SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR - 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI
2017-21

B. E. (ELECTRICAL ENGINEERING)

Published by
Dr. R.S. Pande
Principal
Shri Ramdeobaba College of Engineering & Management
Ramdeo Tekdi, Gittikhadan, Katol Road, Nagpur - 440 013
Ph. : 0712-2580011 Fax : 0712 - 2583237
ISO 9001 : 2008 CERTIFIED ORGANISATION

Electrical Engineering Department

About the department

The Department of Electrical Engineering was established in year 1984 with a sanctioned intake of 60 students. The National Board of Accreditation has accredited the department thrice in succession in the year 2001,2006 & 2012. Presently, the Electrical Engineering Department has post graduate program (M. Tech. in Power Electronics and Power Systems) with sanctioned intake of 18, started from 2011. Department is a Recognized Research Centre, approved by RTM Nagpur University for Master of Engineering (M.E.- By Research) and Doctoral program. Department has twelve well-equipped laboratories.

Department has Two Professors, Nine Associate Professors and Twelve Assistant Professors on the roll. Department has well qualified and experienced faculty with industrial background. Presently, five faculty members are Ph.D., three have submitted their thesis and Sixteen pursing Ph.D. They are normally invited by other institutes and industry to deliver guest lectures. Some of these industries are Ordance factory ambazari and Hindalco Industries, Mouda. They have undertaken many consultancy projects and have been granted patent by government of India.

The department has conducive environment for the academic and overall development of the students. The Electrical Engineering Students Association (EESA) is a platform for promoting the curricular, co-curricular and extracurricular students activities. Department students actively participate in sports and represent the college at various levels. Students are keenly interested in contributing for social cause and join the National Service Scheme (NSS) activities. Department organizes Seminars, Guest lectures and Training programs, Product exhibitions for the students. Students get opportunity to enhance their technical skill by participating in the training program like PLC, SCADA and Microcontroller Applications.

To introduce the graduating students to the latest developments in the industry, the department organizes product exhibition “Empower". Reputed companies namely ABB Limited, ARCTIC Infra Tech Solutions Ltd., Larsen and Toubro Switchgear Ltd, HOIKI Inc. Japan, GRANDSTREAM INDIA Cohesive Technologies (P) Ltd, Grondfos Pumps India Private Ltd, Hager Electro Private Limited, KEI Industries Limited, Powerica Ltd. (Cummins Division), WIPRO Lighting, Texas Instruments, Bergen Associates, Schneider Electrical, HP India, Biosys (India PVT Ltd), Rockwell Automation participated in the exhibition with the wide range of products to display.

The department has excellent placement record. Students are placed in core electrical as well IT companies. Companies visiting the campus for the placement include: Reliance Energy, L&T, Mahindra & Mahindra, and Kirloskar Oil Engines, BILTs, TCS, Tech-Mahindra, Syntel, Mindtree, Raymond Limited, Shapoorji Pallonji, Infosys, EMCO PVT Ltd. and many more.

On academic front, the department results are consistently good with students seeking merit positions on the University level. The department has active Entrepreneur Development Cell to develop the entrepreneurial skills among the students. The department highly encourages the industry interaction. Students go for industry training during the vacation.

Department Vision : Department of Electrical Engineering endeavors to be one of the best departments in India having expertise to mould the students to cater the needs of society in the field of technology, leadership, administration, ethical and social values.

Department Mission : To provide dynamic and scholarly environement for students to achieve excellence in core electrical and multidisciplinary fields by synergetic efforts of all stake holders of the Electrical Engineering Department and inculcate the ethical and social values.

Programme Educational Objectives

PEO1 : Our graduates will work on design, operation and practice in electrical fields by addressing intricacies of engineering and technology applications.

PEO2 : Our graduates will work in multidisciplinary fields and adapt to new technologies, new work environments, pursue additional skills and knowledge leading to professional development.

PEO3 : Our graduates will progress in their career by demonstrating in practice the technical and communication skills with an understanding of ethical and social responsibilities.

Programme Outcomes

PO1. **Engineering knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals to the solution of engineering problems.

PO2. **Problem analysis :** Identify, formulate, review literature, and analyze complex engineering problems using first principles of mathematics, natural sciences and engineering sciences.

PO3. **Design/development of solutions :** Design solutions for complex engineeing problems and design system components or processes that meet the specified needs with appropriate consideration for the public safety, societal and environmental considerations.

PO4. **Conduct problem investigations :** Use research-based knowledge including experimentation, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage :** Select, and apply appropriate techniques, resources, and modern engineering and IT tools for analyzing the engineering activities with an understanding of the limitations.

PO6. **The engineer, industry and society :** Apply contextual knowledge to assess industrial, societal and safety related issues and understand consequent relevance to the professional engineering practice.

PO7. **Environment and sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO8. **Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work :** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication :** Communicate effectively on complex engineering activities such as, being able to understand and write effective reports, make effective presentations and give and receive clear instructions.

PO11. **Project management and finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team in multidisciplinary environments.

PO12. **Life-long learning :** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes

PSO1. Analyze and design electrical networks, machines, control systems, power systems, power converters and evaluate the performance.

PSO2. Understand and develop electrical systems considering energy efficiency, power scenario, environmental issues and industry applications.

Teaching Scheme for First Year (Semester I and II) Bachelor of Engineering

GROUP 1: SEMESTER I / GROUP 2: SEMESTER II

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MAT101 MAT102	Engineering Mathematics-I/II	4	1	0	9	40	60	100	3 Hrs.
2	PHT101	Engineering Physics	4	1	0	9	40	60	100	3 Hrs.
3	PHP101	Engineering Physics lab	0	0	3	3	25	25	50	-
4	EET101	Electrical Engineering	3	1	0	7	40	60	100	3 Hrs.
5	EEP101	Electrical Engineering lab	0	0	2	2	25	25	50	-
6	CST101	Computer Programming	2	0	0	4	40	60	100	3 Hrs.
7	CSP101	Computer Programming lab	0	0	2	2	25	25	50	-
8	HUT101	Communication Skills	2	0	0	4	40	60	100	3 Hrs.
9	HUP101	Communication Skills lab	0	0	2	2	25	25	50	-
10	PEP101	Sports/Yoga	0	0	2	0	-	-	-	-
		TOTAL	**15**	**3**	**11**	**42**	**300**	**400**	**700**	

Teaching Scheme for First Year (Semester I and II) Bachelor of Engineering

GROUP 1 : SEMESTER II / GROUP 2 : SEMESTER I

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MAT102 MAT101	Engineering Mathematics-II/I	4	1	0	9	40	60	100	3 Hrs.
2	CHT101	Engineering Chemistry	4	1	0	9	40	60	100	3 Hrs.
3	CHP101	Engineering Chemistry lab	0	0	3	3	25	25	50	-
4	CET101	Engineering Mechanics	3	1	0	7	40	60	100	3 Hrs.
5	CEP101	Engineering Mechanics lab	0	0	2	2	25	25	50	-
6	MET101	Engineering Drawing	3	0	0	6	40	60	100	4 Hrs.
7	MEP101	Engineering Drawing lab	0	0	3	3	25	25	50	-
8	HUT102	Social Skills	2	0	0	4	40	60	100	3 Hrs.
9	INP102	Workshop	0	0	2	2	25	25	50	-
		TOTAL	**16**	**3**	**10**	**45**	**300**	**400**		

Scheme of Examination of Bachelor of Engineering (Electrical Engineering)
Semester Pattern
III Semester, B.E. (Electrical Engineering)

Sr. No.	Subject Code	Subject Name	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MAT203	Engineering Mathematics-III	3	1	0	7	40	60	100	3 Hrs.
2	EET201	Elements of Electromagnetic	4	1	0	9	40	60	100	3 Hrs.
3	EET207	Network Analysis	4	1	0	9	40	60	100	3 Hrs.
4	EEP207	Network Analysis Lab	0	0	2	2	25	25	50	3 Hrs.
5	CST212	Introduction to Computer Concepts	3	1	0	7	40	60	100	3 Hrs.
6	CSP212	Introduction to Computer Concepts Lab	0	0	2	2	25	25	50	3Hrs.
7	ENT206	Electronic Devices & Circuits	4	1	0	9	40	60	100	3 Hrs.
8	ENP206	Electronic Devices & Circuits Lab	0	0	2	2	25	25	50	3 Hrs.
9	CHT201	Environmental studies I	2	0	0	0	-	-	-	-
		TOTAL	**20**	**5**	**6**	**47**				

Scheme of Examination of Bachelor of Engineering (Electrical Engineering)
Semester Pattern
IV Semester, B.E. (Electrical Engineering)

Sr. No.	Subject Code	Subject Name	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	MAT242	Electrical Engineering Mathematics	3	1	0	7	40	60	100	3 Hrs.
2	HUT202	Principles of Economics and Management	3	1	0	7	40	60	100	3 Hrs.
3	ENT207	Digital and Linear Electronic Circuits	4	1	0	9	40	60	100	3 Hrs.
4	ENP207	Digital and Linear Electronic Circuits Lab	0	0	2	2	25	25	50	3 Hrs.
5	EET203	Electrical Machines-I	4	1	0	9	40	60	100	3 Hrs.
6	EEP203	Electrical Machines-I Lab	0	0	2	2	25	25	50	3 Hrs.
7	EET208	Electrical Measurement and Measuring Instruments.	4	1	0	9	40	60	100	3 Hrs.
8	EEP208	Electrical Measurement & Measuring Instruments Lab.	0	0	2	2	25	25	50	3Hrs.
9	CHT202	Environmental studies II	2	0	0	0	-	-	-	-
		TOTAL	**20**	**5**	**6**	**47**				

Scheme of Examination of Bachelor of Engineering (Electrical Engineering)
Semester Pattern
V Semester, B.E. (Electrical Engineering)

Sr. No.	Subject Code	Subject Name	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET301	Power Station Practice	3	1	0	7	40	60	100	3 Hrs.
2	EET302	Electrical Machines-II	4	1	0	9	40	60	100	3 Hrs.
3	EEP302	Electrical Machines-II Lab	0	0	2	2	25	25	50	3 Hrs.
4	EET303	Electrical Power Systems -I	3	1	0	7	40	60	100	3 Hrs.
5	EET304	Elective I	3	1	0	7	40	60	100	3 Hrs.
6	EEP305	Electrical Engineering Workshop	0	0	2	2	25	25	50	3 Hrs.
7	EEP306	Industrial Visit and Case Study	0	0		2	0	-	-	-
8	EET316	Microprocessor & Interfacing	4	1	0	9	40	60	100	3 Hrs.
9	EEP316	Microprocessor & Interfacing Lab	0	0	2	2	25	25	50	3 Hrs.
10	EET317	Self Study	1	0	0	0	--	--	--	--
		TOTAL	**18**	**5**	**8**	**45**				

Course Code	Elective-I
EET304-1	Electrical Machine Design
EET304-2	Entrepreneurship Development
EET304-3	Energy Management and Audit
EET304-4	Design of Data Acquisition & logic controller

Scheme of Examination of Bachelor of Engineering (Electrical Engineering)
Semester Pattern
VI Semester B.E. (Electrical Engineering)

Sr. No.	Subject Code	Subject Name	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET307	Control System Engineering	4	1	0	9	40	60	100	3 Hrs.
2	EEP307	Control System Engineering Lab	0	0	2	2	25	25	50	3 Hrs.
3	EET308	Electrical Drives & Their Control	3	1	0	7	40	60	100	3 Hrs.
4	EET309	Power Electronics	4	1	0	9	40	60	100	3 Hrs.
5	EEP309	Power Electronics Lab	0	0	2	2	25	25	50	3 Hrs.
6	EET310	Instrumentation	3	1	0	7	40	60	100	3 Hrs.
7	EET313	Open Elective	3	1	0	7	40	60	100	3 Hrs.
8	EEP311	Computer Aided Electrical Engineering Drawing	0	0	2	2	25	25	50	3 Hrs.
9	EEP312	Mini project	0	0	2	0	-	-	-	-
		TOTAL	**17**	**5**	**8**	**45**				

Course Code	Open Elective
EET313-1	Automation
EET313-2	Industrial Drives
EET313-3	Energy Management and Audit

Scheme of Examination of Bachelor of Engineering (Electrical Engineering)
Semester Pattern - VII Semester B.E. (Electrical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET401	Power System-II	4	1	0	9	40	60	100	3 Hrs.
2	EET402	High Voltage Engineering.	4	1	0	9	40	60	100	3 Hrs.
3	EEP402	High Voltage Engineering Lab	0	0	2	2	25	25	50	--
4	EET403	Elective -II	3	1	0	7	40	60	100	3 Hrs.
5	EET404	Power Semiconductor based Drive	3	1	0	07	40	60	100	3 Hrs.
6	EET405	Switchgear & Protection	4	1	0	09	40	60	100	3 Hrs.
7	EEP405	Switchgear & Protection Lab	0	0	2	02	25	25	50	--
8	EEP406	Project Phase I	0	0	4	04	100	--	--	--
		TOTAL	**18**	**5**	**8**	**49**				

Course Code	Elective-II
EET403-1	EHVAC & HVDC Transmission
EET403-2	Utilization of Electrical Energy
EET403-3	Advanced Control System

Scheme of Examination of Bachelor of Engineering (Electrical Engineering)
Semester Pattern - VIII Semester B.E. (Electrical Engineering)

Sr. No.	Code	Course	L	T	P	Credits	Maximum Marks			Exam Duration
							Internal Assessment	End Sem Exam	Total	
1	EET407	Electrical Installation Design & Practice	3	1	0	07	40	60	100	3 Hrs.
2	EET408	Computer Applications in Power System	4	1	0	09	40	60	100	3 Hrs.
3	EEP408	Computer Applications in Power System Lab	0	0	2	02	25	25	50	3 Hrs
4	EET409	Elective -III	3	1	0	07	40	60	100	3 Hrs.
5	EET410	Elective- IV	3	1	0	07	40	60	100	3 Hrs.
6	EEP411	Project Phase II	0	0	4	08	100	100	200	3 Hrs
7	EEP412	Seminar	0	0	2	02	100	--	100	–
		TOTAL	**13**	**4**	**08**	**42**	**--**	**--**	**--**	**–**

Course Code	Elective-III	Course Code	Elective-IV
EET409-1	Embedded Systems	EET410-1	Flexible AC Transmission Systems
EET409-2	Power Quality	EET410-2	Digital Signal Processing
EET409-3	Fuzzy Logic and Neural Networks	EET410-3	EHV Substation Design & Erection

Syllabus of Group 1 - Semester I and Group 2 - Semester I, Bachelor of Engineering

Course Code : MAT101 **Course : Engineering Mathematics-I**

L: 4 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 09**

Course Objective

Course objective of this course is to provide understanding the concepts of Mathematics and its application to Engineering. This course introduces the student to Differential Calculus for one and several variable, Differential Equations and Infinite Series.

Course Outcomes

On successful completion of the course, student shall be able to

1. Solve Engineering problems using the concept of Differential Calculus.
2. Get analytical solution of Ordinary Differential Equations in Engineering.
3. Test convergence of Infinite series.

Syllabus

Unit - I:

Ordinary Differential Calculus: Successive differentiation, Taylor's and Maclaurin's series for function of one variable, indeterminate forms, curvature, radius of curvature and circle of curvature.

Unit - II:

Partial Differentiation: Functions of several variables, first and higher order derivative, Euler's Theorem, Chain rule and Total differential coefficient, Jacobians. Taylor's and Maclaurin's series for function of two variables, Maxima and minima for function of two variables, Lagrange's method of undetermined multipliers.

Unit - III:

Infinite Series: Convergence, divergence and oscillation of series, General properties, Tests of convergence, Alternating series.

Unit - IV:

First Order Differential Equation: First order first degree differential equations: Linear, reducible to linear, exact and reducible to exact differential equations; Non-linear differential equations.

Unit - V:

Higher Order Differential Equation: Higher order differential equations with constant coefficient, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations, simultaneous differential equations, differential equation of the type $d^2y/dx^2 = f(x)$ and $d^2y/dx^2 = f(y)$.

Unit - VI:

Applications of Differential Equation: Applications of first order first degree differential equations: Simple electrical circuits in series. Application of higher order differential equations: Mechanical and electrical Oscillatory circuits (free, damped, forced oscillations)

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, Delhi.
2. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India)
3. Advanced Engineering Mathematics, 2 ed , Jain ,Iynger , Narosa publication

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, Neekunj print process, Delhi.
2. Schaum's Outline of Differential Equations, Richard Bronson , TMH, 3ed, New Delhi
3. Engineering Mathematics by Srimanta, Paul
4. A text book of Applied Mathematics I, T. Singh, K.L. Sarda, Professional Publishing House Pvt.Ltd., Nagpur.

Syllabus of Group 1 - Semester I and Group 2 – Semester II, Bachelor of Engineering

Course Code : PHT101 **Course : Engineering Physics**

L: 4 Hrs, T: 1 Hr, P : 0 Hr., Per week **Total Credits : 09**

Course Objectives :

1. To develop the ability to apply concepts in elementary physics to understanding of engineering applications;
2. To introduce more advanced physics concepts, which form the basis of modern engineering;
3. To provide a sound foundation in mathematical formulation of concepts learnt and their applications;
4. To elaborate the general nature of concepts learnt and of possibility of their cross-disciplinary application;
5. To develop skills for numerical problem solving in areas covered

Course Outcomes :

At the end of the course the students

1. will be able to recognize and analyze phenomena of interference, diffraction and polarization of light waves ;
2. will understand principles of laser action and basic working of many types of laser devices ;
3. will understand geometrical theory of optical fibre communication and the phenomena of attenuation and dispersion of electrical signals in the fibre ;
4. will understand fundamental notions in quantum mechanics such as wave particle duality, de Broglie matter waves, Heisenberg uncertainty relations, wave function of system, quantum confinement, quantization of energy and quantum tunneling of potential barriers;
5. will understand concepts like Fermi energy and density of states, understand calculation of carrier density and electrical conductivity in intrinsic and semiconductors and understand the behaviour of pn-junction;
6. will understand broad principles of electromagnetic electron lenses, cyclotron, mass spectrograph and working of the CRO;
7. will understand the reasons for novel properties at nano-scale, be familiar with elements of some of the methods of synthesis and characterization and some of the properties of such materials ;
8. will be able to understand and perform numerical calculations in areas of optics, lasers, optical fibres, quantum physics, semiconductors, charged particle devices and nano physics at the level defined above for these.

Unit-I:

Optics:

Interference in thin films, division of amplitude and wavefront, wedge-shaped films, Newton's rings, antireflection coatings; Diffraction, single slit, double slit, Different types of polarization of light, Malus' law, production of plane polarized light, birefringence, wave plates.

Unit-II:

Quantum Physics:

Wave-particle duality, wave packets, Heisenberg uncertainty relations; Wave function, probability Schrodinger's equation, time dependent equation and its separation; Infinite potential and finite potential wells, phenomenon of tunneling.

Unit-III:

LASERs and Optical Fibres:

Interaction of matter and radiation, LASER, spontaneous and stimulated emission, population inversion; Common types of lasers and their applications; Optical fibres, structure, types, propagation in a fibre, modes of propagation, signal attenuation, signal distortion.

Unit-IV:

Mass Spectrograph and Particle Accelerators :

Principles of electron optics, cathode ray tube, cathode ray oscilloscope, mass spectrographs, particle accelerators.

Unit-V:

Semiconductors:

Band structure of solids, band diagrams of insulators, semiconductors and conductors, Fermi level in conductors and semiconductors, carrier concentration, conductivity, effective mass; Junction diode and its band diagram, depletion region and barrier potential, diode rectifier equation.

Unit-VI:

Nanophysics:

What is Nanotechnology? Fullerenes and nanoparticles; Outline of methods of preparation; Elements of electron microscopy; Scanning probe microscopy, Outline of properties – physical, thermal, optical, electrical, magnetic; Quantum size-effects; CNTs; Applications.

Text Books:

1. Fundamentals of Physics: D. Halliday, R. Resnik and J. Walker, John Wiley.
2. Engineering Physics: S. Jain and G.G. Sahasrabudhe, Universities Press (2010) / Applied Physics : S. Jain Sahastrabuddhe and S.M. Pande.
3. Introduction to Nanoscience and Nanotechnology: K.K. Chattopadhyay and A.N. Banerjee, PHI Learning (2009)

Reference Books:

1. Electronic Engineering Materials and Devices: J. Allison, TMH.
2. Engineering Physics: H. Malik and A.K. Singh, TMH (2010).
3. Engineering Physics: D.K. Bhattacharya and A.Bhaskaran, Oxford University Press (2010)

Syllabus of Group 1 - Semester I and Group 2 – Semester II, Bachelor of Engineering

Course Code: PHP101 **Course: Engineering Physics Laboratory**

L: 0 Hrs., T: 0 Hrs., P: 3 Hrs., Per week **Total Credits: 03**

Course Outcomes :

1. Students should be able to perform tasks like leveling, alignment, reading vernier scales, do specific measurements, systematically record observations, do calculations from data collected and draw conclusions.
2. Students gain working familiarity with instruments like simple spectrometer, travelling microscope, lenses, prisms, ammeter, voltmeter, the CRO, power supplies etc.;
3. Students gain better understanding of concepts like interference, diffraction, polarization, energy band gap \in semiconductor etc.
4. Students gain a working knowledge of estimating errors in an experiment for which background theory is known;
5. Students should be able to subject data collected to statistical and error analysis.

A minimum of 8 experiments to be performed from the following list of experiments.

List of Experiments :

In addition to the demo experiments, the Lab turns will be utilized for performing the experiments based on the following list:

1. Study of diodes
2. Study of transistors
3. Study of thermistors
4. Study of phenomena of interference due to thin films.
5. Diffraction of light by slit(s), an edge, obstacles, etc.
6. Hall effect
7. Study of CRO
8. Graph plotting, curve fitting, visualization using Mathematica

Reference Books:

1. Physics Lab Manual written by the Teaching Faculty of Physics Department, RCOEM.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : EET101 **Course : Electrical Engineering**

L:3 Hr., T:1 Hrs., P:0 Hrs., Per week **Total Credits : 07**

Course Outcomes :

Upon completion of this course, the students shall be able to,

1. Apply the basic laws of electric and magnetic circuits to obtain the unknown quantities.
2. Represent and interpret the sinusoidal electrical quantities mathematically as well as graphically in the form of waveforms/phasors and analyze the 1-phase/3-phase AC circuits to determine the unknown quantities.
3. Determine the power losses/efficiency and voltage drop/voltage regulation of a 1-phase transformer at full load condition and demonstrate the knowledge related with its need, construction, principle, types and applications.
4. Describe the construction, principle, applications and performance characteristics of DC machines and Induction motors.
5. Demonstrate the concept of electrical power generation, transmission, distribution and the understanding about conventional/renewable energy sources.
6. Demonstrate the understanding about necessity of electrical earthing, safety & protecting devices, electrical energy utilization, illumination sources and their selection.

Unit-I:

DC Electric Circuits: Definition of EMF, Current, Power, Energy Resistance, Variation of resistance with physical parameters viz. length, area, specific resistivity and temperature. Ohm's law, resistances in series and parallel, current and voltage division rules, KVL & KCL, star delta transformation and related numerical. Measurement of DC electrical quantities.

Magnetic Circuit: Concept of MMF, Flux, reluctance, analogy with electric circuits, B-H curve, simple numerical on series magnetic circuits.

Unit-II:

AC Circuits: Generation of single phase and three phase alternating EMF. Average and RMS values for sinusoidal waveform. Phasor representation of sinusoidal electrical quantities, Steady state behavior of RLC circuits with sinusoidal excitation. Reactance, impedance, Power & Energy in AC Circuits. Simple numerical on series and parallel AC circuits. Concept & importance of power factor & its improvement (with simple numerical).

Simple analysis of balanced three phase AC circuits, Star-delta resistive networks. Measurement of AC electrical quantities.

Unit-III:

Introduction to Electrical Power System :

Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind and Solar) with block schematic representation only. Single line diagram for Generation, Transmission & Distribution through different voltage levels; Low voltage radial distribution system (Over head & underground, single phase and three phase).

Necessity of equipment earthings, Fuses (Rewirable and HRC), MCB, ELCB.Basic operation of UPS and Inverters (Block schematic representation).

Unit-IV:

Single phase Transformer :

Principle of operation, Construction Transformer ratings, No load and On load operation with leakage reluctance, losses, efficiency, Definition & formula for voltage regulation, OC/ SC test, equivalent circuit referred to primary side of transformer.

Unit-V:

Rotating Electric Machines :

DC Machines: DC Generator-Principle of working, construction (without details of armature winding), classification of DC generators. DC Motors-Back EMF, necessity of starters, speed and torque equations, characteristics of motors, speed control of DC motors (without numerical), Application of DC motors.

Three Phase Induction Motors: Working principles, types and construction of three phase Induction Motor, synchronous speed, torque, slip, torque slip characteristics, applications of three phase Induction motor.

Single Phase Induction Motors: operating principle of capacitor start and run single phase induction motor and its applications.

Unit-VI:

Utilization of Electrical Energy :

Illumination: Definition of luminous flux, luminous intensity, Candle power, illumination, Luminance, Luminous efficiency (lumens/watt) of different types of lamps, working principle of Fluorescent/Sodium Vapour/ Mercury vapor & CFL Lamps. Simple numerical to determine number of lamps to attain a given average lux level in an area.

Electric Heating: Advantages of Electrically produced heat, types and applications of Electric heating equipment, transfer of heat (conduction, convection, radiation); Resistance ovens, Induction heating (Core & coreless type), Dielectric heating. (Note. Numerical excluded)

Tariff: One part (KWH based) tariff with simple numerical; to calculate the domestic electricity charges.

Text Books :

1. Elements of Electrical sciences: P. Mukhopadhyay, N. Chand & Bros Roorkee (1989).
2. Electrical Technology: B. L. Thareja, S. Chand Publications.
3. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

Reference Books :

1. Basic Electrical Engineering: T.K. Nagasarkar& M. S. Sukhija, Oxford Univ. Press.
2. Utilization of Electrical Energy: H. Pratab, Dhanpatrai& Sons.
3. Utilization of Electrical Energy: E. Openshaw Taylor, Orient Longman.
4. Websites: www.powermin.nic.in, www.mnes.nic.in, www.mahaurja.com.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : EEP101 **Course: Electrical Engineering Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 02**

Course Outcomes :

Upon completion of this course, the students shall be able to,

1. Connect the electric circuits based on the syllabus of theory subject EET101 and test the performance by way of observation, calculations and conclusion.
2. Demonstrate the concept and significance of power factor and how it can be improved.
3. Conduct an electrical energy survey of connected load at residential premises and demonstrate the understanding of energy tariff by calculating the energy bill in accordance with the norms of State Electricity Distribution Company.

List of Experiments :

1. To verify Kirchoff's voltage and current law using D.C. source.
2. To study the R-L-C series circuit with AC source
3. To study R-L-C parallel circuit with AC source
4. To perform direct load test on 1-phase transformer for finding regulation and efficiency
5. To perform open circuit and short circuit tests on 1-phase transformer
6. To study 3-phase star delta connections and verify different relations of voltage ,current and power
7. To study the speed control techniques for DC shunt motor
8. To study the importance of power factor and improvement of power factor using static capacitors.
9. To analyze energy bill of residential category and prepare energy sheet.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code: CST101 **Course : Computer Programming**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 4**

Course Outcomes

On successful completion of the course, students will be able to

1. Understand basics of computer, software, number systems, flowchart and algorithms.
2. Design and code well-structured C programs.
3. Write program on the basis of decision control structures and loop control structures.
4. Perform sorting and various other operations on 1-D and 2-D array.
5. Perform operations on structures, functions and pointers.

Syllabus

Unit-I:

Computer Fundamentals: Basic Structure of a computer, Input/output devices and memories, types of computer. Introduction to DOS and Windows OS, Number Systems: Decimal, Binary, Octal, Hexadecimal and conversion from one to another. Algorithm – Conventions used in writing algorithm, Software Life Cycle, Program and Programming Languages Procedural, Object oriented, High level, Assembly, Machine Language. System Software - Translator, Compiler, Interpreter, Linker, Loader and Flowchart.

Unit-II:

C Programming Language: Keyword, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case.

Unit-III:

Loop Control Structure: go to, while, for, do while, break, continue. Storage classes, Enumerated Data types, Renaming Data types with typedef(), Type Casting, Bitwise Operators.

Unit-IV:

Array: Introduction, array Declaration, Single and multidimensional array. Pointers: Introduction, Definition and use of pointer, Pointer arithmetic, pointer operators, pointer and array, pointer to pointer

Unit-V:

Structures and Union: Declaring and using structure, Structure initialization, Structure within structure, array of structure, pointer to structure.

Unit-VI:

Function Programming: Introduction, User Defined and Library Function, Parameter passing, Return value, Recursion, pointer and function

Text Books:

1. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill
2. Programming in ANSI C,5th ed. : E. Balguruswami McGraw Hill

Reference Books:

1. Let Us C.9thed: Yashwant Kanetkar, BPB Publication
2. Programming with C: Byron Gottfried, Schaums Outline Series.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code: CSP 101 **Course: Computer Programming Lab**

L: 0 Hrs., T: 0 Hrs., P:2 Hrs. Per week **Total Credits: 2**

Course Outcomes :

On successful completion of the course, students will be able to

1. Implement programs based on if-else, switch and loop structure.
2. Implement programs based on 1-D and 2-D numeric and character arrays.
3. Perform operation on structure and pointer.
4. Design programs based on functions.

CSP101practicals based on above CST 101 syllabus

Syllabus of Group 1- Semester I and Group 2-Semester II, Bachelor of Engineering

Course Code : HUT101 **Course: Communication Skills**

L:2 Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits:4**

Course Outcomes :

1. Students have better reading comprehension, pronunciation, and functional English grammar.
2. Students are able to write letters and resumes
3. Students are able to organize their thoughts for effective presentation and writing.
4. Students are able to learn skills to present themselves well in an interview, and handle a Group Discussion

Syllabus

Unit-I :

Communication:

What is Communication, the Media of Communication, Channels of Communication, Barriers to Effective Communication, Role of Communication Skills in Society.

Unit-II :

Reading Comprehension :

The Process of Reading, Reading Strategies Central idea, Tone and Intention, Comprehension Passages for practice.

Unit-III :

Professional Speaking:

Components of an effective talk, Idea of space and time in public speaking, Tone of voice, Body language, Timing and duration of speech, Audio-Visual Aids in speech. Presentation Skills, Group Discussion and Job Interviews

Unit IV :

Orientation to Literary and Scholarly Articles:

Preferably two fictional and two non-fictional texts (Selected by the teachers and the Head). The art of writing articles on social, cultural, scientific and technical issues (Paragraph Writing), Exercises.

Unit V :

Business Correspondence:

Types and Formats of Business letters, Routine Business Letters (Inquiry, Order, Instruction, Complaint, Adjustment), Sales Letters, Resumes and Job applications, Business Memos, Emails.

Unit VI:

Grammar:

Synonym and Antonym, Give one word for, Voice, Narration and Comparison of Adjectives and Adverbs, Transformation of sentences and Common Errors, Idioms and Phrases, Note Making, Précis writing.

Text Book :

1. M. Ashraf. Rizvi. Effective Technical Communication. Tata Mc Graw-Hill Publishing Company Limited.2009

Reference Books :

1. Sanjay Kumar and Pushp Lata. Communication Skills. Oxford Publication
2. Meenakshi Raman and Sangeeta Sharma. Technical Communication. Second Edition Oxford Publication.2011
3. Anne Nicholls. Mastering Public Speaking. Jaico Publishing House.2003
4. Dr Asudani .V. H An easy approach to English. Astha Publication Nagpur. 2009 , 3rd Edition.

Syllabus of Group 1- Semester I and Group 2-Semester II, Bachelor of Engineering

Course Code : HUP101 **Course : Communication Skills Lab**

L:0Hrs.,T:0Hrs.,P:2Hrs.,Per week **Total Credits:2**

Course Outcomes

On successful completion of the course, students will be able to

1. Learn presentation skills
2. Understand effective strategies for Personal Interview and Group Discussions
3. Learn and apply effective language skills – listening, speaking, reading and writing

Sr. No	Name of the Practical	Activities Taken	Medium of Practical
1	Speaking Skills	1. Introduction to effective ways of speaking 2. Oral presentations Extempore / Debate / JAM/Self-introduction	PPT Based, Activity Based
2	Presentation Skills	1. Preparing visual aids/PPTs on given topics	PPT Based, Activity Based, Open Source CDs
3	Group Discussion-Orientation	1. GD types 2. GD techniques/rules - videos 3. General/familiar topics for discussion	Open Source CDs PPT based Activity based
4	Group Discussion-Practice session	1. Divide in group of 6 2. Classification of topics 3. Feedback	PPT Based, Activity Based
5	Group Discussion-Mock	1. Divide in group of 6 2. Mock GDs - types 3. Feedback	Activity Based
6	Interview Techniques-Orientation	1. Various types of interviews 2. Types of interviews 3. Self-analysis 4. KYC sheet 5. Self-introduction	Open Source CDs Activity Based
7	Interview Techniques Practice Sessions	1. Video 2. Non-verbal communication 3. Types of interview questions	Open Source CDs Activity Based
8	Interview Techniques-Mock Interviews Optional Practicals	1. Mock Interviews (One to One) Teacher can decide any other Practical apart from the ones mentioned below	Activity Based
9	Listening Skills	1. Listening Barriers	PPT Based, Activity Based
10	Non Verbal Communication	1. Kinesics in com/interviews 2. Activities/Role play	Open Source CDs PPT based
11	Use Figurative Language	1. Intro phrases/ Idioms/proverbs/ pronunciation	PPT Based, Activity Based

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code :PEP101 **Course: Sports/Yoga**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 00**

Course Outcomes

On successful completion of the course, students will be able to

1. Understand fundamental skills and basic rules of games.
2. Gain health related physical fitness.
3. Develop body-mind coordination through games and yogasans.

BRIEF OBJECTIVES OF SPORTS/YOGA PRACTICAL CLASSES

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, Physical Education department at RCOEM will conduct sports/yoga classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be todevelop team spirit, social skills as well as identify and develop leadership qualities in students through various sports group activities. Training of students to understand the rules of various national and international games would also be an important objective. Sport activities would also be conducted with the objective to provide recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate fitness of students so as to recommend and conduct specific Yoga and Sport activities.

PROGRAMME OUTLINE

1. Sports

1. Introduction to sports i.e. volleyball, cricket, football, basketball, badminton, T.T., Athletics.
2. Health and safety issues related to sports; Knowledge, recognition and ability to deal with injuries and illnesses associated with sports.
3. Awareness about sports skills, techniques and tactics.
4. Rules, regulations and scoring systems of different games (Indoor & Outdoor).
5. Trials of students to participate in inter-collegiate/University level games.

2. Yoga: Includes asanas like sitting, standing and lying, Surayanamaskar, Pranayam.

3. Physical fitness test : this would include speed, Cardiovascular Endurance, strength, skill & flexibility.

Syllabus of Group 1 - Semester II and Group 2 – Semester II, Bachelor of Engineering

Course Code: MAT102 **Course: Engineering Mathematics-II**

L: 4 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits: 09**

Course Objective

The objective of this course is to expose student to understand the basic importance of Integral Calculus and Vector calculus. The student will become familiar with fitting of curves and regression analysis.

Course Outcomes

On successful completion of the course, student shall be able to

1. Understand and use the concepts of Integral Calculus for Engineering problems.
2. Apply technique of Vector differentiation and integration to various Engineering problems.
3. Know basic statistical techniques required for Engineering.

Syllabus

Unit-I:

Integral Calculus I: Beta and Gamma functions, Differentiation of definite integrals, Mean value and root mean square values.

Unit-II:

Integral Calculus II: Tracing of curves (Cartesian, polar and parametric curves), rectification of simple curve, quadrature, volumes and surface of solids of revolutions(Cartesian, polar and parametric forms).Theorem of Pappus and Guldin.

Unit-III:

Multiple Integrals and their Applications: Elementary double integrals, change of variable (simple transformation), change of order of integration (Cartesian and polar), application to mass, area, volume and centre of gravity (Cartesian and polar forms), elementary triple integrals.

Unit-IV:

Vector Calculus I: Scalar point function, Vector point function, vector differentiation, gradient, divergence and curl, directional derivatives with their physical interpretations, solenoidal and irrotational motions, Scalar potential function.

Unit-V:

Vector Calculus II: Vector integration: Line integrals, work done, conservative fields, surface integrals and volume integrals, Stoke's theorem, Gauss divergence theorem, Green's theorem and their simple applications.

Unit VI:

Statistics: Fitting of straight line, $y = a + bx$, parabola $y = a + bx + cx2$ and the exponential curves by method of least squares, Coefficient of linear correlation, lines of regression, rank correlation, multiple regression and regression plane of the type $z = a + bx + cy$, coefficient determination.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, Delhi
2. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India)
3. Advanced Engineering Mathematics, 2 ed, Jain, Iynger, Narosa publication.

Reference Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, Neekunj print process, Delhi.
2. Engineering Mathematics: Principal and Applications Srimanta, Paul, Oxford Univ Press,(2011).
3. Higher Engineering Mathematics: B.V. Ramana, TMH.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course No. CHT101 **Course : Engineering Chemistry**

L: 4 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 09**

Course Outcomes of Engineering Chemistry :

Upon successful completion of the course, the student shall be :

1. Able to understand the basic scientific principles underlying the troubles caused by impurities present in water and treatment to remove the same.
2. Understand the applications of different nanomaterials with their synthtic routes.
3. Able to characterize the fuels and analyze their combustion mechanism.
4. Able to understand the effect of constituents on quantity of cement manufactured with their setting and hardening reactions.
5. Able to understand principles of lubrication along with chemical properties of lubricants.
6. Knowledge of proper engineering materials having better corrosion resistance and sustainability and implement the effective measures to minimize the corrosion wherever possible.

Syllabus

Water Treatment :

Water Treatment for Industrial Applications: Brief introduction regarding sources, impurities in water, hardness of water and their types. Softening of water using lime-soda process: principles in hot and cold lime-soda process. Zeolite softener, demineralization by synthetic ion exchange resins. Boiler troubles: Carryover, Priming and Foaming, Scales and Sludges, Caustic Embrittlement, Boiler Corrosion-causes and effects on boiler operation and methods of prevention. External and Internal conditioning : Phosphate, Carbonate and Calgon conditioning.

Water Treatment for Domestic Water:

Domestic water treatment : Brief discussion and Chemistry involved in the process of sedimentation, coagulation, filtration and sterilization by UV, Ozone, Chlorination including Break point chlorination. Desalination of water using reverse osmosis and electro dialysis.

Numericals Based on Water Softening: Numericals based on (1) lime-soda (2) zeolite / ion-exchange water treatment processes.

Cement :

Process parameters involved in the manufacturing of portland cement, manufacture of portland cement, microscopic constituents of cement and their effects on strength; setting and hardening of cement.

Types and uses of cement : Pozzolonic; Rapid hardening, Low heat and High alumina cements. Additives and admixtures used in cement: Accelerators, Retarders, Air entrainment agents, Water repellants.

Chemical approach to Nanomaterials :

General introduction to nanotechnology, timeline and milestone, overview of different nanomaterials available, potential use of nanomaterials in electronics, sensors, medical applications, catalysis, environment and cosmetics.

Physical chemistry related to nanoparticles such as colloids and clusters: conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state.

Synthesis of nanomaterials: ' Top-Down'- photolithography and 'Bottom-Up'- sol-gel method .

Carbon nanotubes: Single-walled and multi-walled carbon nanotubes, their structures, properties and applications.

Potential risks of nanomaterials- Health and environmental impact.

Fuels and combustion :

Introduction, Calorific value, Higher and Lower calorific value, flame temperature and flame intensity , determination of calorific value by Bomb calorimeter and Boy's calorimeter, numericals based on the determination of calorific value by Bomb and Boy's Calorimater.

Solid Fuels:

Types of coals, proximate and ultimate analysis of coal, its significance, Carbonization of Coal.

Liquid and Gaseous Fuels:

Liquid fuels: mining & fractional distillation of crude petroleum, use of gasoline in internal combustion engine, octane number, cetane number, flash point of combustible liquid fuel, knocking. Fisher-Tropsch's process for manufacture of synthetic gasoline, thermal and catalytic cracking: fixed bed and fluid bed catalytic cracking, aviation gasoline.

Gaseous fuels:

CNG and Significance of flue gas analysis by Orsat apparatus.

Numericals based on Combustion Calculations:

Numericals based on combustion calculations for solid fuels. Numericals based on combustion calculations for liquid and gaseous fuels.

Friction, Wear and Lubricants :

Introduction, lubrication mechanism : Hydrodynamic, Boundary and Extreme pressure lubrication. Classification of lubricants- Solid, Semisolid and Liquid lubricants, Blended oils using different additives viz.:-

Anti-oxidants, E. P. additive, corrosion inhibitor, viscosity index improver, etc. synthetic lubricants viz.:- Dibasic acid esters, Polyglycol ethers and Silicones, Lubricating Emulsions. Properties of Greases: Drop point and consistency test, Properties of liquid lubricants: Viscosity and Viscosity Index, Aniline point, Cloud & Pour point and Decomposition stability. Criteria for selection of lubricants under different conditions of load and speeds.

Corrosion :

Electrochemistry and Theories of Corrosion :

Introduction to corrosion, Cause and Consequences of corrosion, Measurement of corrosion rate, Galvanic series, Dry and Wet corrosion, Pilling-Bedworth rule, factors affecting the rate of corrosion.

Types of corrosion and Preventive Methods; Different types of corrosion (Pitting, Stress, Intergranular and

Galvanic), protection against corrosion, design and selection of engineering materials, cathodic and anodic protection, Brief discussion about Protective Coatings: Metallic, Inorganic, Organic coatings, Corrosion inhibitors.

Text Books :

1. Text Book of Engineering Chemistry, S. S. Dara, S. Chand and Company Ltd., New Delhi.
2. Textbook of Engineering Chemistry, P. C. Jain and Monica Jain, Dhanpat Rai and Sons, New Delhi.
3. Text Book of Environmental Chemistry and Pollution Control, S. S. Dara; S. Chand and Company Ltd., New Delhi.
4. Textbook of Engineering Chemistry, S. N. Narkhede, R. T. Jadhav, A. B. Bhake, A. U. Zadgaonkar, Das Ganu Prakashan, Nagpur.
5. Applied Chemistry, A. V. Bharati and Walekar, Tech Max Publications, Pune.
6. Engineering Chemistry, Arty Dixit, Dr. Kirtiwardhan Dixit, Harivansh Prakashan, Chandrapur.

Reference Books :

1. Engineering Chemistry by Gyngell, McGraw Hill Publishing Company, New Delhi.
2. Engineering Chemistry (Vol I), Rajaram and Curiacose, Tata McGraw Hill Publishing Company, New Delhi.
3. Engineering Chemistry (Vol II), Rajaram and Curiacose, Tata McGraw Hill Publishing Company, New Delhi.
4. Engineering Chemistry, Saraswat and Thakur, Vikas Publication, New Delhi.
5. Engineering Chemistry, B. S. Sivasankar, Tata Mcgraw Hill Publishing Company, New Delhi.
6. Engineering Chemistry, O. G. Palan, Tata Mcgraw Hill Publishing Company, New Delhi.
7. Engineering Chemistry, R. Shivakumar, Tata Mcgraw Hill Publishing Company, New Delhi.
8. Chemistry of Cement, J. D. Lee, Mcgraw Hill Publishing Company, New Delhi.
9. Nanomaterials Chemistry, C. N. R. Rao, A. Muller, A. K. Cheetam, Wiley VCH verlag GmbH and Company, Weinheim.

Syllabus of Group 1 - Semester I and Group 2 - Semester II, Bachelor of Engineering

Course Code : CHP101 **Course: Engineering Chemistry Lab**

L:0 Hr., T:0Hrs., P:3 Hrs., Per week **Total Credits : 03**

Course Outcomes of Engineering Chemistry Lab

After successful completion of the course, the student will be able to

1. Be conversant with various chemical processes involved in qualitative as well as quantitative analysis of different materials, water pertaining to various impurities and to record the information in the scientific way.
2. Understand applicability of different physico-chemical properties of fluids such as viscosity and flash point for various industrial machineries.

Text Books :

1. Text Book on Experiments and Calculations in Engineering Chemistry: S. S. Dara; S. Chand and Company Ltd., New Delhi.
2. Practical Engineering Chemistry : S. N. Narkhede, R. T. Jadhav, A. B. Bhake, A.U. Zadgaonkar, Das Ganu Prakashan, Nagpur.

Reference Books :

1. Concise Laboratory Manual in Engineering Chemistry: R. Shivakumarand J. Prakasan, Tata McGraw Hill Publishing Company, New Delhi.

Syllabus of Group 1 - Semester II and Group 2 - Semester I, Bachelor of Engineering

Course Code: CET101 **Course: Engineering Mechanics**

L:3 Hr., T:1 Hrs., P:0 Hrs., Per week **Total Credits : 07**

Course Outcomes

After Completion of the course in Engineering Mechanics, the student should be able to

1. Define and Describe various parameters related to static and dynamic behaviour of the rigid bodies.
2. Understand and describe physical phenomenon with the help of various theories.
3. Explain and analyse various physical phenomenon with the help of diagrams.
4. Describe and analyse the engineering problems with the acquired knowledge of engineering mechanics

Syllabus

Unit-I:

Fundamental of Engineering Mechanics:

Fundamentals of Engineering Mechanics, axiom's of mechanics, resultant of concurrent force system. Moment of a force, couples, resultant of non-concurrent force system

Unit-II:

Equilibrium of Force System :

Equilibrium of concurrent force system, Equilibrium of non-concurrent force system Friction: Law's of friction, simple application, wedge friction, belt friction.

Unit-III:

3-D Force system & Analysis of trusses :

Moment of a force about a point and about an axis, resultant of spatial concurrent & Non concurrent force system, wrench, equilibrium of concurrent and non-concurrent force system. Analysis of simple trusses (Joint & Section Method)

Unit-IV:

Centroids and moment of inertia :

Centroids locating by first principle, centroid of composite areas, Second moment and product of inertia of plane areas. Moment of Inertia of composite areas. Transfer theorems for moment of Inertia and Product of Inertia.

Virtual work method

Virtual work principle, application of virtual work principle.

Unit-V

Kinematics & Kinetics of Particles :

Rectilinear motion of a particle with variable acceleration, Projectile motion, normal and tangential components of acceleration, kinetics of particle and several interconnected particles. D'Alembert's principle, problems on connected system of particles.

Unit-VI:

Collision of elastic bodies:

Principle of conservation of momentum, Impulse momentum equation, work energy equation, coefficient of restitution, impact of elastic bodies.

Text Books:

1. Engineering Mechanics: F. L. Singer, Harper & Row Publications.
2. Fundamentals of Engineering Mechanics : A.K. Sharma, Sai Publications.
3. Engineering Mechanics :A.K.Tayal, Umesh Publications, New Delhi.
4. Engineering Mechanics : P.B. Kulkarni, Professional Publishing House Pvt. Ltd.

Reference Books:

1. Engineering Mechanics: Timoshenko & Young, Tata McGraw Hill Publications, New Delhi.
2. Engineering Mechanics: Bear and Johnston, Tata McGraw Hill Publications, New Delhi.
3. Engineering Mechanics: I. H. Shames, Phi Pvt. Ltd., India.

Syllabus of Group 1 - Semester II and Group 2 - Semester I, Bachelor of Engineering

Course Code : CEP101 **Course : Engineering Mechanics Lab**

L:0 Hr., T:0Hrs., P:2 Hrs., Per week **Total Credits : 02**

Course Outcome

After Completion of the course in Engineering Mechanics Lab; the student should be able to

1. Define and explain different terminologies of simple lifting machines.
2. Understand and perform practicals on equilibrium of concurrent and non-concurrent force systems.
3. Describe various terminologies related to friction and mass moment of inertia.
4. Explain graphical solutions of equilibrium conditions in engineering mechanics.
5. Analyse the experimental data collected based on practicals and discuss the results.

Minimum of Eight Practical will be performed based on the theory

List of Experiment

Experiments On"Simple Lifting Machines"

1. Law of machine for Differential Axle and Wheel
2. Law of machine for Single Purchase Crab
3. Law of machine for Double Purchse Crab

Experiments On"Equilibrium of force systems"

4. Jib Crane (Equilibrium of concurrent Forces)
5. Simple Beam (Equilibrium of Non-concurrent Forces)
6. Shear Leg Apparatus(Equilibrium of 3-D concurrent forces)

Experiments On"Friction & Inertia"

7. Inclined Plane (Coefficient of friction using Inclined Plane)
8. Belt Friction(Coefficient of friction using coil friction set-up)
9. Fly-Wheel (Mass moment of Inertia of fly-wheel)

Graphical Methods in Engineering Mechanics

10. Resultant of concurrent force systems
11. Resultant of Non-concurrent force system
12. Reactions for simply supported beams
13. Forces in members of simple Trusses
14. Moment of Inertia (Mohr's Circle)

Syllabus of Group 1- Semester II & Group 2- Semester I, Bachelor of Engineering

Course Code: MET101 **Course : Engineering Drawing**

L: 3 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 06**

Course Outcomes : The expected learning outcome is that, the students shall be able to :

1. Draw & interpret technical drawings.
2. Convert 2-D drawing to 3-D drawing & vice-versa.
3. Represent the various positions of planes & solids in different orientations.
4. Develop the solid surface for sheet metal working.

Syllabus (Only First Angle Method of Projection)

UNIT 1

Introduction: Lines, Lettering & Dimensioning, Preparation of Sheet Layout.
Scales - Plain Scale, Diagonal Scale, Vernier Scale.
Engineering Curves; Ellipse: Directrix Focus, Concentric Circles & Rectangle Method.
Parabola: Directrix Focus, Rectangle Method, Tangent Method.
Hyperbola: Directrix Focus & Asymptote Method.

UNIT 2

Theory of Projections - Concept of Projection, First & Third angle projection methods.
Orthographic Projections: Conversion of given 3 dimensional View to 2 dimensional representation.

UNIT 3

Projections of Lines: Oblique Lines, Traces, Applications of lines.

UNIT 4

Projections of Planes - Polygonal Lamina, Circular Lamina.
Projections of Solids- Cube, Prism, Pyramid, Tetrahedron, Cylinder, Cone.

UNIT 5

Sections of Solids & Development of Lateral Surfaces- Cube, Prism, Pyramid, Tetrahedron, Cylinder, Cone.

UNIT 6

Isometric Projections: Isometric Scale, Conversion of given 2 dimensional views to Isometric Projection/View.

Books:

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House Pvt. Ltd.
2. Engineering Drawing by D. A. Jolhe, Tata McGraw Hill Publications
3. Engineering Graphics by H. G. Phakatkar, Nirali Publication.
4. Engineering Graphics by A. R. Bapat, Allied Publishers

References:

1. Engineering Drawing by R.K. Dhawan, S. Chand Publications
2. Engineering Drawing by K.L. Narayana & P. Kannaiah, SciTech Publication.

Syllabus of Group 1- Semester II & Group 2- Semester I, Bachelor of Engineering

Course Code: MEP101 **Course: Engineering Drawing Lab**

L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week **Total Credits: 03**

Course Outcome : The expected learning outcome is that, the students shall be able to:

1. Draw & interpret technical drawings.
2. Plan the sheet layout for the given drawing.
3. Convert 2-D drawing to 3-D drawing & vice-versa.
4. Represent the various positions of planes & solids in different orientations.
5. Develop the solid surface for sheet metal working.
6. Use & demonstrate drafting package.

List of Sheets: (50% of the sheets to be drawn in Auto CAD)

Sheet No.1: Engineering Scales & Curves
Sheet No.2: Orthographic Projections
Sheet No.3: Projection of Lines
Sheet No.4: Application of Lines
Sheet No.5: Projection of Planes
Sheet No.6: Projection of Solids
Sheet No.7: Section & Development of Solids
Sheet No.8: Isometric Projections

Books:

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House Pvt. Ltd.
2. Engineering Drawing by D. A. Jolhe, Tata McGraw Hill Publications
3. Engineering Graphics by H. G. Phakatkar, Nirali Publication.
4. Engineering Graphics by A. R. Bapat, Allied Publishers

References:

1. Engineering Drawing by R.K. Dhawan, S. Chand Publications
2. Engineering Drawing by K.L. Narayana & P. Kannaiah, SciTech Publication.
3. AutoCAD 14 for Engineering Drawing by P. Nageshwara Rao, Tata McGraw Hill Publications

Syllabus of Group 1- Semester II and Group 2-Semester I, Bachelor of Engineering

Course Code: HUT102 **Course:-Social Skills**

L:2 Hrs.,T:0Hrs.,P:0Hrs.,Per week **Total Credits:4**

Course Outcomes

On successful completion of the course, students will be able to

1. Learn the basic concepts of personnel management or manpower planning and the process of recruitment and selection that they will go through as engineers.
2. Learn leadership skills, industrial relations, work organizations, and impact of industry on society.
3. Learn about the political systems and institutions working in India, laws and legislations affecting industry and the application of political principles like democracy in industry.
4. Learn the importance and application of Economics in Engineering.
5. Learn about culture/civilization and develop cross cultural capacity.
6. Learn about Personal, Professional and social ethics.

Syllabus

Unit-I:

Industrial Sociology:-

- Meaning and scope of Industrial Sociology
- Work Organization and its types.
- Concept of Leadership: Meaning, changing roles and its types.
- Concept of Power and Authority: Meaning, Importance, sources and Delegation
- Industrial Culture in India: Effects of Industrialization and Urbanization on Indian Society.

Unit-II:

Industrial Psychology:-

- Meaning and scope of Industrial Psychology
- Recruitment, Selection and Training
- Industrial fatigue
- Motivation, Theories of motivation: Maslow's Need Priority Theory, Macgregor's X And Y Theory, McClelland's Needs Theory
- Dealing with Self: Stress, health, and coping; interpersonal relationships; gender roles; environmental adjustments.

Unit-III:

Political Orientation:-

- Indian Constitution, features and federal structure.
- Fundamental rights
- Directive principles of state policy
- Industrial Democracy.
- Role of Bureaucracy in Modern Democratic states.

Unit-IV:

Economics:-

- Development of Indian Economy
- Infrastructure in the Indian Economy: Energy, power, transport system, road transport system, Rail-Road co ordination, water transport, Civil aviation, communication system, urban infrastructure, science and technology, private investment in infrastructure.
- Role of Public and Private sector in Indian Economy.
- Challenges before Indian Economy in 21st Century.
  Poverty, Unemployment, Corruption, Regional Imbalance, Growth of educational sector.

Unit-V:

Culture and Civilization:-

- Concept of Culture and Civilization.
- Study of engineering skills with special reference to Egyptian and Indus Valley Civilization.
- Role of Engineers as agent of change with specific reference to change in Indian Society during 20th and 21st century.
- Multiculturalism: Meaning, scope and significance especially in Indian context.

Unit-VI:

Ethics and social responsibility:-

- Personal and professional ethics
- Corporate social responsibility
- Social capital, social audit.
- Role of entrepreneurship in nation building.
- Developing scientific and humanitarian outlook for the welfare of nation and society.

Text Books :

1. A new look into Social Sciences by Sheikh and Shabbir
2. RuddarDatt and K.P.M.Sundharam, (67th Revised edition-2013), Indian Economy, S .Chand and Company Ltd, New Delhi.
3. Edmund G. Seebauer and Robert L Barry (2010 reprint) Fundamental of Ethics for Scientists and Engineers, Oxford University Press.

Reference Books:

1. P.C. Tripathi and P.N. Reddy, Principles of Management, (4th edition, 2008), Tata MacGraw Hill Publishing Co. Ltd., New Delhi
2. Martand.T. Telsang, Industrial and Business Management, (2001), S.Chand and Co. Ltd. New Delhi
3. Dr. V.H. Asudani: An Easy Approach To Social Science, (3rd edition, 2008), Astha Publication, Nagpur
4. Tariq Modood, Multiculturalism (Themes for 21st Century Series)(1st Publication 2007), Polity Press, Cambridge, U.K. ISBN-13:97807456-3288-9.
5. Social & Human Skills by Dr. Vinod Asudani and Dr. Monika Seth.

Syllabus of Groups 1- Semester II and Group 2 – Semester I, Bachelor of Engineering

Course Code : INP102 **Course: Workshop**

L: 0 Hr., T: 0 Hrs., P : 02 Hrs., Per week **Total Credits : 02**

Course Objectives :

To impart practical training (hands-on experience) regarding use and operations of various tools, equipment and machine with basic knowledge of manufacturing process and materials.

Course Outcomes :

1. Student will be able to read job drawing, identity and select proper material, tools, equipments and process / machines for manufacturing the required job.
2. Student will be able to use basic marking and measuring instruments to inspect the job for confirming desired dimensions and shape.
3. Student will be able to observe and follow precautions during operation.

List of Experiments :

SHOP	No. of Experiments /Jobs
Fitting Shop	1. Introduction of fitting tools, equipments, machines, material & processes.
	2. Manufacturing & fitting practice for various joints & assembly.
	3. Drilling, tapping & pipe threading operations.
Carpentry Shop	1. Introduction of carpentry tools, equipments, machines, material & processes.
	2. Manufacturing of carpentry joints.
	3. Turning practice on wood working lathe.
	4. Demonstration & practice on universal wood working machine.
Welding Shop	1. Introduction of welding tools, equipments, machines, material & processes.
	2. Fabrication of joints like lap, butt, corner, T etc.
	3. Fabrication of lap joint by spot welding process.
Smithy Shop	1. Introduction of smithy tools, equipments, machines, material & processes.
	2. Forging of combine circular/square/hexagonal cross section.

Text Books :

1. Elements of workshop technology vol -1 by Hajra Choudhari
2. Elements of workshop technology vol -1 by Raghuwanshi

Reference Book:

1. Manufacturing technology by P.C. Sharma
2. Workshop manual by Kannaiah Narayan

III Semester

Syllabus of Semester III, B.E. Electrical Engineering

Course Code : MAT203 **Course : Engineering Mathematics-III**

L: 3 Hrs., T: 1 Hrs. P:0 Hrs., Per week **Total Credits : 7**

Course Objectives

The objective of this course is to expose students to understand the basic concepts of Laplace transform, Fourier series and Fourier transforms.It also focuses on Matrices, Partial Differential Equations and Function of a Complex Variable.

Course Outcomes

On successful completion of the course, student shall be able to

1. Understand Laplace transforms, Fourier series, Fourier Transforms and Partial Differential equations to solve engineering problems.
2. Understand Matrices to solve system of equations.
3. Make use of complex variables to evaluate Contour Integrations.

UNIT I

Laplace Transforms: Laplace transforms and their properties, Application of Laplace Transform to solve ordinary differential equations including simultaneous Differential Equations. Solution of one dimensional Partial differential equations by Laplace Transform method.

UNIT II

Functions of a Complex Variable: Function of a complex variable, Analytic functions, Analytic functions, Cauchy-Riemann conditions, Conjugate functions, singularities, Cauchy's integral theorem and integral formula, Taylor's and Laurent's theorem, Residue theorem, contour integration.

UNIT III

Fourier Series : Periodic Function and their Fourier series expansion, Fourier Series for even and odd function, Change of interval, half range expansions, Practical Harmonics Analysis.

UNIT IV

Fourier Transform : Definition, Fourier Integral Theorem, Fourier Sine and Cosine Integrals, Finite Fourier Sine and Cosine Transform.

UNIT V

Partial Differential equations : Partial differential equation of first order first degree i.e. Lagrange's form. Linear homogeneous PDE of n^{th} order with constant coefficient, method of separation of variables, Application of partial differential equations.

UNIT VI

Matrices: Rank of matrix, consistency of system of equations, linear dependence, linear and orthogonal transformations. Characteristics equations, eigen values and eigen vectors. Reduction to diagonal form, Cayley Hamilton theorem, Sylvester's theorem, determination of largest eigen values and eigen vector by iteration method.

Text Book :

1. Higher Engineering Mathematics : *B. S. Grewal, 43rd ed : Khanna Publishers, Delhi (India)*
2. A text book of Applied Mathematics Volume I & II: *P. N. Wartikar& J. N. Wartikar, 9th ed: Pune Vidhyarthi Griha Prakashan, Pune -411030 (India)*

Reference Books :

1. Advanced Engineering Mathematics, 8th ed: *Erwin Kreyszig, Neekunj Print Process, Delhi.*
2. Schaum's Outline of Complex Variables, 2nd ed:*Murray R Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman, TMH, New Delhi.*
3. Advanced Engineering Mathematics, 2nd ed: *Jain, Iyengar , Narosa Publication*
4. Advanced Engineering Mathematics: *H K Dass, S. Chand Publications.*

Syllabus of Semester III, B.E. Electrical Engineering

Course Code: EET201 **Course: Elements of Electromagnetics**

L: 4Hrs.,T: 1 HrsP:0 Hrs., Per week **Total Credits : 9**

Course Outcomes

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

CO 1: Understand the vector analysis, vector and scalars conversion for different co-ordinate system like conversion of Cartesian to Cylindrical, Spherical co-ordinate system and vice versa

CO 2: Understand scalar and vector magnetic and electric field and how to calculate force on steady and moving charge.

CO 3: Apply Coulombs law, Gauss law, Divergence theorem to electric field intensity i.e. field of 'n' point charges, volume charge, line charge etc.

CO 4: Find potential difference and potential of point charge.

CO 5: Apply effective analysis tool like Poisson's and Laplace equations to current, current density, dielectrics and capacitances, metallic conductors.

CO 6: Understand the nature of dielectric materials like in parallel plate capacitance, two wire line capacitance,

CO 7: Understand steady magnetic field and magnetic forces, also nature of magnetic material. Also how to apply BiotSavorts law, Ampere's circuital law and Stroke theorem to magnetic circuit.

CO 8: Understand the role of Maxwell's equation and boundary conditions.

CO 9: Understand basics electromagnetic waves.

Unit 1 : Vector Analysis

Idea of Vector & Scalars, Vector Algebra, Vector addition, vector subtraction, Dot product, Scalar product in Cartesian co-ordinates system, conversion of variables from Cartesian to cylindrical of Cartesian to spherical and vice versa.

Unit 2 : Coulomb's law, Electrical field intensity and electric flux density

Coulomb's law, electric field intensity, field often, point charges, field due to continuous volume charge distribution, field of line charge, field of sheet charges concept of flux density.

Unit 3 : Gauss's law, Energy and Potential of charge system

Gauss's law, Application of Gauss's law, divergence theorem, definition of potential difference and potential, potential of a point charges, potential field of system of charge, potential gradient, Energy density in Electrostatic field.

Unit 4 : Conductors, Dielectric and Capacitance and Poisson's and Laplace's Equations

Current and current density, continuity of current, metallic conductors, conductor properties and Boundary conditions, Nature of Dielectric materials capacitance and capacitances, Capacitance of parallel plate capacitor, Capacitance of two wire line, Poissons and Laplace equations.

Unit 5 : The Steady Magnetic Field and Magnetic Forces

Biot Savarts law, Ampere's Circuital Law, Strokes theorem, Magnetic flux density, Scalar and Vector Magnetic potentials, force on moving charge, force between differential current elements, nature of Magnetically material, Magnetization and permeability, Magnetic circuits, potential energy, and forces on magnetic materials, Inductance and mutual inductances.

Unit 6

Maxwell's equations and boundary conditions, Elementary idea of Electromagnetic waves,

Text Book:

Engineering Electromagnetic:3rd Ed., Mc-Graw Hill, W. H. Hayt

Reference Book :

Electromagnetic, Joseph A. Administer

Syllabus of Semester III, B.E. Electrical Engineering

Course Code: EET207 **Course: Network Analysis**

L: 4Hrs.,T: 1 HrsP:0Hrs., Per week **Total Credits : 9**

Course Outcomes

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

CO 1: Apply the concept of equilibrium to generate the mathematical model of network, & determine the unknown quantities using different network theorems.

CO 2: Analyze a given signal by applying Fourier Series Expansion and determine the steady state response to non sinusoidal inputs.

CO 3: Find out the initial & final conditions and analyze the network in frequency domain with different input signals using Laplace Transform.

CO 4: Understand the transient behavior of the given system using pole-zero concept.

CO 5: Determine the parameters of Two-port network and analyze the power flow in Three-phase unbalanced system.

Unit-1 :

Nodal and mesh basis equilibrium equations, matrix approach for complicated network, containing voltage, current sources and reactances, source transformations.

Unit-2:

Network Theorems, Superposition, Reciprocity, Thevenin's Norton's maximum power transfer, compensation, Tellegen's theorem as applied to A. C. circuits.

Unit –3:

Trigonometric and exponential Fourier series, Discrete spectra and Symmetry of waveforms, steady state response of a Network to non-sinusoidal periodic inputs, Fourier transforms and continous spectra.

Unit- 4:

Laplace transform and properties, partial fractions, singularity functions, waveforms, synthesis, Analysis of RL, RC, RLC network with and without initial conditions with Laplace transforms evaluation of initial condition.

Unit – 5:

Transient behavior, concept of complex frequency, Driving points and transfer functions, poles, zeros of admittance function, their properties, sinusoidal response from Pole- Zero locations, convolution theorem and integral solution.

Unit- 6 :

Two port Network parameters and inter-connections study of series and parallel resonance in A. C. circuits, three phase unbalanced circuit and power calculations.

Text Books:

1. Network Analysis by Van Valkenburg.
2. Linear Network Theory by Kelkar and Pandit.
3. Circuits and Networks by A. Sudhakar and S. P. Shyam Mohan

Reference Books:

1. Network and System D. P. Roy Choudhary
2. Network Analysis G. K. Mittal.
3. Electrical circuits Dal Toro Prontice Hall.
4. Network systems/ Analysis B. P. Gupta (S.Chand).

Syllabus of Semester III, B.E. Electrical Engineering

Course Code: CST212 **Course: Introduction To Computer Concepts**

L: 3Hrs.,T: 1 Hrs.P:0Hrs., Per week **Total Credits : 7**

Course Outcomes

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

CO 1 : Understand the concepts of operating system and its functions.

CO2 : Understand database management system and architecture along with basic concepts in computer networks.

CO 3 : Differentiate between modular and object oriented programming and implement in the form of classes and objects.

CO 4 : Understand basic concepts of internet programming languages.

UNIT 1:

OPERATING SYSTEMS :

Introduction to Operating Systems, functions of OS, types of Operating Systems, Concept of Process and threads.

DOS: DOS Concepts, Booting concepts, DOS commands, Batch file, AUTOEXEC & CONFIG files.

WINDOWS: History of Windows Operating System, System Structure, Features of Windows 2000, Windows File System

UNIT 2:

DATABASES:

Database System Concepts and Architecture, Relational data Model, ER Model

Introduction to ORACLE: SQL-the relational database standard, DDL, DML, TCL commands, PL/SQL programming.

UNIT 3:

COMPUTER NETWORKS:

Basic Concepts in Computer Networks : OSI & TC/IP Architecture, Transmission Media, Network hardware(Repeater, Router, Hub, Gateway, Nic), Network layer in the internet, IP protocol, IP address, client –server interaction

UNIT 4:

OBJECTS ORIENTED PROGRAMMING:

C++: Features of object oriented programming languages, data encapsulation, inheritance, polymorphism, Abstraction, Concept of a class, instantiating a class ,Access control of members of a class, static and non-static members, overloading a method.

UNIT 5:

JAVA:

Creation of classes, characteristics, methods, overriding, overloading, packages

UNIT 6:

INTERNET BASICS:

Basic Concepts of Internets : Overview of Internet, history, HTTP protocol basics, HTTP request & response, HTML, Javascript, XML, difference between static websites and dynamic websites, CSS (cryptography techniques, worms and viruses, firewalls, security threats, digital signature and certificates)

Text Books:

1. Programming in C++: Balaguruswamy
2. JAVA 2 Programming Black Book: Steven Holzner, Wiley India.
3. Operating Systems: Tennonbaum.
4. Computer Networks: 3rd ed., Andrew Tanenbaum, PHI Publication.
5. Web Technologies: Uttam K. Roy, Oxford University Press.
6. Computer Fundamentals: P.K. Sinha

Reference Books:

1. UNIX Commands: Sumitaba Das
2. Database System Concepts: Abraham Silberschatz, Henry Korth,S.Sudarshan,5th edition, MCGraw Hill
3. SL &PL/SQL for Oracle 10g black book : Dr. P.S. Despande, Dreamtech press.

Syllabus of Semester III, B.E. Electrical Engineering

Course Code: ENT206 **Course: Electronics Devices & Circuits**

L: 4Hrs.,T: 1 Hrs.P:0 Hrs., Per week **Total Credits : 9**

Course Outcomes

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

CO 1: Understand the working of all the electronic semiconductor devices.

CO 2: Demonstrate their theoretical knowledge by doing practical.

CO 3: Design any electronic circuit followed by breadboard testing to check its functionality.

CO 4: Apply the knowledge of Electronics devices and circuits for making projects.

Unit 1:

Semiconductor Diodes and Power Supplies :

Intrinsic and extrinsic semiconductors theory of PN junction, diode junction, capacitance, zener diode, vector diode, Tunnel diode, Power supplies, Half wave and full wave Rectifiers, Voltage doublers, filters, ripple factor, Zener and Emitter follower type series voltage regulators.

Unit 2:

Junction Transistors :

Theory of operation, static characteristics, break down voltage, current voltage, power Limitations, Biasing of BJT, different biasing arrangements, stability factor, Thermal runaway, power transistors.

Unit 3:

BJT Analysis :

Small signal analysis of CE, CB, CC amplifiers and comparison, High frequency analysis, calculation of frequency response, gain bandwidth product.

Unit 4:

Power Amplifiers :

Classification A,B, AB, C classes, efficiency, Push-pull configuration (A,B,AB), complimentary symmetry, Distortions and cross over distortion.

Unit 5:

Positive and Negative Feedback Amplifiers :

Feedback amplifiers, classification, Practical circuits applications, advantages, Stability, Oscillators, Barkha us encriterion RC, LC and Crystal Oscillators.

Unit 6 :

FET and it's Analysis :

Field effect transistor and 'MOSFET', Principle of operation and characteristic, biasing arrangement, small signal analysis of CG, CS, High frequency Analysis.

Text Books :

1. Integrated Electronics: Millman Halkias, Parikh, McGraw Hill.
2. Microelectronics Circuits: Adel S. Sedra, K.Smith, ArunChandorkar, Oxford University Press.

Reference Books :

1. Electronics circuits – Discrete and Integrated: Schilling and Belove, McGraw Hill.
2. An introduction to semiconductor Devices: Donald Nemen ,TMH.
3. Electronics Devices & Circuit Theory,9th edition, R. Boylestad, Pearson Education.

Syllabus of Semester III, B.E. Electrical Engineering

Course Code: CHT201 **Course: Environmental Studies I**

L: 2Hrs.,T: 0 Hrs.P:0Hrs., Per week **Total Credits : 0**

Course Outcomes

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

CO1. : Develop a breadth of the interdisciplinary and method logical knowledge in the environmental fields that enables them to facilitate the definition & solution of environmental problems.

CO2. : Understand modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.

CO3. : Realize the need to change the way in which we view our own environment, using practical approach based on observation and self learning.

CO4 : Understand need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.

By studying environmental science, students may develop a breadth of the interdisciplinary and methodological knowledge in the environmental fields that enables them to facilitate the definition and solution of environmental problems.

CO5 : Identify and analyze environmental problems as well as the risks associated with these problems and understand what it is to be a steward in the environment, studying how to live their lives in a more sustainable manner.

Unit 1:

Multi disciplinary Nature of Environmental Studies: Definition, scope and importance; Need for public awareness.

Unit 2:

Natural Resources Renewable and Non-renewable Resources: Natural resources and associated problems. (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. (e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit 3:

Ecosystems: Concept of an ecosystem; Structure and function of an ecosystem; Producers, consumers, and decomposers; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem (Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems i. e. ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4 :

Biodiversity and its Conservation: Introduction – Definition: genetic, species and ecosystem diversity; Biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-sports of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Text Books:

1. Environmental Chemistry and Pollution Control: N. W. Ingole, D. M. Dharmadhikari, S. S. Patil, Das Ganu Prakashan, Nagpur.
2. Environmental Chemistry: K. Bhute, A. Dhamani, A. Lonkar, S. Bakare, Celebration Infomedia, India.

Reference Books:

1. Text Book of Environmental Chemistry and Pollution Control: S. S. Dara; S. Chand and Company Ltd., New Delhi.
2. Environmental Studies-From Crisis to Cure, Second Edition: R. Rajagopalan, Oxford University Press, New Delhi.
3. Text Book of Environmental Studies: E. Bharucha, University Press (India) Private Ltd., Hyderabad, India.

IV Semester

Syllabus of Semester IV, B.E. Electrical Engineering

Course Code: MAT242 **Course: Electrical Engineering Mathematics**

L: 3Hrs.,T: 1 HrsP:0Hrs., Per week **Total Credits : 7**

Course Objective

The objective of tis course is to expose students to understand the basic concepts of Mathematical modelng and Time response analysis. It also focuses on Z-transform, Numerical Method and Fuzzy sets.

Course Outcomes

On successful completion of the course, student shall be able to :

CO1 Form mathematical model corresponding to engineering problem, convert it into block diagram, find its transfer function, solve it and analyze its time response.

CO2 Understand and use Z-transform to solve difference equations. Understand and use concepts in Fuzzy sets and relations.

CO3 Use Numerical techniques to solve system equations and differential equations.

UNIT I:

Mathematical Modeling: Mathematical modeling of physical system like Mechanical system (basic translational and rotational system), Electrical system (basic RLC series and parallel circuits). Concept of transfer functions. Transfer function of elementary RLC circuit, elementary block diagram of closed loop system. Laplace transform of impulse, step, ramp and parabolic signals, Time response of first order and general second order system for unit step, unit impulse, and ramp input signal. Concept of characteristic equation, Determination of time constants.

UNIT II:

Root locus techniques: Routh stability criterion, Root locus concept, construction of root loci(up to second order system), Time constant and poles zero form of generalized characteristic equation. Construction rules(without proof). Determination of roots for specified open loop gain, determination of open gain for specified damping ratio. Concept of sinusoidal transfer function. Introduction to Polar Plots.

UNIT III:

Z transforms: Formation and solutions of Difference equations, Definition and properties, One sided Z-transform: Definition and properties, z-transforms pairs, inverse Z-transform, correlation of Laplace transform to Z- transform. Properties of Z- Transforms, z-transfer function, Convolution of two sequences, poles and zeros. Solution of difference equations.

UNIT IV:

Fuzzy sets: Fuzzy sets and systems, crisp sets, overview of fuzzy logic and classical logic, fuzzy compliment, union, intersection and combination of fuzzy sets, fuzzy operations, crisp and fuzzy relations.

UNIT V:

Numerical solution of algebraic and transcendental equations: Iteration method, Regula falsi method, Newton Raphson method, Convergence / rate of convergence of iterative methods, Solution of system of non linear equations. Solution of system of linear equations, Gauss Elimination, Gauss Seidal method, Crout's method.

UNIT VI:

Numerical methods for Differential Equations: Numerical solution of ordinary differential equations by Picards method, Taylor's series method, Euler's method, Modified Euler's method, Runge Kutta methods, Milne's Predictor corrector method, Solution of second order differential equation.

Text Books:

1. Control systems Engineering: *J Nagrath and M Gopal*
2. Fuzzy Engineering: *Bart Kasko*
3. Principles of control systems: *Xavier and Babu, S Chand, New Delhi*

Reference Books:

1. Introductory method of numerical analysis: *4th ed:S. S. Sastry, PHI, New Delhi*
2. Advanced Engineering Mathematics:*2nd ed: Jain, Iyengar, Narosa publication*

Syllabus of Semester IV, B.E. Electrical Engineering

Course Code: HUT202 **Course: Principles of Economics & Management**

L: 3Hrs.,T: 1 Hrs.P:0Hrs., Per week **Total Credits : 7**

Course Outcomes

After the completion of the course the student will be able to :

CO 1: Get acquainted with the basics of economics.

CO 2: Develop the understanding of micro economics.

CO 3: Have hands -on experience of macro economics.

CO 4: Acquainted with the basics of management.

CO 5: Develop the understanding of marketing management.

CO 6: Learn the working of financial management.

Unit 1 : Introduction to Economics

- Meaning and Scope
- Basic Economic concepts : Goods, Utility, Value, Wealth, Income, Saving, Investment, Equilibrium, Static, Dynamics.

Unit 2 : Micro-Economics

- Law of Diminishing Marginal Utility
- Concept of Demand
- Law of Demand
- Elasticity of Demand
- Concept of Supply
- Law of Supply
- Elasticity of supply
- Indifference Curve
- Types of Market (Perfect and Imperfect Competition)

Unit-3 Macro-Economics

- Concepts of Inflation and Deflation;
- Business cycles;
- Banks : Types, Functions of Central Bank and Commercial banks;
- Monetary and Fiscal Policies;
- Direct and indirect taxes;
- Liberalization, Privatization and Globalization

Unit-4 Concepts of Management :

- Definition, nature and scope of Management
- Functions of Management - Planning and Controlling
- Human Resource Management : Job safety, Work stress and Human Resources Panning.

Unit-5 Marketing Management:

- Meaning and nature of Marketing Management
- Marketing Mix
- Market segmentation
- Advertisement and sales promotions
- Channels of distribution.

Unit-6 Financial Management

- Meaning, nature and scope of financial management
- Profit and loss account,
- Balance sheet,
- Budgets,
- Ratio analysis,
- Depreciation and its methods.

Text Books :

1. K.K. Dewett; Modern Economic Theory; (43rd edition); S. Chand and Co. Ltd; New Delhi.
2. Paul A. Samuelson and William D. Nordhaus, (18th edition); Mc Graw - Hill Companies (2005).
3. Harold Koontz andCyril O' Donnell, Principles of Management; An Analysis of Managerial Functions, McGraw-Hill, New York, 1984.
4. P.C. Tripathi and P.N. Reddy; Principles of Management ; Tata MacGraw Hill Publishing Co. Ltd.; New Delhi.
5. K. Aswathappa; Human Resource Management, Tata - McGraw-Hill Publishing Co. Ltd. New Delhi
6. V.S. Ramaswamy and S Namakumari, Marketing Management : Global Perspective Indian Context, MacMillian Publishers India Ltd., New Delhi.

Reference Books :

1. K.K. Dewett and J.D. Verma; Elementary Economic Theory; (28th edition) S. Chand and Co. Ltd.; New Delhi.
2. Rudradutt and K.P.M. Sundaram; Indian Economy (45threvised edition); S. Chand and Co. Ltd.: New Delhi.
3. Marthand. T. Telsang; Industrial and Business Management; S. Chand and Co. Ltd. New Delhi.
4. T. Ramasamy; Principles of Management; Himalaya Publishing House, (10th edition) Mumbi.

Syllabus of Semester IV, B.E. Electrical Engineering

Course Code: ENT207 **Course: Digital and Linear Electronic Circuits**

L: 4Hrs.,T: 1 Hrs.P:0Hrs., Per week **Total Credits : 9**

Course Outcomes

After the completion of the course, student will be able to :

CO 1: Use basic components to design digital circuits.

CO 2: Design different combinational circuits for various applications.

CO 3: Design various sequential circuits for different applications.

CO 4: Design and verify digital systems using combinational and sequential circuits.

CO 5: Understand the fundamental background in differential amplifier which is necessary for understanding the working principle and Characteristics of the Operational amplifier.

CO 6: Understand the basic Operational amplifier circuits with different feedback.

Unit 1:

Analog V/sDigital systems, Digital Codes and conversions, Boolean algebra, Logic problems.

Unit 2:

Logic gates, Karnaugh Map, Decoders, Encoders, Multiplexers, Demultiplexers.

Unit 3:

Sequential circuits – Latches, Flip Flop, Conversion of one Flip Flop to another, Arithmetic Circuits - Adders and Subtractors, Memory Organization.

Unit 4:

Differential amplifier, DC and AC analysis, cascaded differential amplifier stages, Opamp Configuration inverting and non-inverting,

Unit 5:

Op-amp Parameters & their analysis, Linear Applications like summing amplifier, V to I converter, Integrator, differentiator & Instrumentation Amplifier. Non Linear applications like Clipper, clamper, Schmitt trigger, Sample & Hold Circuit.

Unit 6:

Active Filter Design, Timer IC LM-555, VCO IC 566, PLL IC 565, LM324

Text Books:

1. Fundamentals of digital circuits: A. Anand Kumar, Prentice-Hall of India, 2nd edition
2. Modern Digital Electronics: 4th ed., RP Jain, Tata McGraw Hill.
3. Op-Amps and Linear ICs: Fiore J. M, Thomson Delmar Learning
4. Operational Amplifiers Design & Applications: Tobey Graeme, Huelsman, McGraw hill

Reference Books:

1. Digital Integrated Electronics: H.Taub & D. Shilling, Mc Graw Hill.
2. Digital Electronics: Ryan ,Tata Mc Graw Hill.
3. Operational Amplifiers and Linear Integrated Circuits: 4th ed., Coughlin Driscoll, PHI.
4. Analog Filter Design: M. E. Van Valkenburg, PHI
5. Op-Amp and Linear Integrated Circuits, Ramakant A. Gaikwad.

Syllabus of Semester IV, B.E. Electrical Engineering

Course Code: - EET 203 **Course: Electrical Machines-I**

L: 4Hrs.,T: 1 Hrs.P:0Hrs., Per week **Total Credits : 9**

Course Outcomes

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

CO 1 : Constructional features and operation of single phase and three phase transformer to determine the equivalent circuit parameters per calculation of power efficiency and percentage regulation at different loads.

CO 2 : Various transformer connection, polarity test and phasor groups, parallel operation and load sharing, and concept of daily load cycle to calculate all day efficiency.

CO 3 : Construction, operation characteristics speed control of dc motor and calculate its losses and efficiency.

CO 4 : Construction operation and characteristics of three phase induction motors, and its testing to calculation of equivalent circuit parameters.

CO 5 : Starting and speed control of three phase induction motor and find power losses to calculate efficiency.

CO 6 : Construction and principal of operation of double cage induction motor, induction generator, and single phase induction motors.

Unit 1 :1 phase & 3 Phase Transformer :

Transformer operation and principle, O.C. &S.C. test on three phase transformer, determination of equivalent circuit. Parameters, Regulation, Efficiency, Auto transformer, Magnetizing current and harmonics.

Unit 2 :

Daily Load Cycle and All day efficiency of transformer, Polarity test, various connections with vector groups, Three phase to two phase conversion, parallel operation of three phase transformer, methods of cooling, temperature rise test, maintenance of transformer.

Unit 3 :

D. C. Motors:

Basic principle & operation of DC motors (separately excited, shunt and series), Types of excitation, Characteristics of shunt, series, speed control of DC motor (separately excited, shunt & series), Losses & Efficiency

Unit 4 :

Three Phase Induction Motor :

Types of induction motor and production of torque, Torque-slip characteristics, No load blocked rotor test, equivalent circuit & determination of equivalent circuit parameters, losses, efficiency, operating characteristics & influence of machine parameter on the performance of motor.

Unit 5 : Operation of 3 phase Induction Motor :

Starting of three phase I. M., Speed control of I. M. by pole changing, frequency control, rotor resistance control and by varying supply voltage.

Unit 6 : Single Phase I. M. :

Double cage motors, Induction Generator Operation. Single phase I.M. double revolving field theory, split phase motor, shaded pole motor, equivalent circuit, Torque-slip characteristics, A.C. Series motor, Universal motor.

TEXT BOOKS:

1. Electrical Machines: Dr. P.S. Bimbhra
2. Electrical Machines: Ashfaq Hussain
3. A Text Book of Electrical Technology: B. L. Theraja (Vol. II)

REFERENCE BOOKS :

1. Performance & Design of A.C. Machine: M. G. Say
2. Electrical Machines: I.S. Nagrath & Dr. D.P. Kothari
3. Laboratory Courses in Electrical Engineering: Tarnekar, Kharbanda, Bodkhe & Naik

Syllabus of Semester IV, B.E. Electrical Engineering

Course Code: EET208 **Course: Electrical Measurements & Measuring Instruments**

L: 4Hrs.,T: 1 Hrs.P:0 Hrs. Per week **Total Credits :9**

Course Outcomes:

On completion of this course, the students will be able to

CO 1: Understand classification of different types of instrument and errors in it.

CO 2: Measure different types of resistances using DC bridges

CO 3: Analyse and measure the Inductance, Capacitance & frequency by using bridges.

CO 4: Understand various types of analog and digital instruments and its application.

CO 5: Understand the principle and construction of Instrument Transformer for measurement of high voltage and current.

UNIT-1:

Classification of Measuring Instruments, comparison of analog and digital instruments, absolute and secondary instruments, indicating type, recording type and integrating type instruments, loading effect of instruments.

UNIT-2:

Measurement of Resistance: classification, Measurement of low resistance by Kelvins' Double Bridge, Measurement of medium resistance by Voltmeter-Ammeter method, Wheatstone bridge. Measurement of high resistance by Ohmmeter, Megger and Loss of Charge Method.

UNIT 3:

General theory of AC bridges, Measurement of Inductance: study of Maxwell, Hay's, Owen's, Measurement of Capacitance: De Sauty's, Wien and Schering Bridges, detectors for AC bridges.

UNIT-4:

Ammeter, Voltmeter, Principles of moving coil, moving iron and dynamometer type instruments, extension of range using series and shunts.

UNIT-5:

Measurement of power in single phase and three phase circuit by using dynamometer type instrument. Digital Measurement - True RMS measurement, measurement of frequency, measurement of power, measurement of Energy.

UNIT-6 :

General theory of extension of range using CT and PT, errors in instrument transformers, applications of instrument transformers.

Text Books :

1. A Course in Electrical and Electronics Measurements and Instrumentation: 11th ed., Sawhaney A. K., Dhanpat Rai & Sons, Delhi 1994.

2. Electrical Measurements and Measuring Instruments: 3rd ed., Golding, E. W., Widdis, F. C., Wheeler's Student Edition, 1994.

Reference Book :

Electronic Measurements and Instrumentation: 3rd ed., Cooper, W.D., Helfrick, A.D., Prentice-Hall of India, New Delhi 1991.

Syllabus of Semester IV, B.E. Electrical Engineering

Course Code: CHT202 **Course: Environmental Studies - II**

L:2Hrs.,T: 0 Hrs. P:0Hrs., Per week **Total Credits : 0**

Course Outcomes

After the completion of the course, student will be able to :

CO 1 : Understand the modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.

CO 2 : Realize the need to change the way in which we view our own environment, using practical approach based on observation and self-learning.

CO 3 : Recognize the need to create a concern for our environment that will trigger pro-environmental action; including simple activities, we can do in our daily life to protect it.

CO 4 : Identify and analyze environmental problems as well as the risks associated with these problems and understand what it is to be a steward in the environment, studying how to live their lives in a more sustainable manner.

Unit I

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, and Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides.

Unit II

Social Issues and the Environment: From Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problems and concerns, Case Studies; Environmental ethics: Issues and possible solutions; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case Studies; Wasteland reclamation; Consumerism and waste products; Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation; Public awareness.

Unit III

Human Population and the Environment: Population growth, variation among nations, Population explosion – Family Welfare Programme; Environment and human health; Human Rights; Value Education; HIV/AIDS; Women and Child Welfare; Role of Information Technology in Environment and human health,Case Studies.

Field work

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

Text Books:

1. Environmental Chemistry and Pollution Control: N. W. Ingole, D. M. Dharmadhikari, S. S. Patil, Das Ganu Prakashan, Nagpur.
2. Environmental Chemistry: K. Bhute, A. Dhamani, A. Lonkar, S. Bakare, Celebration Infomedia, India.

Reference Books:

1. Text Book of Environmental Chemistry and Pollution Control: S. S. Dara; S. Chand and Company Ltd., New Delhi.
2. Environmental Studies-From Crisis to Cure, Second Edition: R. Rajagopalan, Oxford University Press, New Delhi.
3. Text Book of Environmental Studies: E. Bharucha, University Press (India) Pvt. Ltd., Hyderabad, India.

V Semester

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET301 **Course: Power Station Practice**

L: 3Hrs.,T: 1 HrsP:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course, students will be able to,

CO 1: Solve the load requirement and distribution problems along with the practical parameters of generation capabilities.

CO2: Draw and study the load curve, load duration curve, energy load curve, different types of loads and their requirements.

CO3: Prepare the operating schedule of Generating units and calculate the generation costs & depreciation cost.

CO4: Understand the practical aspects of working of thermal power stations, the accessories and non-accessories systems of it.

CO5: Understand the hydrological, topological topographical and practical aspects of hydroelectric power stations, major civil engineering systems and find out the actual electrical power potential for given site.

CO6: Understand the practical aspects of nuclear stations, nuclear physics and different nuclear reactors.

CO7: Understand the practical aspects of various non-conventional energy sources.

CO8: Understand the voltage and frequency regulators and their workings, different excitation systems and other practical switching devices, structure of tariff.

UNIT I : Sources of Electrical Energy : Coal, oil and natural gas, water power, nuclear fission and fusion. Recent development in power generation.

Generation:- Different factors connected with a generating station, connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity and utilization factor, load curve, load duration curve, load survey, base load and peak load station, advantages of interconnection. Depreciation of plant, load forecasting

UNIT II : Thermal Stations : Choice of site, size and number of units, general layout, major equipment, essential and non-essential auxiliaries, electric supply to auxiliaries, cost of generation, effect of different factor on costs. Treatment on water, Tests on coal, Automatic control of different of different system. Advantages and disadvantages.

UNIT III : Hydro station : Hydrology, stream flow, flow duration curve, power duration curve, mass curve reservoir capacity, type of hydro plants and their field of use, pumped storages plants and their utility, surge tanks, governing characteristics of turbine and hydro generators. Advantages and disadvantage, Automatic and remote control, advantages and disadvantages.

UNIT IV: Nuclear station : Principle of Nuclear energy, materials, types of nuclear reactors, breeder reactors, location, material for moderator and control rods, cost economics

UNIT V: Voltage control of A.C. generators: Methods of stabilizing exciter voltage, Automatic Voltage regulator action. Tariff different consideration of Flat & two part economical choice.

UNIT VI: Non conventional techniques of energy production :

a. Solar energy- Introduction, Physical Principles of conversion of Solar radiation into heat. Solar energy collectors, solar energy storage,
b. Electrical power generation and other miscellaneous applications of solar energy.
c. Wind energy – Introduction, Basic principles of wind energy conversion, Wind Delta, energy estimation, site selection, Basic component of Wind energy conversion system, Wind turbines and their analysis, Wind Electrical generation, stand alone, and grid connected wind-electrical power systems, various applications of wind energy.
d. Energy from Tides and Oceanic Waves :- Introduction, Basic principles of Tidal power, site selection storage and plant layout for Tidal Power Plant, Introduction to Wave energy and its Energy plants, Wave energy based power plants layout, Analysis of Tidal and Wave energy plants.

Text Books:

1. Electrical Power Stations: Car.
2. Generation of Electrical Energy: Dr. B. R. Gupta
3. Power plant Engineering: P. C. Sharma

Reference Books:

1. Electrical Power Station Control: H.P. Young.
2. Elements of Power Station Design: M.V. Deshpande.
3. Energy Conservation and Power Generation: L.D. Agrawal and G. K. Mittal.
4. Non Conventional Energy Sources: G. D. Rai.

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET302 **Course: Electrical Machines-II**

L: 4 Hrs. T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 9**

Course Outcomes

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

CO 1 : Understand the constructional features of synchronous machines, induced EMF equation & Harmonics.

CO 2 : Understand the stedy state operation of cylindrical rotor & salient pole synchronous generator at different power factors.

CO 3 : The steady state operation of cylindrical rotor and salient pole synchronous motor.

CO 4 : Analyze the operation of synchronous machine connected to infinite bus and synchronization & parallel operation of generator, power angle characteristic (P-8 curve), V and inverted V curve, Losses and efficiency.

CO 5 : Understand the transient analysis under sudden Three phase short circuit condition and methods to obtain various reactances.

CO 6 : Understand the construction and principle of operation of various special purpose motors.

Unit- 1 :

Three Phase Synchronous Generators :- Introductions, constructional features of cylindrical and salient pole rotor, machines introduction to armature winding and field windings, MMF of armature and field windings induced EMF equation and harmonics.

Unit-2: :

Synchronous Generator: Steady State Operation of cylindrical and salient pole rotor synchronous generator. Phasor diagram, OC and SC test and calculation of percentage regulation using EMF/ synchronous impedance method.

Unit-3:

Synchronous Motor: Principle of operation of synchronous motor, steady state operation of cylindrical rotor and salient pole synchronous motor, phasor equations and phasor diagram,

Unit- 4:

Performance of synchronous Machines: Synchronous Machines On Infinite Bus, synchronization of alternator with infinite bus, parallel operation and load sharing, power angle characteristic(P-δ curve), steady state stability limit and role of damper windings .V curve and inverted V curves for synchronous motors and generators., losses and efficiency.

Unit-5:

Transient behavior: sudden three phase short circuit and its various component of short circuit current, transient and sub-transient reactance and their measurements, equivalent circuit diagram under steady-state, transient, sub-transient state. Unbalance operation of synchronous machine and measurement of positive, negative and zero sequence reactance, Measurement of Xd and Xq by slip test.

Unit-6:

Introduction To Special Machines : Reluctance motor, hysteresis motor, permanent magnet motor, Repulsion motor.

Text Books :

1. Electrical Machines:AshfaqHussain.
2. Electrical Machinery:Nagrath and Kothari.
3. Electrical Machinery: P.S. Bhimbra.

Reference Book :

Electrical Technology Vol. II: B. L. Thareja and et. al.

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET303 **Course: Electrical Power System-I**

L: 3Hrs., T: 1 Hrs P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes :

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

CO 1 : Find the per unit values for various power system components.

CO 2 : Calculate different parameters of overhead line and underground cable.

CO 3 : Understand and analyze different types of transmission lines.

CO 4 : Understand different distribution schemes and types of cables.

CO 5 : Understand power flow in transmission line, load sharing between alternators and types of insulators.

CO 6 : Understand the load flow problems and calculation of Y_{BUS} matrix.

Unit 1:

Structure of electrical power system, brief exposition of generation, transmission and distribution aspects, use of high voltage, idea about substation (indoor and outdoor), concept of real, reactive and complex power unit system, load and their characteristics, voltage and frequency dependence of loads, overhead v/s underground transmission, per unit system, representation of power system elements and per unit impedance diagram.

Unit 2:

Concept of GMD & GMR, calculation of the inductance and capacitance of overhead transmission lines with symmetrical and unsymmetrical spacing, effect of earth on capacitance, transposition of line, bundle conductor, double circuit three phase lines.

Unit 3: Elementary distribution schemes :

Types of cables, capacitance of single phase and three-phase cable, grading of cable, DC Cables, power factor and heating of cables.

Types of distribution system, comparison, feeders and distributors, numerical on AC and DC distribution system.

Unit 4 :

Representation of transmission lines, ABCD parameters of transmission lines, Voltage regulation and efficiency of power transmission lines, Power flow equations and circle diagrams.

Unit 5:

Interconnection of system elements to form two bus system, Illustration of active and reactive power transmission, Introduction to load flow studies in multibus system(Methods of solution not expected), Introduction of frequency and voltage as system state indicators.

Unit 6 :

Elementary concepts of real and reactive power control, Steady state performance of turbine governors, load sharing between generators, preliminary concepts of automatic voltage regulators for turbot generators, Insulation of overhead lines, insulator string, efficiency, types of insulators.

Text Books:

1. Modern Power system Analysis:Nagrath and Kothari.
2. Electrical Energy System Theory:Elegard.
3. Elements of Power System Analysis: Stevenson.

Reference Books :

1. Elements of Power System Analysis: Stevenson Westinghouse Transmission and Distribution Handbooks.
2. Power System Analysis:Wadhwa C. L.

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET 304-1 **Course: Elective – I Electrical Machine Design**

L: 3Hrs., T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

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

CO1. Select proper materials for making different parts of electrical machines and compute the final temperature attained by machines during heating & cooling processes.

CO2. Design different components f transformer and estimate the performance characteristics from the design.

CO3. Design different components of induction motor and estimate the performance characteristics from design.

CO4. Design an electromagnet.

Unit :1

Review of matrial used in construction of electrical machines: Classification of insulating material depending upon permissible temperature rise, properties of transformer oil, standard specifications, CMR and short time of machines, heating and cooling characteristics.

Unit: 2

Design of magnetic circuit : Magnetization characteristics. Design of electromagnets, magnetic pull or force, ampere-turn requirement, temperature rise, Design of inductor, small chokes.

Unit: 3 :

Transformer Design: Specific loading equation for voltage per turn for power and distribution transformers, output equation.

Unit: 4:

Principles of electric and magnetic circuit design. Estimation of performance characteristics from the design data.

Unit: 5

Induction Motor: main dimension, output equation, loading constants estimation of axial lengths, air gap diameter, winding design.

Unit : 6

Air gap lengths, rotor of IM, cage rotor and wound rotor design. Calculation of no load current and other performance from characteristics for design data.

Text Books:

1. Performance and design of A.C. Machines: M.G.Say.
2. Electrical Machine Design: A.K.Sawhney in Dhanpatrai& Sons. Delhi.
3. Electrical Machine Design: Balbir Singh in Brite Students Publications. Pune.

Reference Books

1. Electrical Machine Design: M.V. Deshpande.
2. Principles of Electrical Machine Design: R. K. Agrarwal

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET 304-2 **Course: Elective –I Entrepreneurship Development**

L: 3Hrs., T: 1 Hrs P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course students will be able to understand,

CO 1: Qualities and Functions of an Entrepreneur.

CO 2: Government policy towards Entrepreneur.

CO 3: Small business environment of an Entrepreneur

CO 4: Knowledge centre and assistance available to an Entrepreneur

CO 5: How to organize and setup an Entrepreneur business model

CO 6: Project report, finance and marketing models for a new Entrepreneur.

CO 7: Problems encountered by a new Entrepreneur

a. Finance
b. Labour
c. Purchase
d. Manufacturing
e. Marketing
f. Branding
g. Government Taxes and duties.

UNIT :1

Entrepreneurial traits types and significance. Definitions characteristics of Entrepreneur type's. Qualities and functions entrepreneurship role and importance of entrepreneur economic growth .Competing theories entrepreneurship .Entrepreneurial Development Programmed in India History Program in India History Support. Objective stages of performances. Planning and EDP Objectives.

UNIT :2

Target group selection of center pre-training work, Policy towards SSI's .Entrepreneurial Behaviors entrepreneurial motivation, achievement of management success. Entrepreneurial success in rural area. Innovation and entrepreneur.

UNIT :3

Establishing Entrepreneurial System. Search for business idea. Sources of ideas, processing. Input requirements. Sources and criteria of farcing, fixed and working capital assessment Technical assistance. Marketing assistance, sickness of units and remedial assistance Preparation of feasibility reports and legal formalities and documentation.

UNIT : 4

Small Business in Indian Environment - Economic, Social .Political Cultural and Legal Policies Governing Small Scale Units. Industrial Policies and Strategies relating to small scale sector; Technological know-how and Appropriate Technology; Quality Circles and productivity, and linkage between Small and Big Business.

UNIT : 5

Organizational Structure and other Characteristics of Small -Firms .Special Problems m the Management of small Business in various Functional Areas like Finance. Marketing, Production and Personnel Sickness in the small Scale Sector. Modernization of Small and Village Industries; Training Programmers and consultancy Senders; Institution Assisting Export Promotion of Small Business m India; Export Promotion Councils Global perspective of Small Business in selected countries.

UNIT :6

Problems of Industrialization in underdeveloped countries with special reference to India .Industrial policy. Regulations and control of Industries in India , Mechanics of setting of new enterprises -size and location, optimum units-its meaning and determinants size of industrial units in India. Theory of industrial location factors determining the industrial location. Regional distribution of industrial activity in India; Recent trends in the localization of industrial activity in India, Regional planning of industrial activity in India; Feasibility studies technical, marketing and financial. Managerial problems of new Enterprises production purchasing. Financing labour and marketing problems .Facilities provided by different Institutions and Agencies in India. Financing facilities for new enterprise. Marketing and other facilities.

Text Books:

1. Entrepreneurship 6th edition. Robert D Hisrich:Tata McGraw-Hill.
2. Kuratko- Entrepreneurship – A Contemporary Approach: Thomson Learning Books
3. Small-Scale Industries and Entrepreneurship : Desai, Vasant Himalaya Publishing House, Delhi. (2003).

Reference Books:

1. Chary – Business Gurus speaks: Macmillan
2. S.S. Khanka – Entrepreneurial Development: S. Chand & Co.

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET 304-3 **Course : Elective –I Energy Management and Audit**

L: 3Hrs., T: 1 Hrs P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course, students will be able to,

CO 1 : Understand the basics of energy with material and energy balance.

CO 2 : Understand the role of ESCO and analyze the different financial options of investment.

CO 3 : Understand details about Electrical Energy consumption, its uses, and its efficiency.

CO 4 : Evaluate the performance of Compressed Air System and Heating, Ventilation & Air Conditioning (HVAC)

CO 5 : Find out the energy saving opportunities in Pumps, Pumping System and Cooling Towers.

CO 6 : Correlate the energy and its effect on environment.

Unit I:

Energy Scenario: Basics of Energy and its various forms: Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Unit II:

Financial Management: Investment-need, appraisal and criteria, financial analysis techniques - simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs). Energy Monitoring and Targeting: CUSU, Energy Management Information Systems.

Unit III :

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. Star operation, voltage unbalance, energy efficient motors, soft starters with energy saver, variable speed drives. Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues. Diesel/Natural gas Power Generating systems: Factors affecting selection, energy performance assessment of diesel conservation avenues. Waste heat recovery.

Unit IV:

Compressed Air System and (HVAC): Types of air compressors, reciprocating vsscrew, compressor efficiency, efficient compressor operation, Heating, ventilation, air conditioning and Refrigeration System: Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pressure drop calculation.

Unit V:

Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Energy conservation in boiler feed water pump, pumping systems for municipal drinking water, and sewerage, agriculture pump sets. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.

Unit VI:

Energy, Environment and Climate change: Energy and environment, air pollution, climate change United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM, Prototype Carbon Fund (PCF). Energy conservation in Buildings and Energy Conservation Building Codes (ECBC): About Energy Conservation Building Codes (ECBC), building envelope, insulation, lighting, Heating, ventilation, air conditioning (HVAC), fenestrations, water pumping, inverter and energy storage/captive generation, elevators and escalators, star labeling for existing buildings, Energy Service Companies based case studies.

Text Books:

1 Archie, W Culp. Principles of Energy Conservation:McGraw Hill, 1991.

2 P. O'Callaghan : Energy Management: McGraw - Hill Book Company, 1993.

3 Thuman A and Mehta D Paul, Handbook of Energy Engineering: the Fairmount Press.

Reference Books:

1. Handbook on Energy Audits and Management, Amit Kumar Tyagi.
2. Energy Efficient Buildings, Majumder Milli, TERI.
3. Energy Management, Paul O'Callaghan, McGraw Hill.
4. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.

Syllabus of Semester V, B.E. Electrical Engineering

Course Code : EET 304-4 | **Course : Elective –I : Design of Data Acquisition and Logic Controllers**

L: 3 Hrs., T: 1 Hr. P:0 Hrs. Per week | **Total Credits : 7**

Course Outcomes

Upon the completion of this course, students will be able to understand,

CO1. Concept and advantages of PLC

CO2. Standards, which guide the programming of a PLC and communication protocols.

CO3. Concepts and design of DCS and SCADA systems

CO4. Interface of PLC, DCS and SCADA with protocols

CO5. Report generation from SCADA and DCS systems.

CO6. Concept of MMI and user interface panel design.

CO7. Wireless communication of DCS, SCADA and PLC systems.

CO8. Modern Factory Control Systems.

Unit 1: Programmable Logic Controllers: Automation: Basic Concepts and Need, Types of Processes and Automation Strategies, Requirements of Batch and Sequential control Design of Relay Logics with electrical accessories, Sequencing, Interlocking and latching concepts, PLC working along with Hardware details, Programming of PLC as per IEC61131-3, Ladder Diagram and Functional Block diagram programming, HMI Programming along with alarms and displays.

Unit 2: Introduction to DCS, DCS Introduction, functions, advantages and limitations, DCS components and architecture, Specifications of DCS, Engineering and design details, SCADA-DCS Interface.

Unit 3: Configuration software as per IEC-61131-3 standard, Types of Editors used for configuration software, Functionalities of the Important "Function Blocks", Ladder programming.

Unit 4: SCADA (Supervisory Control & Data Acquisition System), SCADA features, SCADA architecture, Alarms, Events, Trends, Graphic generation, Report generation, Communication protocols, Interface with PLC and DCS.

Unit 5 : MMI / HMI programming, Working principle & types of HMI, WinCE based HMI.

Unit 6 : Industrial Communications, Introduction to Industrial Networking, Distributed I/O, device-level networks, TCP/IP and industrial Ethernet Implementations, Wireless on plant-floors.

Text Book :

1. Programmable Logic Controllers and Industrial Automation: An Introduction by Madhuchhanda Mitra Penram International Publishing(India) Pvt Ltd.

Syllabus of Semester V, B.E. Electrical Engineering

Course Code: EET316 | **Course : Microprocessor & Interfacing**

L: 4 Hrs., T: 1 Hrs. P:0 Hrs. Per week | **Total Credits: 9**

Course Outcomes

On the completion of course, students shall be able to:

CO1 : Understand the architecture of 8085 microprocessor and it's working.

CO2 : Develop assembly language program using 8085 microprocessor instruction set.

CO3 : Interface various Input / Output devices with the microprocessor.

CO4 : Discuss the use of various peripherals in the microprocessor system.

Unit-1: Approach to integrated system design using microprocessor. Organization of a computer with MPU, Bus concepts, Memory organization, linear/absolute decoding.

Unit-2: Introduction of Intel's 8085A: Architecture, description. Instruction Set, Addressing modes, Timing diagrams.

Unit: 3: Flag structure, concept of PSW, Stack and Subroutine, Simple and Nested subroutines, Push-Pop, Call-Return instructions, Stack manipulation, (simple programming).

Unit: 4: Interrupt concept& structure in 8085, Interrupt Service Routines (ISR), advanced instructions of Programming of 8085A.

Unit: 5: Serial data transfer, Synchronous and Asynchronous data transfer. Simple hardware to interface standard Latches, Buffers, Keys, FND display devices as I/O ports to 8085A.Interfacing with ADC/DAC.

Unit: 6: Architecture and interfacing of 8255 to 8085 in simple I/O mode, BSR mode. Architecture and Interfacing of 8253.

Text Book :

R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing.

Reference Books :

1. D. V. Hall, Programming of 8085,McGraw Hill Publishing.
2. B. Ram, Fundamentals of Microprocessor and Microcomputers, Dhanpat Rai Publications.

VI Semester

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET307 **Course : Control System Engineering**

L: 4 Hrs., T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 9**

Course Outcomes

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

CO 1: Convert physical models into physical systems and then formulating the appropriate mathematical model and converting mathematical models into the block diagrams/ signal flow graphs and then find the transfer function of the system

CO 2: Understand various time response specifications, perform time response analysis and understand techniques of compensation for improving the system response.

CO 3: Apply various methods to investigate stability of a given system.

CO 4: Understand the concept of root locus, Bode plots, Nyquist plots for design and analysis of a system

CO 5 : Understand the concept of modern control system theory for design and analysis of a system.

UNIT 1:

Introduction, Block Diagrams and Signal Flow Graphs

Introduction to need for automation and automatic control. Use of feedback, broad spectrum of system application. Mathematical modeling (Electrical and Electro mechanical), transfer functions, block diagram, signal flow graphs, application to elementary systems, simplifications. Effect of feedback on parameter variations, disturbance signal, servomechanism and regulators. Control system components, electrical, electro mechanical, their functional analysis and input output representation.

UNIT 2:

Time Response Analysis

Time response of system, first order and second order system, standard inputs, concept of gain and time constants. Steady state errors, type of control system, approximate methods for higher order system. Types of Controllers.

UNIT 3:

Stability

Stability of control systems, condition of stability, characteristics equation, Routh Hurwitz criterion, special cases for determining stability, relative stability.

UNIT 4 :

Root Locus

Root location and effect on time response, elementary idea of root locus, Construction of root locus effect of addition of pole and zero in proximity of imaginary axis.

UNIT 5 :

Frequency Response

Frequency response method of analyzing linear system, Nyquist and bode plot, stability and accuracy analysis from frequency response, open loop and close loop frequency response, Nyquist criterion, effect of variation of gain and addition of pole and zero on response plot, stability margin in frequency response. Introduction to basic Lag-Lead Compensator.

UNIT 6 :

State Space Analysis

State variable method of analysis, characteristics of system state. Choice of state variables, representation of vector matrix differential equation, standard form, relation between transfer function and state variables.

Text Books:

1. Automatic Control System:B.C.Kuo (P.H.I.)
2. Control System Analysis: Nagrath & Gopal
3. Linear System Design: D'azzo and Houpis (M.H.)

Reference Book:

Modern Control Theory:M. Gopal.

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET308 **Course : Electrical Drives and Their Control**

L: 3 Hrs., T: 1 Hrs P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course, the students will be able to,

CO 1: Examine factors governing selection of Electric Motors like speed torque characteristics under starting, running, and braking for particular application in a common electric drive system.

CO 2: Select motor rating, Flywheel of common drive motors for continuous and intermittent periodic duties.

CO 3: Analyze control circuit of ac/dc contactors and relays for automatic starting and braking of ac/dc motors.

CO 4: Analyze the performance and suitability of motors used in ac/dc traction, their performance characteristic, control and braking.

CO 5: Apply digital control of electric motor, plc programming in electrical drives.

Unit 1:

Factors Governing Selection of Electric Motors, Types of Drives and Types of Load, Starting of electric motors, Speed control of Electric motors. Definition classification and speed torque characteristics of common drive motors and their characteristics under starting, running, Electric Braking. Types of enclosures.

Unit 2:

Selection of Motor: Insulating materials, Temperature rise in Electrical machines, Duty cycles, Power capacity for continuous and intermittent periodic duties, Load equalization and flywheel effect. Brief idea about drives commonly used in industries.

Unit 3:

Control devices for industrial motors,AC and DC contactors and relays: Lock out contactors, magnetic structure, operation , arc interruption, contactor rating, H.V. contactors. Control circuits for automatic starting and braking of DC motor and three phase induction motor. Control panel design for MCC.

Unit 4 :

Different systems of Traction. Train movement and energy consumption. Traction Motors: Motors used in AC/DC traction, their performance and desirable characteristics, requirements and suitability of motor for traction duty.

Unit 5

Traction motor control – Starting and speed control traction motors. Series parallel control with numerical. Starting and speed control of 3-phase induction motors. Braking of traction motor.

Unit 6

PLC, its programming and its applications in electrical drives. Digital control of Electric motor, Block diagram arrangement, comparison with other methods of control.

Text books:

1. Utilization of Electric power and Electric Traction : J. B. Gupta
2. Modern Electrical Traction : H. Pratap
3. Programmable Logic Controllers and Industrial Automation an introduction : Madhuchhanda Mitra & Samarjit Sen Gupta.

Reference Books:

1. A course in Electric Power Soni, Gupta and Bhatnagar.
2. Art and Science of Utilization of Electrical Energy: H. Pratap.
3. Magnetic Control of Industrial Motors: Heumann

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET309 **Course : Power Electronics**

L: 4 Hrs., T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 9**

Course Outcomes

Upon the completion of this course, students will be able to,

CO 1: Understand construction, working, static V-I & dynamic characteristics, ratings, specifications of basic power electronic switches with necessity of series & parallel connections of SCRs and triggering mechanism.

CO 2: Understand the working of different types of AC-DC converters with their performance parameters, output waveforms and applicability depending on nature of load.

CO 3: Select and compare power electronic switches depending upon requirement and nature of power electronic controller with design of protection parameters for the circuit.

CO 4: Understand the working of different types of DC-DC & DC-AC converters with their performance parameters, output waveforms, applicability depending on nature of load and PWM techniques.

Unit 1 : Thyristors : Static VI characteristics of SCR, TRIAC and DIAC, gate characteristics of SCR, SCR turn ON and turn OFF process, Transient characteristics of SCR during turn ON and turn OFF, ratings and specifications of SCR, series and parallel connections of SCRs, TRIAC and its applications, Unijunction transistors, Gate triggering circuits.

Unit 2 : Line commutated converters : Working of single pulse converter with R, R-L and R-L-E load, two pulse converter, three pulse converter and three phase six pulse bridge converter with highly inductive load, effect of source inductance in converters, effect of freewheeling diode.

Unit 3 : Single phase and three phase half controlled converters with highly inductive load, Performance parameters of converters, Cycloconverters (Single Phase).

Unit 4 :- Static controllable switches: VI Characteristic and working of MOSFET, Gate turn off thyristor(GTO) and insulated gate bipolar transistor(IGBT), Protection of SCR, gate circuit protection, over voltage and over current protection, snubber circuit design.

Unit 5 :- D.C. Choppers : Commutation of SCRs, various techniques, Principles of step down chopper, step up chopper, classification of choppers, choppers using SCRs, Multiphase choppers, Practical application of Choppers.

Unit 6 :- Inverters: Classification of Inverters, Basic series resonant inverter, half bridge and full bridge series resonant inverters. Single phase and three phase bridge inverters, causes of generation of harmonics and reduction techniques using PWM method.

Text Books:

1. Power Electronics Circuits Devices &Application: M. H. Rashid
2. Thyristor& their Application: G. K. Dubey & Joshi &Doralba
3. Industrial Power Electronics: Deodatta Shingare.

Reference Books :

1. Power Electronics ; M.D. singh & Khanchandani
2. Power Electronics ; P.S. Bimbhra

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET310 **Course: Instrumentation**

L: 3 Hrs., T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 7**

Course Outcome:

Upon the completion of this course, the students will be able to

CO 1: Understand various transducers for motion measurement.

CO 2: Understand various Temperature transducers and their applications.

CO 3: Understand the techniques used for measurement of pressure, flow, pH, volume of gas and liquid

CO 4: Understand analog to digital conversion and Signal transmission.

CO 5: Familiarize with data acquisition systems (DAS) and SCADA systems.

Unit 1: Motion Measurement: Relative and absolute motion measurement, measurement of velocity and acceleration, electrical transducers for motion measurement. LVDT, piezo electric transducers, variable inductance transducers, measurement of shaft torque and power.

Unit 2: Temperature measurement: Law of thermo-electric circuits, thermocouples, cold junction compensation, thermistor, radiation thermometry, broadband narrow band radiation methods. Two color pyrometers, optical pyrometers, temperature compensation of temperature sensors, heat flux sensors.

Unit 3: Pressure measurement: Pressure measurement of gas and liquids. Flow and level measurements of gas and liquids, Measurement of pH, Simultaneous measurement of volume, temperature and pressure of gas and liquids.

Unit 4: Method of Analog to Digital Conversion: Errors in A to D conversion, Transmission of signals in analog and digital forms. 4-20 ma, RS232, RS485.

Unit 5: Conversion of various transducer signals into electrical signals

Unit 6: Data Acquisition Systems, SCADA

Text Books

1. Measurement System Application and Design: E.O. Doeblin in McGraw Hill.
2. Electronics Instrumentation and Measurement Technique: W.D. Cooper in Prentice hall.
3. Instrumentation of Engineering Measurements:Dalley, Railey, McConnelin John Wiley & Sons.

Reference Books

1 Electrical and Electronic Measurement and Instrumentation: A.K.Sawhney.
2. Instrumentation Devices and Systems:Rangan in Tata McGraw Hill.

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET313-1 **Course: Open Elective-Automation**

L: 3Hrs., T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

After the completion of this course, students will be able to understand,

CO 1: Automation strategy in a Plant, its design and implementation.

CO 2: Standard protocols used in Plant Automation. How different protocols hand shake.

CO 3: Implementation of PLC / DCS / SCADA platforms in Automation, its integration and communications.

CO 4: Linking DCS with ERP, and its tools for report generation.

CO 5: OPC support for Automation process.

CO 6: Case study of application of Automation in different industries.

Unit 1:

Plant wide Control Systems and Automation Strategy: Evolution of instrumentation and control, Role of automation in industries, Benefits of automation, Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC, Automation strategy evolution, Control system audit, performance criteria, Safety Systems

Unit2:

Advance Applications of PLC and SCADA: PLC programming methods as per IEC 61131, PLC applications for batch process using SFC, Analog Control using PLC, PLC interface to SCADA/DCS using communication links (RS232, RS485) and protocols (Modbus ASCII/RTU)

Unit3:

Instrumentation Standard Protocols: HART Protocol introduction, frame structure, programming, implementation examples, Benefits, Advantages and Limitations. Foundation Fieldbus H1 introduction, structure, programming, FDS configuration, implementation examples, Benefits, Advantages and Limitations. Comparison with other Fieldbus standards including Device net, Profibus, Controlnet, CAN, Industrial Ethernet etc.

Unit4:

Distributed Control Systems Basics: DCS introduction, functions, advantages and limitations, DCS as an automation tool to support Enterprise Resources Planning, DCS Architecture of different makes, Latest trends and developments.

Unit 5:

Distributed Control Systems Engineering and Design: DCS detail engineering, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc. Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC supports, Security and Access Control etc. Performance Criteria for DCS and other automation tools.

Unit 6:

Application development and Automation for industry verticals: Application development and automation for following industries – Power, Water and Waste Water Treatment, Food and Beverages, Cement, Pharmaceuticals, Automobile and Building Automation.

Text Books:

1 Distributed Computer Control for Industrial Automation, Poppovik Bhatkar, Dekkar Publications.
2 Programmable Logic Controllers: Principles and Applications: Webb and Reis, PHI.
3 Computer Aided Process Control: S. K. Singh, PHI

Reference Book:

Introduction to Programmable Logic Controllers: Garry Dunning, Thomson Learning.

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET313-2 **Course: Open Elective-Industrial Drives**

L: 3Hrs., T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course, the students shall be able to :

CO 1 : Identify the different components of load torque and classify the industiral load into constant torque load, constant power load and variable torque load.

CO 2 : Calculate equivalent moment of inertia for industrial loads and torque & horse-power rating of the motor required to drive the load.

CO 3 : Understand and select appropriate type of DC motor for specific industrial application on the basis of characteristics.

CO 4 : Understand and select AC motor for specific industrial application on the basis of characteristics and control method

CO 5 : Understand and select power semiconductor switches/ power converters for controlling industrial drives.

CO 6 : Understand control circuit for industrial drives and promote energy conservation concept in electric drive.

Unit 1. Fundamentals of Mechanics and Mechanical Loads:

Force, Torque, Mechanical power of a motor, kinetic energy of linear and rotational motion, calculation of moment of inertia from mass, shape and dimensions, speed of a motor/load system, motor driving inertia load, motor driving linear motion load, [2]-[4] steady-state stability of electric drive, classification of mechanical load, components of load torques, constant torque loads, variable torque loads, constant horsepower loads, determination of equivalent inertia and load torque of a motor feeding multiple loads through motion converters, experimental determination of load torque and moment of inertia (retardation test), four- quadrant operation, simple numerical on determination of motor horsepower rating for given mechanical loads.

Unit 2. AC Motor Drives :

Basic elements of electric drive, 3-Ph. Induction Motor: construction, principle of operation, types, performance characteristics, starting and speed control methods.

3-Ph. Synchronous Motor: construction, principle of operation, types and performance.

(Mathematical treatment and numerical not expected)

Unit 3. DC & Special Motor Drives:

DC Motor: construction, principle of operation, types, performance characteristics and speed control.

Special types of industrial motor: Traction motor, Electric drive for Cranes.

(Mathematical treatment and numerical not expected)

Unit 4. Power Electronic Control of Electric Motors:

Power semiconductor switches (SCR, MOSFET and IGBT): basic construction and static characteristics.

Types of controllers, 1-phase Half and full wave uncontrolled/controlled AC to DC converters, 3-ph AC to DC bridge type converter, 1-ph and 3-ph bridge type inverter, Sinusoidal pulse width modulation. (Mathematical treatment and numerical not expected)

Unit 5. Industrial Motor Control, Selection of Electric Motor and Energy Conservation Aspects:

Control diagrams, starting methods, inching and jogging, reversing the direction of rotation, plugging, reduced voltage starting methods, classes of motor duty, General guidelines for selection of motors, selection of motor power rating, measures for energy conservation in electric motors, use of variable speed (frequency) drives.

Unit 6. Common types of Industrial load and specific application drives:

Fan load, pump load, turbo compressors, drives for textile mills, steel rolling mills and machine tools.

Textbooks:

1. "Electrical Machines, Drives, and Power Systems," Theodore Wildi, Pearson Education Asia, Delhi.
2. "Electric Drives, Concepts & Applications," Vedam Subrahmanyam, Tata McGraw Hill, New Delhi.
3. "Fundamentals of Electric Drives," Gopal K. Dubey, Narosa Publishing House, New Delhi.
4. "Electric Motors, Applications and Control," M.V.Deshpande, PHI Learning Pvt. Ltd. New Delhi.

Reference books:

1. "Modern Electric Traction", H. Partab, DhanpatRai& Co., Delhi.
2. "Utilization of Electric Power & Electric Traction," J.B.Gupta, S.K.Kataria& Sons, New Delhi.
3. "Power Electronics, Circuits, Devices & Applications," M.H.Rashid, Pearson Education Asia, Delhi.

Syllabus of Semester VI, B.E. Electrical Engineering

Course Code: EET313-3 **Course: Open Elective-Energy Management and Audit**

L: 3Hrs., T: 1Hrs P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course, students will be able to,

Upon the completion of this course, students will be able to,

CO 1: Understand the basics of energy with material and energy balance.

CO 2: Understand the role of ESCO and analyze the different financial options of investment.

CO 3: Understand details about Electrical Energy consumption, its uses, and its efficiency.

CO 4: Evaluate the performance of Compressed Air System and Heating, Ventilation & Air Conditioning (HVAC)

CO 5: Find out the energy saving opportunities in Pumps, Pumping System and Cooling Towers.

CO 6: Correlate the energy and its effect on environment.

Unit I:Energy Scenario: Basics of Energy and its various forms: Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Unit II: Financial Management: Investment-need, appraisal and criteria, financial analysis techniques-simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs). Energy Monitoring and Targeting: CUSU, Energy Management Information Systems.

Unit III : Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. Star operation, voltage unbalance, energy efficient motors, soft starters with energy saver, variable speed drives. Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues. Diesel/Natural gas Power Generating systems: Factors affecting selection, energy performance assessment of diesel conservation avenues. Waste heat recovery.

Unit IV : Compressed Air System and (HVAC): Types of air compressors, reciprocating screw, compressor efficiency, efficient compressor operation, Heating, ventilation, air conditioning and Refrigeration System: Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pressure drop calculation.

Unit V : Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Energy conservation in boiler feed water pump, pumping systems for municipal drinking water, and sewerage, agriculture pump sets. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.

Unit VI : Energy, Environment and Climate change: Energy and environment, air pollution, climate change United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM, Prototype Carbon Fund (PCF). Energy conservation in Buildings and Energy Conservation Building Codes(ECBC): About Energy Conservation Building Codes (ECBC), building envelope, insulation, lighting, Heating, ventilation, air conditioning (HVAC), fenestrations, water pumping, inverter and energy storage/captive generation, elevators and escalators, star labeling for existing buildings, Energy Service Companies based case studies.

Text Books:

1. Principles of Energy Conservation: Archie, W Culp McGraw Hill, 1991.
2. Energy Management: P. O'Callaghan McGraw - Hill Book Company, 1993.
3. Handbook of Energy Engineering: Thuman A and Mehta D Paul, the Fairmount Press.

Reference Books:

1. Handbook on Energy Audits and Management: Amit Kumar Tyagi:, TERI
2. Energy Efficient Buildings: Majumder Milli, TERI
3. Energy Management: Paul O'Callaghan, McGraw Hill
4. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.

VII Semester

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET401 **Course : Power System-II**

L: 4Hrs. T: 1 Hrs P:0 Hrs. Per week **Total Credits: 9**

Course Outcomes

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

CO1: Identify understand the difference between various types of faults in power system and analyze them.

CO2: Apply the knowledge for stable operation of power system and analyze its stability.

CO3: Understand the economical of power system.

CO4: Identify need of effective grounding in practice and understand the use of effective compensation in power system.

UNIT I:-Symmetrical Components:

Symmetrical Component transformation, Three phase power in unbalanced circuit in terms of symmetrical component, Sequence impedances of Generator, Transformer, Transmission line and Passive loads, Phase shift in Star/delta three phase transformer (Yd1, Yd11 connection).

UNIT II:-Symmetrical Fault:

Symmetrical fault analysis without and with pre-fault load currents, selection of circuit Breakers ratings, current limiting reactors.

UNIT III:-Unsymmetrical Faults:

Unsymmetrical fault Analysis – L-G, L-L-G, L-L, Open Conductors faults analysis using symmetrical components.

UNIT IV:-Stability of Power System:

Steady state, dynamic and transient stability definition. Dynamics of synchronous machine, swing equation, swing equation for machines swinging coherently and Non-Coherently, power angle equation, Steady state stability studies.

Transient stability studies: - Swing curve, Equal Area criterion for transient stability, Application of equal area criterion for different disturbances, Methods of improving transient stability.

UNIT V:-Economic operation of Power system:

Introduction, Distribution of load between units within the plant, Optimum generation scheduling with and without considering transmission losses, Representation of transmission loss using loss formula co-efficient, Derivation of loss formula co-efficient, simulation of co-ordination equation on digital computer. Preliminary concept of load dispatch centre.

UNIT VI:-Neutral Grounding and Compensation:

1. Grounding of Neutral in power system.
2. Shunt & series compensation - Generalized equation, shunt reactor, compensation of very long line with intermediate switching station, series capacitor compensation at line centre, shunt reactors at both ends and series capacitor in middle of line, Elementary idea of sub-synchronous resonance problem and counter measures.

Text Books:

1. Power System Analysis, J.J.Grainger and W.D.Stevenson Jr.,McGrawHil.
2. Modern Power System Analysis, ,I.J.Nagrath and D.P Kothari, McGraw Hill
3. Electrical Power Systems, C.LWadhaw, New Age International

Reference Books:

1. Extra High Voltage A.C. – Transmission Engineering, R.D. Begamudre, New Age International
2. Power System Analysis, Hadi Sadat, McGraw Hill

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET402 **Course: High Voltage Engineering**

L: 4Hrs.T: 1 Hrs. P:0 Hrs. Per week **Total Credits: 9**

Course Outcomes

Upon the completion of this course, student will be ble to understand

CO1: The breakdown mechanisms in insulation.

CO2: The over voltage phenomenon in power system and their protection.

CO3: The generation & measurement techniques of high voltage for testing purpose.

CO4: The non destructive and high voltage testing of electrical equipments.

UNIT 1:- Breakdown mechanism in Dielectrics:

Ionization processes in gaseous dielectrics, Townsend's criterion for break-down, break-down in electro-negative gases, timelag for break-down, Streamer theory of break-down in gases, Paschen's law, break-down in non-uniform fields, corona discharges and introduction of corona, post break-down phenomenon and applications, practical considerations in using gases for insulation purpose; break-down in vacuum; liquid as insulators, conduction and break-down in pure and commercial liquids; break-down in solid dielectrics; break-down in composite dielectrics.

UNIT 2:- Lightning and Switching over voltages:

Lightning mechanism, types of lightning strokes, parameter and characteristics of lightning strokes, protection of power system against lightning over voltages, types of lightning arresters, surge absorbers; types of switching over voltages and their causes, protection against switching over voltages; Insulation coordination, BIL and SIL.

UNIT 3:- Travelling waves:

Travelling waves on transmission lines, reflection and transmission of waves, behavior of travelling waves at transition points-typical cases, Bewley's lattice diagram.

UNIT 4:- Generation of high voltage and currents:

Generation of high D.C. voltage by rectifier, voltage doublers and multiplier circuit, Van-de-Graff generator; generation of high AC voltage by cascade transformers, resonant transformer; generation of high frequency AC high voltage; impulse waveform, generation of impulse voltage, tripping and control of impulse generator; generation of switching surges; generation of impulse current.

UNIT 5:- Measurement of high voltage and current:

Measurement of high AC and DC voltages by micro ammeter, generating voltmeters, resistance and capacitance potential divider, series impedance voltmeter, CVT, magnetic type potential transformers, electrostatic voltmeter, peak reading AC voltmeters, sphere gap arrangement; measurement of impulse voltage by potential dividers and peak reading voltmeters; measurement of high AC, DC and impulse currents :

UNIT 6:- Non-destructive and high voltage testing of electrical apparatus:

Non-destructive testing: Significance of non-destructive testing, measurement of DC resistivity, measurement of di-electric constant and loss-factor, partial discharge phenomenon and measurement, discharge detection in power cables.

High voltage testing: Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, lightning arresters and power capacitors.

Text Books:

1. High Voltage Engineering, M.S. Naidu & V. Kama Raju, Tata McGraw Hill Publication.
2. High Voltage Engineering, C. L. Wadhawa, New Age international (P) Ltd Publisher.
3. High Voltage Engineering, M.P. Chaurasiya, Khanna Publisher.

Reference Book:

Fundamentals of High Voltage Engineering, S.K. Singh, Dhanpatrai& Co.

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET403-1 **Course: Elective - II ; EHVAC & HVDC Transmission**

L: 3Hrs.T: 1 HrsP:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

On completion of this course, the students will be able to,

CO1: Calculate the power handling capacity and surface voltage gradient of EHVAC transmission system,

CO2: Understand the concept of AC to DC conversion and power flow control in HVDC transmission system.

CO3: Discuss the necessity of various components in the HVDC transmission system substation.

CO4: Discuss about the substation protection and insulation co-ordination schemes used in HVDC transmission system.

Unit 1:

Power Handling capacities of EHV AC transmission lines, Introduction to voltage gradient on EHV conductors, Electric field of point charge, sphere gap, line-charge, single and three phase lines, and bundled conductors. Maxwell's potential coefficients, Mangoldt Formula.

Unit 2:

Corona types, critical disruptive voltage, factors affecting corona, methods for reducing corona power loss, corona current wave form, charge voltage diagram, audible noise and radio interference.

Electrostatic and electromagnetic fields of EHV lines, Electric shock and Threshold current, Capacitance of long object, calculation of electrostatic field of A.C. Lines (3-ph. Single and double circuit lines only), Effect of high electrostatic field, measurement of electrostatic field, induced voltages in insulated ground wires, electromagnetic interference.

Unit 3:

Comparison of EHV AC and HVDC transmission systems, HVDC converter: Rectifier and Inverter, Kinds of DC link, Power flow control in HVDC system, Constant current, constant voltage, constant ignition and excitation angle control, control characteristics.

Unit 4:

Parallel operation of AC and DC links (Synchronous and Asynchronous links).

Earth electrode and earth returns: Introduction objectives, location and configuration, resistance of electrodes, means of reducing earth electrode resistance, troubles caused by earth current and remedies.

Multi-terminal HVDC system : Introduction, 2 pole transmission, MTDC system with series and parallel connected convertors, advantages and parallel connected converters, advantages and applications, configurations and types.

Unit 5:

Harmonic Filters: Introduction, Filters, surge capacitors and Damping circuits, shunt filters, series filters, AC filters, design of AC filters and tuned filers, double frequency and damped filters, cost considerations. DC Harmonic filters.

Reactive power compensation: - Reactive power requirements of HVDC convertors, substations, effect of Delay angle and extinction angle on reactive power.

Unit 6:

HVDC circuit breakers: Introduction, construction, principle, switching energy, interruption of DC current, application of MRTB, Types of HVDC C.B., capability and characteristics of HVDC circuit breakers.

Introduction to HVDC substation protection against short-circuits and over-voltages, Difference between insulation coordination of AC and DC systems, Surge-Arresters protection scheme, Insulation coordination and protection margin.

Text Books:

1. EHV AC Transmission Engineering. Rakosh Das Begamudre, 4th Edition, New Age International Pvt. Limited.
2. EHV-AC and HVDC Transmission and Distribution Engineering,S.Rao,Khanna Publications.
3. Electrical Power System, C.L. Wadhwa, 2ndEdition, New Age International Pvt. Limited.

Reference Book :

Extra High Voltage Engineering, Rakosh Das Gupta.

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET403-2 **Course : Elective - II ; Utilization of Electrical Energy**

L: 3Hrs.T: 1 Hrs. P:0 Hr. Per week **Total Credits: 7**

Course Outcomes

Upon the completion of this course,

CO1: The students should be able to understand the process and application of different types Electric Heating and Welding equipments.

CO2: Students should be able to understand basics of illumination and working principles of different light sources.

CO3: The students shall be able to apply the fundamentals of illumination systems for lighting design for indoor/ outdoor installations for residential/ commercial and industrial applications.

CO4: The students should be able to understand the working principles and applications for various electrolytic processes for industrial applications.

CO5: The students should be able to select proper rating of DG sets, know the operational factors and adopt various energy saving techniques for its efficient use.

Unit I: Electric Heating :

I) Electric Heating: Types and methods of electrical heating, advantages of electrically produced heat, types & application of electric heating equipment, transfer of heat.

ii) Resistance Ovens: General constructions, design of heating elements, efficiency & losses, radiant heating.

iii) Induction heating: Core type & core less induction furnace, indirect induction oven, high frequency eddy - current heating.

iv) Dielectric heating: Principle and application.

v) Arc furnace: Direct & indirect arc furnace, power supply, characteristics & control.

Unit II: Electric Welding :

I) Importance, Advantages & Disadvantages of welding, classification of welding processes.

ii) Resistance welding, Butt welding, Spot welding, Projection welding, Seam welding.

iii) Electric arc welding: Carbon arc welding, metal arc welding, submerged arc welding.

iv) Ultrasonic welding, electron beam welding, laser beam welding.

Unit III: Illumination Fundamentals:

Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, construction & operation of light sources (Incandescent, Fluorescent Tube, Sodium Vapor Lamp, Mercury Vapor Lamp, Neon tube).

Unit IV : Designing of Lighting Systems:

Lux level requirements for various applications, classification of light fittings and luminaires, factors affecting the design of indoor lighting installations, total lumen method of calculation, Lighting design for indoor applications, Outdoor lighting system design for street lighting and flood lighting.

Unit V : Electrolytic Processes:

Fundamental principles, laws of electrolysis, Extraction & Refining of metals, Electro-deposition, Electro plating, Anodizing, manufacture of chemicals, Power supply for electrolytic processes.

Unit VI :

Diesel Generating Systems: Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets.

Text Books :

1. Utilization of Electric Energy,E. Openshaw Taylor, Orient Longman.
2. Utilization of Electric Power & Electric Traction, J.B. Gupta, Kataria& Sons.
3. Art and Science of Utilization of Electrical Energy,HPartap, DhanpatRai& Sons, Delhi

Reference Book :

Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET403-3 **Course: Elective - II; Advanced Control System**

L: 3Hrs T: 1 Hrs P:0 Hrs. Per week **Total Credits: 7**

Course Outcomes

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

CO1: Analyze continuous time system using state space technique and investigate controllability and observability of the system.

CO2: Use Optimal Control theory to solve variety of control system problems.

CO3: Able to differentiate between Analog and Digital PID Controller.

CO4: Analyze Digital Control System & investigate its stability.

CO5: Understand nonlinear systems and evaluate the stability of nonlinear systems.

UNIT I :

Design by state variable feedback : Review of state variable representation. Solution of state equation. Controllability and Observability. Design of SVF

UNIT II:

Optimal Control System: Performance Index(PI), Desirability of single P.I., Integral square error. Parameter Optimization with & without constraints. Optimal control problem with T.F. approach for continuous time system only.

UNIT III:

Controller Tuning: Review of analog PID controller, PID tuning methods in process control (Ziegler-Nichols tuning method) ,digital PID controllers.

UNIT IV:

Digital Control System : Representation of Sample Data Control System (SDCS). Sample & Hold Circuit. Z – Transform. Inverse Z- Transform & solution of difference equation. Z & S domain relationship.

UNIT V:

Stability by bilinear transformation & Jury's test. Comparison of time response of continuous and digital control system, Effect of sampling period on transient response characteristic Discretization of continuous time state equation. Solution of Discrete time state equations. Controllability & Observability of Discrete time systems.

UNIT VI:

Introduction to Non Linear Control System(NLCS): Types of non-linearities, characteristics of NLCS, Describing function method for analysis, Stability analysis, Limit cycle and its stability. Difference between describing function and phase plane method for analysis of NLCS.

Text Books:

1 Control System Analysis, Nagrath & Gopal.
2 Linear System Analysis, D'Azzo & Houpis.
3 Modern Control Engineering, Ogata.

Reference Books:

1 Control Systems: Principles and Design, M. Gopal.
2 Digital Control and State Variable Methods, M.Gopal

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET404 **Course: Power Semiconductor Based Drives**

L: 3Hrs T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes

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

CO 1 : Draw the complete block schematic diagram of an electric drive system, know the functions of each component, understand the importance of automation in an industry, the speed-torque characteristics of typical load in industry, the operating point of motor load system, stability and dynamics of drive system.

CO 2 : Understand the concept of operation of D.C. motor in all the four quadrants of tarque - speed plane and understand the concept of regenerative braking mechanism.

CO 3 : Select proper power electronic converter to control speed of D.C. motor, 3 phase Induction motor, Synchronous motor and select controlling parameter depending on the application of motor.

CO 4 : Understand the use of solar power for giving supply to special purpose motors and their operating mechanisms.

CO 5 : Compare the electric and non electric traction system with conventional methods of operation of traction system, understand the latest mechanisms used in electric traction using power semiconductor switches.

UNIT I:

Dynamics of electric drives and control of electric drives, energy conservation in electric drives.

UNIT II:

D.C. Motor drives, controlled rectifier fed D.C. Drives, single phase and three phase rectifier control of D.C. separately excited motor.

Dual converter control of D.C. separately excited motor. Power factor supply harmonics and ripple in motor current. Chopper controlled DC drives of separately excited DC motor chopper control of series motor, source current harmonics.

UNIT III:

Induction motor drives, stator voltage control, variable frequency control using voltage source inverter, current source inverter & cycloconverter.

UNIT IV:

Synchronous Motor Drives, starting, braking of synchronous motor, variable frequency control, self controlled synchronous motor drive employing load commutated Thyristor inverter or cycloconverter, starting of large synchronous motors.

UNIT V:

Brushless DC motor, stepper motor, switched reluctance motor drives and eddy current drives. Introduction to solar and battery powered drives.

UNIT VI:

Traction drives, Conventional D.C. and A.C. traction drives, semiconductors converter controlled Drives, 25KV AC Traction using semiconductor converter controlled DC Motor. DC Traction using semiconductor, chopper controlled DC motors, Poly Phase AC motors for traction drives

TEXT BOOKS:

1. Fundamentals of electric drives, G. K. Dubey.
2. Modern Electric Traction, H. Pratap.
3. Electric drives concepts and applications, V. Subramanan.

REFERENCE BOOKS :

1. Electrical Drives, Jon Boldea, N.A. Nasar
2. Electrical Drives Control, R. Krishnan

Syllabus of Semester VII, B.E. Electrical Engineering

Course Code: EET405 **Course: Switch Gear and Protection**

L:4Hrs T: 1 Hrs P:0 Hrs. Per week **Total Credits: 9**

Course Outcomes:

On completion of this course the student will able to,

CO1: Describe the principle and operation of relays and protective relaying.

CO2: Select and apply protective relays for protection of overhead lines and busbars.

CO3: Select and apply protective relays for protection of power transformers

CO4: Select and apply protective relays for protection of alternators and motors

CO5: Describe the methods of arc interruption, principle of operation of circuit breakers and their applications.

Unit 1:- General Philosophy of Protective Relaying :

Faults & their classification, Protective Zones, Primary Protection, Back up protection, Remote and Local Back up, Selectivity, characteristics of CT & PTs for protection.

Unit2 :- Medium Voltage Line Protection :

Over current relaying, directional over current relays, limitations of overcurrent relaying.

Unit3:- High Voltage Line Protection :

Distance relays, carrier distance schemes, Unit carrier schemes.

Unit4 :- Equipment Protection :

Principles of differential relaying, protection of generator, transformers and busbars by differential relaying and other relays.

Protection of Induction Motors against overloads, short circuits, thermal relays, miniature circuit breakers.

Unit5 :- Introduction to Static Relays :

Comparison of static and electro mechanical relays, two input amplitude and phase comparators and their duality, Generation of various distance relay characteristics using above comparators. Introduction to numerical relays.

Unit6 :- Switchgear :

Circuit breakers, Arc interruption theory, recovery and re-striking voltages, RRRV, breaking of inductive and capacitive currents, C.B. ratings, different media of arc interruption, overview of oil circuit breakers, construction and operation of Air blast, SF6 and vacuum breakers.

Text Books:

1. Art & Science of Protective Relaying, Mason.
2. Protective Relaying, Vol. I & II, Warrington.
3. Fundamentals of Power System Protection, Y. G. Paithankar, S. R. Bhide, PHI

Reference Books:

1. Switchgear and Protection, Ravindranath and Chander; New Age Int Publishers.
2. Power System Protection and Switchgear B. Ram, D.N. Vishwakarma, TMG.

VIII Semester

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET407 **Course: Electrical Installation Design & Practices**

L: 3Hrs. T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes

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

CO 1: Assess the electrical load and select the conductors suitable to carry the load currents.

CO 2: Calculate short circuit currents at different locations and select proper switchgear.

CO 3: Design and select suitable components of starters for induction motors, understand its operation and select capacitors for reactive power management.

CO 4: Design and understand procedures for installation, testing and commissioning practices for various components of transformer substation suitable for 11 and 33 k V installations.

CO 5: Design the electrical systems for residential, commercial and industrial establishments.

Unit 1:

Electrical load assessment: Concept of electrical load, categories of load, types of loads, connected load, demand factor, Maximum demand, diversity factor, load factor, power factor, TOD Tariff, Industrial Electric Bills, regression Analysis for Load Forecasting.

Cables, conductors &bus-bars:

Construction, selection, installation, testing of LT/ HT cables, overload & short circuit ratings, rating factors; Overhead line conductors.

Unit 2:

Symmetrical Short Circuit Calculations:

Determining symmetrical short circuit currents at various locations for selecting proper circuit breaker rating & determining value of series reactors for limiting short circuit current. Overcurrent protection with two phase fault & one ground fault relays.

Switching & protection devices: Types, specifications; selections of isolators, switches, switch fuse units, MCB, MCCB, ACB, VCB, SF6 breakers, dropout/ horn gap fuses, AB switches, contactors for voltages up to 33 kV. Various types of protective releases for above circuit breakers.

Unit 3:

Electric supply to Induction Motors in industries: Types of motors, SLD and working of DOL/ Star-Delta/ Autotransformer starters; types, specifications, selection of power contactors, Overload relays, short circuit protective devices.

Reactive power management in industries:

Reactive power compensation in industries using static capacitors, use of Power Triangle, Calculating payback period for reduced system currents.

Unit 4:

Transformers: Specifications, ratings, selection, installation, testing & commissioning.

Substations: 11kV & 33 kV, indoor/ outdoor substations, plan/ elevations.

Unit 5:

Design of Industrial Electrical Installations: Preparing load list, assessing various factors associated with loads, selection of transformer, design of PCC & MCC, selection of all the associated electrical apparatus, busbars, cables, switchgear, protective devices, earthing system, testing, commissioning.

Illumination:

Design definitions, polar curves, and simple calculations, working principles of fluorescent, sodium vapor and mercury vapors lamps.

Unit 6:

Earthing (IS 3043): Necessity of earthing, concept of system & equipment earthing, definitions of various terms, types of earthing, earth tester and measurement of earth resistance.

IE Rules:

Important IE Rules applicable to residential, commercial & industrial installations.

Note : The scope of this subject shall cover installations up to 33 kV.

Text Books:

1. Electric Power Distribution, A. S. Pabla
2. Design of Electrical Installations, V. K. Jain, Amitabh Bajaj
3. Electrical Systems Design Data Handbook, M. K. Giridharan

Reference Book:

1. Indian Electricity Rules, Latest Edition
2. IS 3043, Code of Practice for Earthing.
3. Manufacturers' Catalogues & technical write-ups on their websites.

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET408 **Course: Computer Applications in Power Systems**

L: 4Hrs. T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 9**

Course Outcomes

Upon the completion of this course, students will be able to,

CO 1: Describe the Graph theory and Form single phase Incidence and Network Matrices.

CO 2: Form Bus Impedance and Bus Admittance Matrices using Algorithm and steps for simulating the construction of Network by adding one element at a time.

CO 3: Describe three phase representation of networks, transformation Matrix, symmetrical components along with formation of Incidence matrices and to form only three phase Bus Incidence Matrix using algorithm.

CO 4: Determine power flows and system voltages during normal and emergency conditions, draw flow charts and elementary programming for Numerical solution to linear and non linear algebraic equations.

CO 5: Analyze symmetrical / unsymmetrical faults for a chosen power system Network at any location Construct flow charts and write elementary programming for achieving this task.

CO 6: Obtain the solution of swing equation / differential equations employed in Transient stability studies.

UNIT I :

Incidence and Network Matrices: Graph Theory, Incidence Matrices, Primitive network, formation of network matrices by Singular transformations.

UNIT-II :

Algorithm for formation of Bus Impedance and Bus Admittance matrix for system without mutual coupling.

UNIT – III:

Three Phase Networks: - Three phase balance network elements with balanced and unbalanced excitation. Incidence and network matrices for three phase element. Algorithm for formation of three phase bus impedance matrices without mutual coupling.

UNIT – IV:

Load Flow Studies :- Power system load flow equations, solution technique :- Gauss Seidel, Newton Raphson and fast decoupled technique with and without voltage control buses. Elementary flow charts and programs for Load flow analysis.

UNIT – V:

Short circuit studies :- Three phase network short circuit calculations using bus impendence matrix for balanced and unbalanced faults. Computer program for short circuit studies on simple system.

UNIT – VI :

Transient Stability Studies:-

Modeling of synchronous machine, power system network for transient stability studies, Numerical solution of swing equation using Modified Euler and Rungekutta 4th order method. Elementary flow charts for the transient stability study.

Text Books:

1. Computer method in power system analysis, Stag and El-Abiad. McGraw Hill.
2. Electric Energy System Theory and introduction, Oile I. Elgard.
3. Elements of power system analysis, William D. Stevenson.

Reference Book :

Computer Analysis of Power system, R.N. Dhar

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET409-1 **Course: Elective - III; Embedded Systems**

L: 3Hrs. T: 1HrsP: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes :

On completion of this course, students will be able to,

CO1. : Differenciate between different architecture, language and instruction set of different processors.

CO2 : Apply the knowledge for interfacing with devices/ports.

CO3 : Use different software tools for real time operating system.

Unit – I Introduction to Embedded System

Introduction to functional building blocks of embedded systems – Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories.

Unit – II Risc Processor Architecture & Instruction Set

Structural units in a processor; selection of processor & memory devices; shared memory; DMA; interfacing processor, memory and I/O units; memory management – Cache mapping techniques, dynamic allocation - Fragmentation.

CASE STUDY: Required Memory devices for an Automatic Washing machine, Chocolate vending machine and for a Digital Camera and Voice recorder.

Unit - III Peripheral & Network Components

I/O devices; timer & counting devices; serial communication using I2C, CAN, USB buses; parallel communication using ISA, PCI, PCI/X buses, arm bus; interfacing with devices/ports, device drivers in a system – Introduction.

Unit - IV Embedded Software Architecture

I/O instruction – Transfer rate, latency; interrupt driven I/O - Non-maskable interrupts; software interrupts, writing interrupt service routine in C & assembly languages; preventing interrupt overrun; disability interrupts. Multi threaded programming – Context switching, premature & non-premature multitasking, semaphores. Scheduling – Thread states, pending threads, context switching, round robin scheduling, priority based scheduling, assigning priorities, deadlock, watch dog timers.

Unit - V Real Time Operating System (RTOS)

Introduction to basic concepts of RTOS, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools.

Text Books

1. Embedded System – Architecture, Programming, Design,P. Rajkamal, Tata McGraw Hill,2003.
2. Fundamentals of Embedded Software,Daniel W. Lewis 'Prentice Hall of India, 2004.
3. Embedded System Design – A Unified Hardware & Software Introduction, Frank Vahid, John Wiley, 2002.

Reference Books

1. Embedded Real Time Systems Programming,Sriram V. Iyer, Pankaj Gupte, Tata McGraw Hill, 2004.
2. Embedded System Design,Steve Heath, 2nd Edition, Elsevier, 2003.

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET409-2 **Course: Elective - III; Power Quality**

L: 3Hrs. T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes

On completion of this course, the students will be able to,

CO 1: Identify the various power quality events like short and long duration variations, Waveform distortion, Unbalance, Transients, Power factor etc.

CO 2 : Discuss about the sources causing the power quality issues.

CO 3 : Suggest suitable mitigation strategies for some of the power quality issues.

CO 4 : Discuss about the equipments for measurement of power quality events.

Unit 1

Introduction to Electric Power Quality, Power Quality standards, Different Power Quality terms and definitions.

Unit 2

Voltage Sag and Interruptions, Sources of Voltage sag and interruptions, type and characteristics of voltage sag and interruptions, Factors affecting characteristics of voltage sag and interruptions, behavior of different equipments during voltage sag, concept of area of vulnerability, CBEMA and ITI Curves .

Unit 3

Voltage Swell and transient overvoltage, sources of overvoltage like capacitor switching, load switching, lighting etc, various causes of voltage flicker and their effects. Short term and long term flickers, various means to reduce flickers, Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

Unit 4

Harmonic distortions, voltage and current harmonics, THD, sources of harmonics, ill effects of harmonics, interharmonics, harmonics filters, IEEE 519-1992 definitions, reactive power under harmonics, K-rated transformer.

Unit 5

Voltage Unbalance, Impact on equipment performance, other power quality related issues like EMI, noise, notching, DC offset , Typical wiring and grounding problems causing poor power quality, solution to wiring and grounding problems.

Unit 6

Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring, Mitigation techniques at different environments.

Text Books:

1. Electrical power system quality – R. C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty, Second edition, McGraw Hill.
2. Understanding power quality problems, voltage sag and interruptions - M. H.J. Bollen, IEEE press, 2000, series on power engineering.
3. Power Quality by C.Sankaran, CRC Press

Reference Books / Reading Material :

1. IEEE std 519-1992/ IEEE std 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.
2. Power system quality assessment - J. Arrillaga, M.R. Watson, S. Chan, John Wiley and sons.

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET409-3 **Course: Elective - III Fuzzy Logic and Neural Networks**

L: 3Hrs. T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes:

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

CO 1: Apply the fuzzy logic concept to engineering applications.

CO 2: Apply the neural network concept to engineering applications.

Unit 1. Introduction of Fuzzy Logic: Introduction of artificial intelligence, fuzzy logic concept, fuzzy v/s crisp set, properties of fuzzy sets, linguistic variables, operation of fuzzy sets.

Unit 2. Fuzzy Logic Model: Introduction, membership functions, fuzzy if-then rules, fuzzy inference, defuzzyfication.

Unit 3. Fuzzy Logic Applications: Fuzzy knowledge based systems, fuzzy logic in engineering applications.

Neural Network

Unit 4. Introduction of Neural Networks: Introduction of biological and artificial neuron, artificial neural model and network architecture, learning strategies (supervised, unsupervised, reinforced), learning rules.

Unit 5. Types of Neural Networks: Single layer feed-forward neural network, Multi layer feed forward neural network, associative memory.

Unit 6. Neural Network Applications: Neural network in engineering applications.

Text Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms by S. Rajsekaran and G. A. Vijayalaxmi.
2. An Introduction to Fuzzy Control by D. Draiankov.
3. Fuzzy Sets and Fuzzy Logic: Theory and Application by George D. Klir and Bo Yan

Reference Books :

1. Neural Network and Fuzzy System by Bart Kosko.
2. Neural Network design by Hagan, Demuth and Beale.
3. First Course on Fuzzy Theory and Applications by K. H. Lee

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET410-1 **Course: Elective - IV; Flexible AC Transmission Systems**

L: 3Hrs. T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 7**

Course Outcome

Upon the completion of this course, students will be able to

CO 1: Understand the effect of reactive power flow on performance of transmission line and types of FACTS controllers.

CO 2: Understand the application of converter for FACTS devices.

CO 3: Understand the application of FACTS controller.

UNIT I :

FACTS Concept & general system consideration: Transmission inter connection, flow of power in an AC system, Factor affecting the loading capability, Power flow & dynamic stability consideration of transmission inter connection. Importance of controllable parameters, FACTS controller.

UNIT II :

Voltage sourced & current sourced converters : Basic concept of voltage sourced converters , single phase full wave bridge converter operation, single phase leg operation, square wave voltage harmonics for single phase bridge, three phase full wave bridge converter, sequence of valve conduction process in each phase leg, transformer connection for 12 pulse operation, three level voltage sourced converter, pulse width modulation converter, generalize technique of harmonic elimination & voltage control, basic concepts of current sourced converter, Thyristor based converters (with gate turn on), current source converter with turn off devices. Current source verses voltage source converter.

UNIT III :

Static Shunt Compensators: SVC and STATCOM,

Objectives of shunt Compensation, Methods of Controllable Var Generation, Static Var Compensators SVC and STATCOM, Comparison between STATCOM and SVC, Static VAR System

UNIT IV :

Static Series Compensators: GCSC, TSSC, TCSC and SSSC

Objectives of series Compensation, Variable Impedance, Type Series Compensators, Switching Converter Type, Series Compensators, External (System) Control for Series Reactive Compensators.

UNIT V :

Static Voltage and Phase Angle Regulators: TCVR and TCPAR

Objectives of Voltage and Phase Angle Regulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators (TCVR and TCPARS) Switching Converter – Based Voltage and Phase Angle Regulators, Hybrid Phase Angle Regulators.

UNIT VI :

Combine Compensators (UPFC, IPFC) and Special Purpose FACTS Controllers

The Unified Power Flow Controller (UPFC), Interline Power Flow Controllers Generalized and Multifunctional FACTS Controllers, Sub synchronous Resonance, NGH-SSR Damping Scheme, Thyristor-Controlled Braking Resistor (TCBR)

Text Book :

Understanding FACTS, Naryan G. Hingorani and Laszlo Gyigyi (Standard Publishers).

Reference Books :

1. Flexible AC Transmission System (FACTS)'Yong Hua Song and Johns (IEEE Publishers).
2. Thyristor Based FACTS controllers for Electrical Transmission SystembyR.MohanMathur and Rajiv K. Verma (IEEE Press)

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET410-2 **Course : Elective - IV Digital Signal Processing**

L: 3Hrs. T: 1 Hrs. P: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes:

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

CO1: Differentiate between different types of signals and systems.

CO2: Find the Fourier transform of a given discrete signal.

CO3: Apply the z transform to a given system.

CO4: Represent and design IIR & FIR filters

CO5: Find the DFT and FFT of a given signal

Unit 1:

Discrete time signals & systems: Linearity, causality, stability,static dynamic, Time Invariance Time variance, classification of discrete time systems, convolution, cross correlation, Autocorrelation, sampling theorem & sampling process, Reconstruction of sampling data.

Unit 2:

Frequency domain representation of discrete time signals and systems, Fourier transform of discrete time signals, properties of discrete time Fourier transform.

Unit 3:

The Z - transform: Definition, Properties of the region of convergence for the Z- transform, Z – transform properties, Inverse Z - transform using contour integration, complex convolution theorem, unilateral Z - transform.

Unit 4:

Transform analysis of LTI system & structures for discrete - time system: Frequency response of LTI system, relationship between magnitude & phase, all pass system, minimum phase system, linear system with generalized linear phase. Block diagram representation & signal flow graph representation of linear constant Coefficient difference equations, basic structures for IIR systems, transposed forms, basic network structures for FIR systems, lattice structures.

Unit 5:

Filter design techniques: Design of discrete time IIR filters from continuous time filters. Frequency transformations of low pass IIR filters.

Design of FIR filters by windowing technique and Frequency sampling method.

Unit 6:

Discrete Fourier Transform: Discrete Fourier series, properties of discrete Fourier series discrete Fourier transform, properties of DFT, circular convolution using discrete Fourier transform. Decimation in time FFT algorithm, decimation in frequency FFT, FFT of long sequences using overlap add & overlap save method.

Text Books:

1. Digital Signal Processing, 2nd Edition, S Salivahanan, A Vallavaraj, Mc. Graw Hill Publication.
2. Discrete time signal processing,2 Edition, Alan V. Oppenheim, Ronald W. Schafer &Buch Pearson.
3. Digital Signal Processing –C & DSP Processors Assembly Programming,N.G.Palan, Tech Max Publication

Reference Books:

Digital signal processing Theory &Applications, 3rd Edition Prows and Manolakis, PHI Ltd.

Syllabus of Semester VIII, B.E. Electrical Engineering

Course Code: EET410-3 **Course: Elective - IV; EHV Substation Design & Erection**

L: 3Hrs. T: 1 Hrs P: 0 Hrs. Per week **Total Credits: 7**

Course Outcomes:

Upon the completion of the course, Student will be able to :

CO1 : Understand category and utility of substation on the basics of different parameter

CO2 : Classify the substation and the basics of different parameter and understand the important of different components in substation.

CO3 : Design by basic substation layout and the substation placement of the basic of inputs.

CO4 : Understand system procedure of different equipment in substation weight approximate intimation.

Unit – I Electrical substation – General concept as referred to function, layout, voltage levels, types of substations, features and necessity, Concept of EHV-AC and HVDC substation. Single line diagram.

Unit _II – Introduction to EHV substation equipments like Bus bars, circuit breakers, power transformers CT & PTs, Isolators and earth switches, lightening arrestors.

Unit-III – Classification of substation on basis of configuration, Indoor and Outdoor, Application. General specifications of substation. Bus bar system, bays and layout of EHV substation.

Unit-IV – Principle of substation design, Terms and definitions, Stresses on equipments , all clearances, maintenance zones, all type of substation structures, Dimensions of structures, preparation of layout drawing using Autocad or other tools.

Unit-V – Design concepts of substation bus bar system, material for bus bar, current carrying Capacity, Insulation requirements, clearance. Different insulators used in substation, Design aspects of substation earthing system.

Unit-VI – Auxiliary supplies required in substation, Basic concept of protection, control and automation in EHV substations, concept of power line carrier communication, planning for installation, commissioning and testing of all equipments in EHV substation, Estimation of substation and agencies for providing the finance for erecting substation, technical and commercial feasibility.

Text Book:-

Electrical Substation Engineering and Practice, S. R. Rao, Khanna Publisher.

References:

1. Electrical Transmission &Distribution Ref. book by Westinghouse, USA.
2. Technical literature, Papers, Installation Manuals, ABB, Siemens, etc.

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR

Ramdeobaba Tekadi, Gittikhadan, Nagpur - 440013
Ph. : 0712-22580011 / Fax : 0712-2583237
Website : www.rknec.edu

Shri Ramdeobaba Temple on Campus

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