 4G system, Internet, Video conferencing, Fax. **[10]**

3. **ELECTRONICS IN HOME CARE:** Basic of electricity and electrical cables, Multi meter and basic electronic component, Power supply, UPS/Inverter, SMPS, Washing machine, Microwave oven, Steam iron, Electric rice cooker, Electric kettle, Induction plate. **[8]**

4. **ELECTRONICS IN IOT:** Introduction, IoT applications for industry: Future Factory Concepts, Smart Objects, Smart Applications, Smart Homes, Structural Monitoring, Buildings, Smart Cities , Transportation Healthcare Warfare, Physical Intrusion Detection, Surveillance. **[10]**

5. **ELECTRONICS IN HEALTHCARE:** ECG, EEG, Defibrillator, Computed Tomography, Magnetic Resonance Imaging, Glucometer, Sphygmomanometer, Digital and Infrared Thermometer. **[8]**

Outcomes:

At the end of this course, the student should be able to

1. Know about fundamentals of Electronic Components.
2. Understand the concept of Communication.
3. Understand the concepts of electronics behind various home appliances.
4. Learn about basics of health care equipment.

Text Books:

1. Ben G. Streetman, Sanjay Kumar Banerjee: Solid state Electronic Device Electronics, Sixth Edition, Prentice Hall.
2. Adel S. Sedra, Kenneth C. Smith: Microelectronic circuit, Sixth Edition, Oxford.
3. Richard. C. Jaeger, “Microelectronic Circuit Design”, Tata McGraw-Hill Companies Inc., International Edition.

Reference Books:

1. B. P. Lathi, “Modern Digital and Analog communication Systems”, Oxford University Press, 2010.
2. William C. Y. Lee, Mobile cellular telecommunication – Analog and Digital systems, McGraw Hill, 2nd Ed, 2006

MODY UNIVERSITY

OPEN ELECTIVE CBCS COURSE

Course Code: **ET 18.104** | **Energy Sources & Sustainable development** | **3-0-0-3**

Total Lectures: 39

Objective(s): *The course is designed to give knowledge of various energy sources and basics of power production techniques. It lays emphasis on basic understanding of green energy technology and its importance for environment and sustainable development.*

1. **World Energy Status:** Present Situation and future Energy Scenario, Evolution of Energy Security; India's Energy Scenario; Introduction to nexus between Energy, Environment, and Sustainable development and Climate Change and societal issues [14]

   Conventional Energy Sources: Fossil Fuel, Coal, Oil, Gas, Thermal Power Stations,

   Hydro power generation, Comparison of various conventional energy systems, their prospects and limitations

   Scenario of Green Energy Sources: Difference between conventional and renewable energy systems, Needs and advantages of green energy sources, social implications.

2. **Solar Energy:** Principles of photovoltaic generation of electricity; Silicon cell; Photon absorption; Cell efficiency; Solar cell construction; Types and usage of photovoltaic systems. solar cell modules and arrays, solar cell types, material, applications, advantages and disadvantages, solar energy conversion into heat, types of solar collectors, cylindrical parabolic collector, solar energy thermal storage. [14]
   Nuclear Energy: Present Status of Nuclear Power; Nuclear Fission & Fusion, National Nuclear Power Program,, Natural Radioactivity, Radioactive Decay, Radiation Doses, various types of nuclear power plants, Nuclear Reactor Safety, Fusion reactor

3. **Wind Energy:** Energy available from wind, basics of wind energy conversion system, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, and applications. [6]

   Bio Energy: Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages, biomass energy, energy plantation, gasification

4. **Ocean Energy:** Ocean energy resources-ocean energy routes - Principles of ocean thermal energy conversion systems- ocean thermal power plants- Principles of ocean wave energy conversion and tidal energy conversion. [5]

   Geothermal energy: Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and limitations

Outcome(s): *After learning the subject, student will be able to understand the basic principle of power production from different energy sources. Advantage of renewable and green energy sources for sustainable development and environmental issues related to energy sources and societal implications*

Text Books:

1. S.P. Sukhatme, Solar Energy: principles of Thermal Collection and Storage, Tata McGraw-Hill
2. C. S. Solanki, "Solar Photovoltaics: Fundamental Applications and Technologies, PHI, 2009
3. S. Glasstone & A. Sesonkse, Nuclear Reactor Engineering, CBS, 2004
4. D. A. Spera, Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering, ASME Press.

Reference Books:

1. Non-conventional energy resources, Shobh Nath Singh, Pearson India
2. Principles of Solar Energy, Frank Krieth& John F Kreider, John Wiley, New York
3. David Bodansky, Nuclear Energy: Principles, Practices and Prospects, Springer 2004.

MODY UNIVERSITY OF SCIENCE & TECHNOLOGY
College of Fashion Design &
Merchandising Bachelors of Design
(Fashion Design) BFD Autumn (2015-16)

First Year
FOUNDATION PROGRAMME

Total L & P: 45

Title of Course: Fashion in Everyday Life **3-0-0-3**

Semester:
Autumn Course
Code: FD 115

Pre-requisite(s): Basic interest in fashion and trends

Course Objectives: This course will give the students overview of fashion and its use in everyday life considering trends, forecast; body anatomy, colour preferences and styling techniques. The course will also elaborate on fashion market segments while giving an idea on leading fashion brands, designers and trendsetting celebrities

Course Description:

- Basic Introduction to Fashion: Brief Introduction to fashion and regularly used fashion terminologies, Overview of types of clothing such as Formal Wear, Casual Wear, Evening Wear, Ethnic Wear, Traditional Wear etc., Fun facts related to fashion **(3)**
- Body Analysis: Triangular figure study, Eight headed figure, Hour glass structure, Vital statistics, Clothing suggestions as per body types **(3)**
- Practical Colour Study in Fashion: Colour selection in clothing as per skin – tones for day wear and evening wear **(6)**
- Styling tips with ensembles – An introduction to fashion styling, Exploring various mix and match combinations like print plain combination, combining ethnic and western fashion elements, etc. - **GO, get the desired look!!** **(5)**
- Fashion Market Segments – A brief insight to different consumer market segments in fashion such as Haute Couture, Pret a Porter (Ready to Wear), Semi Couture, Premium Fashion, High Street fashion, Street fashion, Bridge Fashion, Fast fashion, etc. in context of products, features and service **(3)**
- Fashion Brands – To Study and compare national and international women's wear fashion brands such as Prada, Dior, Chanel, LVMH, Zara, Aldo, Biba, W, Elle, Aakruti, FabIndia, AND, etc. across market segments and their incorporation by consumers in everyday life **(5)**
    - Fashion Designers – A brief look into the profile and work of renowned Indian and International fashion designers like Manish Malhotra, Sabyasachi Mukherjee,

Manish Arora, Ritu Beri, Ritu Kumar, Coco Chanel, Yves Saint Laurent, Giorgio Armani, Christian Dior, Prada, etc. who changed the fashion industry. **(10)**

- Trailblazers of Fashion: To study the role of celebrities (David Beckham, Lady Gaga, Sonam Kapoor, Hrithik Roshan, etc.) red carpets (Oscars, Golden Globes, Filmfare Awards, IIFA, etc.) movies (Piku, Tanu Weds Manu, Dil Dhakadne Do, Devil Wears Prada, etc.) television series (Sex and the City, Gossip Girls, Two Broke Girls, Roadies, Splitsvilla, etc.) on the fashion trends at Indian and Global level **(10)**

Learning Outcomes:

- Demonstrate a basic knowledge of fashion and common fashion terms
- Understand clothing selection with respect to body type and colour tones while applying basic styling tips to get desired looks
- Explore and evaluate different fashion brands, fashion designers and other popular influencers of fashion

Reference Books:

1. Malcom Barnard, UK March 2014. *Fashion Theory: An Introduction.* Routledge Publishers
2. Harriet Worsley, UK. August 2011. *100 Ideas that Changed Fashion.* Laurence King Publishing
3. Helen Warner. UK April 2014/US June 2014. *Fashion on Television- Identity & Celebrity Culture*. Bloomsbury Academic
4. Pamela Church Gibson. UK December 2011/US December 2011. *Fashion & Celebrity Culture.* Berg Publishers
5. Shanon Burns. UK April 2013/US February 2013. *Style Wise- A Practical Guide to Becoming A Fashion Stylist*. Fairchild Books
6. Patrizia Caietato. Translated by Lisa Adams. UK April 2014/US June 2014. *Luxury- Fashion, Lifestyle & Excess.* Bloomsbury Academic
7. Laura Eceiza, UK. 2008. *Atlas of Fashion Designers.* Rockport Publishers
8. Mark Tungate, UK. 2008. *Fashion Brands.* Kogan Page Limited

Evaluation Process:

Course Work: 50% weightage. It includes Quiz
Exam: 50% weightage. It includes running jury of fashion display

Other Study Material:

1) Websites: www.highheelconfidential.com, www.theblondesalad.com, www.stylebubble.co.uk , www.weworewhat.com, www.wendyslookbook.com
2) Handouts: As indicated by the course instructor
3) Magazine & Other Reading Material: Vogue, GQ, Elle, Harper Bazaar, Jaipur Times

Mody University

College of Architecture and Design (CAD)

Open Elective in Free hand sketching for all Undergraduate Programmes

Paper Code: FH 141 **3-0-0-3**

Paper Name: FREEHAND SKETCHING

Learning Objectives:

1. To ensure that students begin to understand pencils, grades, holding to sketch.
2. To provide students an exposure to express with sketching and understand proportions.
3. To gain skill of sketching indoors.
4. To enhance ability to sketch outdoors.
5. To develop rudimentary ability to use pencil as a media in sketching.

CONTENTS

Unit-I. Introduction to Graphic Skills: **[04]**

Understanding the meaning of graphic skill; basic techniques, types of pencil shades and grades.

Unit - II. Geometry of Objects **[10]**

Understanding geometry of an Object, Free hand sketching of an object, object in different eye level, Optical illusions, effect of light on object.

Unit–III. Fundamentals of Perspective **[05]**

Diminution, Foreshortening, convergence, overlapping shades and shadow

Unit-IV. Outdoor Sketching & Indoor Sketching

Outdoor: **[10]**

Sketching buildings, road activity, Landscape, Environmental scenes, principles of perspective drawing, natural forms, built form, their texture.

Indoor: **[10]**

Sketching of an arranged objects, indoor activity, still life, furniture, equipment, understanding depth, light, shade, shadow; memory drawing.

Expected Outcome:

Students learn and able to draw freehand sketch scenes with addition detailing of foreground and background from

pencil effectively on paper.

Suggested Readings

- Buildings;Ian Sidaway, : New Holland Publishers.
- Perspective;Milind Mulick,: Jyotsana Prakashan.
- The fundamentals of Water colour Paintings;D.Carter: Arcturus Pubishing Ltd
- Drawing for designers; Koptievsky: Sterling Publishing
- Rendering with pen & Ink; .R.W Gill: Thomas & Hudson
- Drawing and designing with confidence: A step by step guide; M.W Lin: John Wiley & Sons
- Perspective drawing Handbook; Joseph D'Amelio: Dover Publication
- Urban Sketching a complete guide; Thorspecken: Search Press

Evaluation Scheme: 20%=Internal, 80%=End term

Open Elective in Law for all Undergraduate Programmes

Choice Based Credit System (CBCS)

Paper Code: LF 100 **Credits: 3-0-0-3**

Paper Name: Gender Justice and the Law

Position of Women in Vedic, Post Vedic & Medieval period [03]

Constitutional Provisions and Gender Justice — Relevant provisions relating to women in Fundamental Rights, Directive Principles of State Policy and Fundamental Duties etc. under the Indian Constitution [06]

Laws Relating to Marriage, Divorce, Maintenance, Adoption and Succession under the relevant personal laws with special emphasis on Women and Maintenance under Code of Criminal Procedure, 1973 [12]

Provisions under the Indian Penal Code, 1860 (Sec. 292, 293, 294, 304B, 326A, 326B, 354, 354A, 354B, 354C, 354D, 370, 370A, 375, 376, 376A to 376E,359 to 374, 494,495 497, 498A, 507 & 509) [10]

Provisions under the Code of Criminal Procedure,1973- relating arrest, search & seizure

Socio-Legal position of women and the law — Dowry Prohibition Act, 1961 – Protection of Woman against Domestic Violence Act, 2005, The Prohibition of Child Marriage Act, 2006 [06]

Free Legal Aid for Women [02]

Text Books: -

1. Myeni, Women and Law, Asia Law House, (2008)
2. Rao Mamta, Law Relating to Women and Children, EBC(2010)

Reference Books: -

1. Jaisingh Indira.: Law of Domestic Violence, New Delhi, ULPCo. (2007)
2. Anand Justice A.S.: Justice for Women- Concerns and Expressions, Jaipur, Bharat Law House (2004)
3. Jain M. P., Constitution of India, Recent Edition
4. Shukla V. N., Indian Constitution, Recent Edition
5. Goel A, Kaur M.: Violence Against Women: Issues and Perspectives, Deep & Deep Publication (2006)
6. Ajnes Flavia, Law as Gender Inequality, Oxford University Press (1999)
7. Relevant Reports of the Law Commission of India

MODY UNIVERSITY OF SCIENCE AND TECHONOLOGY

Open Elective CBCS course

Course Title: Vedic Knowledge **3-0-0-3**

Course Code: VK 111

Course Description:

Unit-1 History of Vedic Literature (13)

1. Importance of Vedas in Indian Tradition (भारतीय परम्परा में वेदों का महत्व)
2. The emergence of the Vedas (वेदों का आविर्भाव)
3. Introduction of Vedic Svara (वैदिक स्वर परिचय)
4. Definition of Sukta (सूक्त की परिभाषा)
5. Introduction of Rig-veda: Samhita, Brahmana, Aranyaka and Upanishad.
(ऋग्वेद का परिचय -संहिता,ब्राह्मण,आरण्यक एवं उपनिषद -)
6. Introduction of Yajur-veda: Samhita, Brahmana, Aranyaka and Upanishad.
(यजुर्वेद का परिचय - संहिता,ब्राह्मण,आरण्यक एवं उपनिषद)

Unit -2 Suktas related to Rigveda Samhita (Shakalashakha) (11)

1. Lord of fire :	Agnisuktam	(अग्निसूक्तम्-ऋग्वेद 1/1/1-4)
2. Lord 0f creation :	Vishnusuktam	(विष्णुसूक्तम्-ऋग्वेद 7/100/1-3)
3. Lord of omniscient :	Brahmanaspatisuktam	(ब्रह्मणस्पतिसूक्तम् -ऋग्वेद 1/40/1-4)
4. Lord of pre-creation :	Hiranyasuktam	(हिरण्यगर्भसूक्तम्- ऋग्वेद 10/121/1-3)
5. Goddess of Glory :	Shreesuktam	(श्रीसूक्तम्-ऋग्वेद-परिशिष्ट 1-4)

Unit-3 Suktas related to ShuklaYajurved Samhita(Madhyandinashakha) (15)

1. God of wisdom :	Ganapatistavanam	(गणपति-स्तवनम् -यजुर्वेद – 23/19)
2. Identification of nation :	Rashtrageetam	(राष्ट्रगीतम् -यजुर्वेद - 22/22)
3. Good faith :	Svastivachanam	(स्वस्तिवाचनम् -यजुर्वेद-14/19,21-22)
4. Perception power :	Medhasuktam	(मेधासूक्तम् -यजुर्वेद -32/13 -16)
5. Concept of mind :	Shivasuktam	(शिवसंकल्पसूक्तम् -यजुर्वेद -34/1-6)
6. Origin of creation :	Purushasuktam	(पुरुषसूक्तम् (यजुर्वेद-31/1-4,7,16)
7. Goddess of learning :	Sarasvati-stavanam	(सरस्वती-स्तवनम् (यजुर्वेद -20/84-86)
8 Serenity Prayer of Vajrsada :	Shaantipaathah	(शान्तिपाठः - यजुर्वेद -36/17)

Text books :-

1.Vedic Sukta Sangrha: (Code No.1885) 7th Edn. Pub. Gita Press Gorakhpur

(वैदिकसूक्त-संग्रह – प्रकाशक - गीताप्रेस, गोरखपुर)

2. Vedic Sukta Sangrha: Acharya Bheshraja Sharma First Edn. Pub. Hansa prakashan Jaipura (वैदिकसूक्तसंग्रह - आचार्य भेषराज शर्मा, हंसा प्रकाशन, जयपुर)

3. Vedic Sangraha: Dr. Krishna Lal First Edn. Pub.Istarna book Linkarsa Delhi. (वैदिक संग्रह डा कृष्ण लाल ,ईस्टर्न बुक लिंकर्स , दिल्ली)

Reference books:-

1. RigvedaSamhita: Acharya Shri Ram Sharma Publishers-Yuganirmana Yojana, Mathura U.P. (ऋग्वेदसंहिता - आचार्य श्रीराम शर्मा प्रकाशक युग निर्माण योजना मथुरा उ.प्र)

2. Yjurveda: Acharya ShriRam Sharma Publishers Yuganirmana Yojana,Mathura U.P. (यजुर्वेदसंहिता- आचार्य श्रीराम शर्मा प्रकाशक युग निर्माण योजना मथुरा उ.प्र)

3. Vedas: The source of Ultimate science: Dr. Shri Ram Varma, Nag Publishers Delhi.

4. Vedic Sahitya ka Itihasa aur sanskriti: Shri Baldeva upadhyaay Publishers Sharadasansthan Varanasi .U.P.

5. Vedic dicsnory: Bhagavad Datta and Hansaraja Publishers- VishvBharti Anusandhan prishada Gyanpura U.P. (वैदिककोश - भगवद दत्त एवं हंसराज प्रकाशक –विश्वभारती अनुसंधान परिषद् ज्ञानपुर उ.प्र.)