Curricula of B.E. Degree for 3rd – 8th Semesters in Electrical Engineering (EE)

Semester-III

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	M 301	Engineering Mathematics-III	3	1	0	3	100
2	EE 301	Circuit Theory and Networks	3	1	0	3	100
3	EE 302	Electromagnetics and Electrical Fields	3	1	0	3	100
4	EE 303	Electrical Measurements	3	1	0	3	100
5	ECE 321	Analog Electronics and Circuits	3	0	0	2	100
6	ME 301	Basic Engineering Thermodynamics and Fluid Mechanics	3	0	0	2	100
7	HS 301	Values and Ethics (Non-credit)*	3	0	0	0	100
Practical/Sessional Papers							
8	EE 351	Circuit Theory and Networks Laboratory	0	0	3	2	100
9	EE 352	Electrical Measurements Laboratory	0	0	3	2	100
10	ECE 371	Analog Electronics and Circuits Laboratory	0	0	3	2	100
11	HS 381	Group Discussion and Personality Development	0	0	3	2	100
		Sub-total	**21**	**4**	**12**	**24**	**1000**
		Total	**37**			**24**	**1000**

*** Marks for this paper will not be reflected in total marks for the semester**

Semester-IV

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	M 402	Numerical Methods & Optimization Techniques	3	1	0	3	100
2	EE 401	Electrical Machines-I	3	1	0	3	100
3	EE 402	Power Systems-I	3	1	0	3	100
4	ME 401	Heat Power and Hydraulics Engineering	3	0	0	2	100
5	ECE 421	Digital Electronics and Circuits	3	1	0	3	100
6	ECE 423	Fundamentals of Signals and Systems	3	0	0	2	100
7	PH 402	Electrical Engineering Materials	3	0	0	2	100
Practical/Sessional Papers							
8	EE 451	Electrical Machines-I Laboratory	0	0	3	2	100
9	EE 452	Power Systems-I Laboratory	0	0	3	2	100
10	ECE 471	Digital Electronics and Circuits Laboratory	0	0	3	2	100
		Sub-total	**21**	**4**	**12**	**24**	**1000**
		Total	**37**			**24**	**1000**

Semester-V

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	EE 501	Electrical Machines-II	3	1	0	3	100
2	EE 502	Power Systems-II	3	1	0	3	100
3	EE 503	Power Electronics Devices and Applications	3	1	0	3	100
4	EE 504	Control Systems-I	3	1	0	3	100
5	AEIE 521	Electrical and Electronics Instrumentation	3	1	0	3	100
6	ECE 522	Principles of Communication Engineering	3	0	0	2	100
Practical/Sessional Papers							
7	EE 551	Electrical Machines-II Laboratory	0	0	3	2	100
8	EE 552	Power Systems-II Laboratory	0	0	3	2	100
9	EE 553	Power Electronics Laboratory	0	0	3	2	100
10	EE 554	Control Systems-I Laboratory	0	0	3	2	100
		Sub-total	**18**	**5**	**12**	**25**	**1000**
		Total	**35**			**25**	**1000**

Semester-VI

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	EE 601	Electrical Machines-III	3	1	0	3	100
2	EE 602	Power Systems-III	3	1	0	3	100
3	EE 603	Control Systems-II	3	1	0	3	100
4	ECE 621	Microprocessors and Microcontrollers	3	1	0	3	100
5	ECE 623	Advanced Signal Processing	3	1	0	3	100
6	HS 601	Industrial Management and Entrepreneurship	3	0	0	2	100
Practical/Sessional Papers							
7	EE 651	Electrical Machines-III Laboratory	0	0	3	2	100
8	EE 652	Power Systems-III Laboratory	0	0	3	2	100
9	EE 653	Control Systems-II Laboratory	0	0	3	2	100
10	ECE 671	Microprocessors and Microcontrollers Laboratory	0	0	3	2	100
		Sub-total	**18**	**5**	**12**	**25**	**1000**
		Total	**35**			**25**	**1000**

Semester-VII

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	EE 701	Electrical Drives	3	1	0	3	100
2	EE 702	High Voltage Engineering	3	1	0	3	100
3	EE 703	Power Station Practice	3	1	0	3	100
4	AEIE 721	Process Instrumentation and Control	3	0	0	2	100
5	Refer Appendix-I	Elective-I	3	1	0	3	100
Practical/Sessional Papers							
6	EE 751	Electrical Drives Laboratory	0	0	3	2	100
7	EE 781	Electrical Machine Design-I	0	0	3	2	100
8	ECE 771	Digital Signal Processing Laboratory	0	0	3	2	100
9	EE 791	Project-I	0	0	3	4	100
10	EE 792	Seminar-I	0	0	3	2	100
		Sub-total	**15**	**4**	**15**	**26**	**1000**
		Total	**34**			**26**	**1000**

Semester-VIII

Sl. No	Paper Code	Paper Name	Periods/Week			Credits	Full Marks
			L	T	P		
Theoretical Papers							
1	EE 801	Utilization of Electrical Power	3	1	0	3	100
2	EE 802	Power System Operation and Control	3	1	0	3	100
3	**Refer to Appendix-II**	Elective-II	3	1	0	3	100
4	**Refer to Appendix-III**	Elective-III	3	1	0	3	100
Practical/Sessional Papers							
5	EE 881	Electrical Machine Design-II	0	0	3	2	100
6	EE 891	Project-II	0	0	6	6	100
7	EE 892	Seminar-II	0	0	3	2	100
8	EE 893	Grand Viva	0	0	0	3	100
		Sub Total	**12**	**4**	**12**	**25**	**800**
		Total	**28**			**25**	**800**

Appendix-I
Elective-I (EE 7th Semester)
List of Electives

Sl. No	Paper code	Name of the paper
1	EE 711(a)	Optimal Control
2	EE 711(b)	Special Electrical Machines and Drives
3	EE 711(c)	Advanced Instrumentation-I
4	EE 711(d)	Advanced Power System Analysis
5	EE 711(e)	Illumination Engineering-I
6	M 711(e)	Advanced Optimization Techniques
7	ECE 711(e)	Embedded Systems and It's Applications
8	ECE 711(f)	Photonics and Optoelectronics

Appendix-II
Elective-II (EE 8th Semester)
List of Electives

Sl. No	Paper code	Name of the paper
1	EE 811(a)	Electrical Machine Modeling and Analysis
2	EE 811(b)	Advanced Instrumentation-II
3	EE 811(c)	Energy Audit and Management
4	EE 811(d)	Illumination Engineering-II
5	EE 811(e)	Advanced Topics in Power Systems
6	CSE 811(g)	Soft Computing
7	M 811(e)	Mathematical Modelling and Stochastic Processes

Appendix-III
Elective-III (EE 8th Semester)
List of Electives

Sl. No	Paper code	Name of the paper
1	EE 812(a)	Advanced High Voltage Engineering
2	EE 812(b)	Robust Parametric Control
3	EE 812(c)	Non-conventional Energy Systems
4	EE 812(d)	Process Automation and Robotics
5	EE 812(e)	Advanced Power Electronics
6	M 812(a)	Introduction to System Biology
7	IT 812(a)	Introduction to Robotics

Semester-III

Paper Name : Engineering Mathematics-III
Paper Code : M-301
Weekly Load : L: 3 T: 1 P: 0
Credit Unit : 03
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Complex Analysis:** Complex Variable functions; Limit, Continuity, Differentiability and analyticity of functions of a complex variable, Cauchy-Riemann Equations, Laplace Equation, Harmonic function, Mobius transformation, Cauchy's integral Theorem, Cauchy's integral formula, Power series, Taylor's series, Liouville's Theory, Laurent's series, Zeros and singularities, Calculus of residues, Contour integration.	**15L+5T**
2	**Probability:** Conditional probability, multiplication rule, independence, total probability, Bayes' theorem, applications. Random variables: Definition, Discrete and continuous random variable, probability mass function and probability density function, expectation and variance Some special distributions: Uniform, Exponential, Hypergeometric, Binomial, Poisson and Normal distribution. Joint distribution: Joint, Marginal and conditional distributions, Covariance, Correlation, Independence of random variables.	**12L+4T**
3	**Statistics:** Regression: Least square method, linear fitting, parabolic curve fitting, goodness of fit. Sampling distribution: Central limit theorem, distribution of sample mean and sample variance for a normal population, Chi-square, t and F distribution.	**6L+2T**
4	**Estimation:** Consistent and unbiased estimate, Maximum likelihood estimation, Applications. Confidence intervals: Confidence intervals for the means and variances of different distributions. Testing of Hypotheses: Null and alternative hypotheses, Critical and acceptance region, Type-I and Type-II error, power of the test, Neymann-Pearson lemma, Applications in population.	**9L+3T**
	Total:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. Probability, Statistics and Random Processes-T.Veerarajan, Tata McGrawHill, 2002
2. Stochastic Processes-J. Medhi, Wiley, 1994
3. Theory of Functions of a complex variable- Shanti Narayan, P.K. Mittal, S.Chand Publishing & Company
4. Complex Variables-Spiegel, McGrawHill

Paper Name : Circuit Theory and Networks
Paper Code : EE-301
Weekly Load : L: 03 T: 01 P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**Introduction to networks and signals:** Networks-circuits-systems: definitions , ,classifications: active and passive, instantaneous and dynamic , fixed & time varying, linear and nonlinear, lumped and distributed, causal and non-causal systems, continuous and discrete systems, Test signals: doublet, impulse, step, ramp, parabolic, cubic, exponential and sinusoidal, signum function, Pulse signal, Waveform synthesis: Square wave, Triangular wave, Saw-tooth signals etc., Independent and dependent sources. **Fourier series and its applications:** Fourier series , Application in circuit analysis, odd and even signals, half and quarter wave symmetry, solution of problems **Coupled circuits:** Magnetic coupling, polarity of coils, polarity of induced voltage, concept of self and mutual inductance, coefficient of coupling, Modeling of coupled circuits, Solution of problems. Coupled circuit's use of transformer for the purpose of impedance matching. **Graph theory and Networks topology:** Concept of tree, co-tree, branch, twigs, links, loop and mesh, Planar and non-planar graph, Incidence matrix, Tie-set matrix, Cut set matrix. Duality, Network equilibrium equations using KVL and KCL, Solution of problems.	12L+3T
2	**Laplace Transform and its applications:** --Definition, Concept of complex frequency, transform of standard periodic and non-periodic waveforms. Independent and dependent sources and equivalence of sources. Circuit elements and their transformed equivalents, treatment of mutual couplings. Transient(AC &DC) and steady state response of RL, RC, LC and RLC circuits in transient with or without stored energy – solutions in t & s domains. Concept of natural frequency and damping. Sketching transient response, determination of peak values. Practical applications. Concept of convolution theorem and its application, Complete response analysis of switched circuits, Introduction to Fourier transform.	10L+4T
3	**Two Port networks –** open circuit and short circuit parameters, transmission Parameters, hybrid parameters, interconnection of networks, characteristics of Unsymmetrical networks, Image and iterative impedances, propagation function, Characteristics of symmetrical networks, characteristic impedance, propagation function, some typical networks- T, Π, lattice, bridged T, bartlett's bisection theorem - its proof and application, Insertion loss.	10L+4T

4	**Filters:** Mechanism of filter action, conditions of pass band and stop band, frequency responses of filter networks, Analysis and synthesis of RLC filters, design of Prototype low pass, high pass, band pass and band stop sections (both T & Π section), m-derived sections, modern filter design concepts. **Attenuators and Equalisers:** T, Π, Bridged T, Lattice and L type attenuators, ladder Attenuator, amplitude and phase equalizer- Lattice and Bridged T, application of Attenuators and equalizers.	10L+3T
	Total	**42L+14T**
	Total Week Required	**14**
	No. of Week Reserved	**02**

Text/Reference Books:

1. Network Analysis, M.E.Van Valkenburg (Prentice Hall), 3rd Edition.
2. Engineering Circuit Analysis, W.H.Hayt, J.E.Kenmerly, S.M.Durbin,(TMH), 6th Edition, 2002.
3. Network and Systems, Ashfaq Husain,(Khanna Book Publisher), 2000.
4. Network and Systems, D.Roychowdhury,(New Age International) ,2001.
5. Modern Netwok Analysis, F.M.Reza & S.Seely, McGraw Hill.

Paper Name : Electromagnetics and Electrical Fields
Paper Code : EE-302
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks: 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Elements of vector calculus:** Gradient, divergence and curl: Physical significance; integral calculus (line, surface and volume integrals; Gauss and Stokes theorem, Dirac delta function; Helmholtz theorem for vector fields Laplace equation, poission equation. Coordinate system and inter-relation: Cartesian, cylindrical and spherical coordinates **Introduction to Static Electric Fields:** Coulomb's law, Faraday's law, Electric Flux density, Electric Potential and Potential Gradient, Electric stress and mechanical force in charged conductors, Energy stored in electric field, Gauss's integral law for electric displacements fields, Electric dipole fields, Electric Polarization and its relation to the permittivity of dielectric media.	10L+3T
2	**Elctrostatic Boundary-value problem:** Solution of Laplace's equation by separation of variables method, Capacitance of coaxial cables and two wire transmission lines and related electric fields, Numerical analysis of electric fields by solving Laplace's equation, Uniqueness theorem, Method of Images for the solution of electric fields. **Magnetostatics field:** Biot-Savart's law, Ampere's circuital law, application, magnetic flux density, Scalar and Vector magnetic potential, Lorentz force, Motoring and generating principles, Faraday's Law of electromagnetic induction, Ampere's law in both integral and differential forms, Boundary conditions, Solution of field problem by image method, Self and mutual inductance, Inductance of coaxial cable and two wire transmission lines, Energy in magnetic field, Force due to magnetic field in magnetic medium.	12L+3T
3	**Plane Wave Propagation:** Homogeneous, isotropic medium, orientation of electric field, magnetic field and direction of propagation, Helmholtz equation, wave equation in free space, conducting medium, Uniform plane wave, intrinsic impedance, Poynting's vector, polarization: circular, elliptical. Wave propagation through various media; good conductor, perfect dielectric Reflection and refraction:	13L+6T

	normal incidence and oblique incidence in perfect conductor, perfect dielectric, horizontal and vertical polarization, Brewster angle, total internal reflection, evanescent wave, surface impedance, phase and group velocity; skin depth	
4	**Transmission lines:** Parameters, equation: current, voltage, input impedance, condition of lossless line, distortionless line, characteristic impedance SWR: Voltage and current, shorted line, open circuited line, matched line, power, impedance transformation; Quarter wave transformer, single stub, double stub, Elements of wave guide and radiating systems (antenna), Diffusion equation for eddy currents and skin effect.	7L+2T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1) Electromagnetic Waves and Radiating Systems by E.C. Jordan K.G. Balmain (PHI)
2) Elements of Electromagnetics by Matthew N. O. Sadiku (Oxford)
3) Time-Harmonic Electromagnetic Fields Roger F. Harrington (Willey Interscience)
4) Electromagnetic Theory by Stratton Julius Adams, Julius Adams Stratton
5) Electromagnetic Field Theory Fundamentals by B S Guru, H R Hiziroglu (Cambridge University Press)
6) Foundations of Electromagnetic Theory by John R. Reitz, Frederick J. Milford, Robert W. Christy (Addison Wesley)

Paper Name: **Electrical Measurements**
Paper Code: **EE- 303**
Weekly Load: **L : 3 T : 1 P : 0**
Credit Point: **03**
Total Marks: **100**

Module	Detailed Description	Lecture/ Tutorial Period
1	Classification of electrical measuring instruments, class & accuracy, general feature of indicating instruments: controlling, damping, balancing Galvanometer, dynamics, sensitivity, D'Arsonval galvanometer, Ballistic galvanometer, Vibration Galvanometer, PMMC instrument, temperature compensation, rectifier type instrument, Moving iron instrument, errors and compensations, Electrodynamometer type instrument, power measurement, low power factor wattmeter, wattmeter connections and errors	13L+4T
2	Induction type energy meter: characteristics, errors and their compensation, Extension of instrument range: shunt, multiplier, current transformer, potential transformer; testing and calibration of measuring instruments, Measurement of resistance: Kelvin double bridge, series and shunt type ohmmeter, megger.	8L+3T
3	Measurement of inductances and capacitances, measurement of incremental inductances, errors in bridges. dc potentiometer: Weston normal cell,Vernier type, Kelvin-Verley slide, dual range, applications, phantom loading. ac potentiometer: polar type and co-ordinate type	10L+4T

4	Use of Ballistic Galvanometer in magnetic testing, ac magnetic testing: Lloyd-fisher square. Cathode ray oscilloscope (CRO): Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO. Localization of cable faults. Murray and Varley Loop test.	11L+3T
	Total	**42L+14T**
	Total Week Required:	**14**
	No. of Week Reserved:	**02**

Text/Reference Books

1. Electrical Measurement & Measuring Instrument : by Golding & Widdis
2. Electrical Measurement : by F. K. Harris
3. Electrical Measurement Analysis : by Ernest Frank
4. Alternating Current Bridge Networks : by Hague & Foord
5. Basic Electrical Measurement : by M. B. Stout
6. Electrical Measurement : by C. T. Baldwin

Paper Name: Analog Electronic and Circuits
Paper Code: ECE- 321
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 02
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**BJT and analog circuits:** Overview of analog circuits, application of analog circuits implementation. Characteristics of BJT; Ebers-Moll equations and large signal models; inverse mode of operation, early effect; BJT as an amplifier and switch. Biasing and dc circuits of BJT. Small signal models, Small signal analysis of CE, CB, CC amplifiers using r_e models, frequency response of amplifiers. Multistage amplifiers (Cascade, Cascode)	11L
2.	**FET:** JFET types, Device structure and operation , Volt-amp characteristics. **MOSFET** enhancement NMOS, PMOS and CMOS, Device structure and operation of Volt-amp characteristics. Nonlinearities in MOSFET, Biasing and dc circuits of JFET, MOS. Current source biasing. Small signal analysis of JFET, MOS amplifiers (CS, CG, Source follower).	8L
3.	**Power amplifiers, Differential and operational amplifiers :** Class A, Class B, Class AB Class C, Class- D Circuit operation, transfer characteristics, power dissipation, and efficiency. Practical BJT and MOS power transistors; thermal resistance; heat sink design; IC power amplifiers. Advantages of differential amplifiers; Ideal operational amplifier(OP-AMP) parameters, Characteristics. Inverting and noninverting configurations; Common OPAMP ICs: Gain-frequency and Slew rate etc. Applications of Op-AMP: Inverting, Non-Inverting amplifiers; Instrumentation Amplifier, Integrators, Differentiators; LOG amplifier, Anti Log Amplifier , Comparators; Schmitt triggers, Active RC filters.	9L

4.	**Feedback, Oscillators and Application Specific ICs :** Feedback concept and definition; Four basic feedback topologies with real circuits; Analysis of Series-shunt, series-series, shunt-shunt and shunt-series feedback amplifiers; stability in feedback amplifiers, frequency compensation; Principle of sinusoidal oscillators and Barkhausen criterion; Relaxation oscillation Active-RC and Active-LC sinusoidal oscillators; Wien Bridge; Phase-Shift; Quadrature Oscillators; Crystal Oscillators, Multivibrators, 555 timer as Astable and Monostable multivibrators, VCO(LM 566) amd PLL (LM 565). **Voltage regulations**: Linear regulators using transistors and Op-Amps. Monolithic regulators. SMPS Concepts.	14L
	Total	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/References:

1) Microelectronic Circuits – Sedra and Smith (Fifth Edition) (Oxford)
2) Sergio Franco – Operational Amplifier (TMH)
3) Electronic Devices and Circuit theory – Boylestead and Nashlesky – PHI/Pearson Education
4) Design of Analog CMOS Integrated Ckts- Behzad Razavi-Mc Graw Hill Pub.
5) CMOS Analog Circuit Design-P.E. Allen & D.R.Hollberg –Oxford Pub.
6) Millman and Halkias – Integrated Electronics – TMH Op Amp and Linear Ics.
7) P. Horowitz and W. Hill, The Art of Electronics, 2nd Edition, Cambridge University Press, 1989.
8) Foundations of Analog and Digital Electronic Circuits. Agarwal, Anant, and Jeffrey H. Lang. San Mateo, CA: Morgan Kaufmann Publishers, Elsevier
9) R. A. Gayakwad, Op-Amps and Linear Integrated Circuit, Prentice Hall of India,
10) Fundamentals of Microelectronics –Behzad Razavi- John Wiely

Paper Name: Basic Engineering Thermodynamics & Fluid Mechanics.
Paper Code: ME 301
Weekly Load: L: 3, T: 0, P:0
Credit Point: 02
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Basic Concepts of Thermodynamics**: Definition, Scope and Application of Thermodynamics, Macroscopic and Microscopic Approach, Thermodynamic systems, Working Substance, Pure Substance, Thermodynamic Equilibrium, Properties of Systems, Process, Cycle, Point and Path Function, Heat, Specific Heat, Heat Capacity, Thermodynamic and Mechanical Work, Pressure, Energy. **Zeroth law and Temperature**: Concept of Temperature, Zeroth Law of Thermodynamics, Measurement of Temperature, Thermometers and thermometric property, Temperature measuring scales. **Properties and Thermodynamic Processes of gas**: Introduction, General gas Equation, Equation of state and Characteristic Equation of gas, Universal Gas Constant, Specific heats of Gas, Relation between C_p and C_v, Enthalpy of a Gas, Classification of Thermodynamics Process, Heating and Expansion of gases in Non Flow Process, Real gas.	8L

2	**First Law of Thermodynamics**: Introduction, First law for a closed system undergoing a cycle and undergoing a change of state, Energy- a property of system,PMM-1,Energy of a Isolated System, Limitation of First Law, Application of First law to non Flow Process, First law of Thermodynamics for Flow Process, Mass balance and energy Balance Equation, Engineering application of Steady Flow Energy Equation(SFEE) **Second Law of Thermodynamics**: Introduction, Heat Engine, Heat Reservoirs ,Refrigerator, Heat Pump, Statement of Second Law of Thermodynamics- Clausius statement, Kelvin Plank statement, Equivalence of Kelvin Plank and Clausius statements, PMM-2,Thermodynamic Temperature, Carnot Cycle, Carnots theorem, Entropy, Clausius Inequality, Temperature- Entropy diagram, Change of entropy for various thermodynamic processes, Irreversibility, Reynold's Transport Theorem. **Air Standard Cycles:** Otto Cycle , Diesel Cycle and their efficiency Properties of Pure substances and Steam Power Cycle	16L
3	**Basics of Heat Transfer Modes:** Conduction, Convection, Radiation **Heat Transfer by Conduction**: Fourier's law, Thermal conductivity of materials, Thermal Resistance, Heat conduction through plane and composite walls, overall heat transfer co-efficient, Heat conduction through hollow and composite cylinders, Heat conduction through hollow composite sphere, Critical thickness of Insulation **Heat Transfer by Convection:** Principle of Free and Forced Convection, Convection heat transfer Co-efficient. **Heat Transfer by Radiation:** Introduction, Surface emission properties, Absorptivity, Reflectivity and Transmissivity, Concept of a black body, Stefan-Boltzmann law, Kirchhoff's law, Plank's law, Wiens displacement law, Intensity of radiation and lamberts cosine law.	7L
4	**Basics of Fluid Mechanics:** Types and properties of fluids, Viscosity, Surface tension, Capillarity. **Fluid Statics:** Fluid Pressure and its measurement, Pascal's law, Total pressure and centre of pressure, Hydrostatic forces on surfaces, Buoyancy, Centre of buoyancy, Metacentre, Metacentric height, Stability of submerged and floating body. **Fluid Kinematics:** Fluid motion, Types of fluid flow, Discharge, Continuity equation, Velocity & acceleration, Velocity potential function and stream function **Fluid Dynamics:** Euler's equation of motion along a stream line, Bernoulli's equation, assumptions, Physical significance of different heads, Application of Bernoulli's equation in flow measurement devices – Venturimeter, Orifice meter, Pitot tube.	11L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text / Reference Books:

1. P K Nag – Engineering Themodyamics – TMH Pub.
2. P K Nag – Power Plant Engineering. – TMH Pub.
3. P S Ballaney – Thermal Engineering – Khanna Pub.
4. Domkundwar & Arora – Power Plant Engineering – Dhanpat Rai & Co.
5. R S Khurmi & J K Gupta – Thermal Engineering – S Chand Pub.
6. Kothandaraman, Domkundwar - A Course in Thermodynamics(Thermal Engg.) - Dhanpat Rai & Co
7. R K Bansal – Fluid Mechanics & Hydraulics Machines- Laxmi Pub.

8. A R Basu – Fluid Mechanics & Hydraulics Machines – Dhanpat Rai & Co.
9. R K Rajput - Fluid Mechanics & Hydraulics Machines – S Chand Pub.
10. Som, Biswas - Fluid Mechanics & Hydraulic Machines – TMH Pub

Paper Name: Values and Ethics
Paper Code: HS 301
Weekly Load: L: 3, T: 0, P: 0
Credit Point: 0
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Nature of professional ethics**:-Introduction, definition, morals &ethics sources of ethics, sources of ethics, relationship between ethics and management. Nature of professional ethics, importance of ethics in profession, nature and objectives of ethics, need for ethics. **Ethical decision making:-** Values, morals, standards, corporate social responsibility, attitude and beliefs, ethical values and dimensions dilemmas-decision making, organization and power politics.	11L
2	**Effects of technological growth:-** Energy Crisis, Rapid technological growth, environmental degradation and pollution, human operator in Engineering projects and industries, problems of man, machine, interaction. Impact of assembly line and automation.	8L
3	**Ethics in profession:-**Engineering profession, ethical issues in engineering practice, conflicts between business demands and professional ideals, social and ethical responsibilities of technologists, code of professional Ethics, Whistleblowing and beyond, effects of globalization in modern organization, case study. **Managing ethics**:- Building a value system, role of law enforcement, training in ethics, ethics in commercial and operational profession, ethics in finance, ethics in HRM, ethics in Global Business, ethics and IT.	15L
4	**Engineering Ethics:** Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories. Valuing Time – Co-operation – Commitment – Nature of Engineering Ethics, Profession and Professionalism, Professional Ethics, Code of Ethics, Sample Codes – IEEE, ASCE, ASME and CSI.	8L
	TOTAL:	42L
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text / Reference Books:

1. Blending the best of the East & West, Dr. SubirChowdhury, EXCEL
2. Ethics& Mgmt. & Indian Ethos, Ghosh, VIKAS
3. BusinessEthics,Pherwani,EPH
4. Ethics,Indian Ethos & Mgmt., Balachandran,Raja,Nair, Shroff Publishers
5. Business Ethics: concept and cases, Velasquez, Pearson
6. Engineering Ethics: Charles D, Fleddermann, Pearson / PHI, New Jersey 2004 (Indian Reprint)
7. Engineering Ethics – Concepts and Cases:Charles E Harris, Michael S. Protchard and Michael J Rabins, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
8. Ethics and the Conduct of Business:John R Boatright, Pearson Education, New Delhi, 2003.

9. Fundamentals of Ethics for Scientists and Engineers:Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford, 2001.

Paper Name : Circuit Theory and Networks Laboratory
Paper Code : EE 351
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

01. Study of Open Circuit (Z) and Short Circuit(Y) Parameters of a Two Port Network.

02. Study of Transmission (ABCD) Parameters of a Two Port Network.

03. Study of different types of Impedances of a Two Port Network:
a) Image Impedance, b) Characteristic Impedance, c) Iterative Impedance.

04. Conversion from T & ∏ Network to Lattice Network using Bisection Theorem.

05. Design of T-type Attenuator Network.

06. Study of First Order Low Pass Filter & determination of Cut- Off Frequency from its Frequency Response. (Hardware/ Simulation)

07. Study of First Order High Pass Filter & determination of Cut-Off Frequency from its Frequency Response. (Hardware/ Simulation)

08. Study of Transformer Coupled Circuit used for Impedance Matching.

09. Study of DC transient Response of R-L-C series circuit.

10. Circuit and Network simulation using MATLAB.

Module 1: Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB. Response analysis of simple electrical networks and Circuits.

Module 2: Determination of Laplace transform and Inverse Laplace transform using MATLAB. It's application in solving electrical network problems.

Module 3: Amplitude and Phase spectrum analysis of different signals using MATLAB.

Paper Name : Electrical Measurements Laboratory
Paper Code : EE 352
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

1. Instrument workshop- Study of construction of PMMC, Dynamometer, Moving iron and Rectifier type instruments, Oscilloscope and Digital Multi-meter.
2. Calibration of moving iron and electrodynamometer type ammeter/voltmeter by potentiometer.
3. Calibration of dynamometer type Wattmeter by potentiometer.
4. Calibration of A.C. energy meter.
5. Measurement of resistivity of a material using Kelvin's Double Bridge.
6. Measurement of Power using Instrument transformers.
7. Measurement of 3-phase Power by two-wattmeter and single-wattmeter method.
8. Measurement of Frequency by Wien Bridge using Oscilloscope.
9. Measurement of Inductance by Anderson Bridge.
10. Measurement of Capacitance by De Sauty Bridge.
11. Measurement of High resistance.
12. Calibration of dynamometer type Power Factor meter.
13. Power Measurement by 3 Ammeter and 3 Voltmeter method.
14. Measurement of Capacitance by Schering Bridge

Paper Name : Analog Electronics and Circuits Laboratory
Paper Code : ECE 371
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

1) Study of Clipping circuits.
2) Study of Clamping circuits.
3) Study of CE Amplifier.
4) Study of frequency response single stage R – C coupled voltage amplifier.
5) Study of Power Amplifier.
6) Study of OP-AMP characteristics.
7) Study of Integrator and Differentiator circuits.
8) Study of Transistor Phase – Shift Oscillator.
9) Study of series voltage regulator using Transistor and Zener diode.
10) Study of 555 timer as Astable, Monostable multivibrators
11) Study of Active filters using OP-AMP.

Paper Name : Group Discussion and Personality Development
Paper Code : HS 381
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

Module	Detailed Description	Practical Period
1	**Group Discussion:** Students must be made aware of the difference between conversation and group discussion. UGC produced video cassettes could be used to teach them the strategies to be followed in group discussion. Students must also be given practice on contemporary social , economic, political and educational topics.	7P

2	**Mock Interview** Students are to be taught the strategies of facing an interview. Mock Interviews Must be arranged for them.	7P
3	**Presentation** Students will be taught how to make lab presentations by using different audio-visual aids.	*7P*
4	**Language tests** Students will be prepared for facing language tests like T.O.E.F.L	3P
	TOTAL:	24P
	Total Week Required:	**12**
	No. of Week Reserved:	**04**

Text/Reference Books:

1 Group discussion and interview(With audio cassette) by Prasad, Published by TMH.
2 Communication at work by Alder and Elmhorst, By MHI

Semester-IV

Paper Name : Numerical Methods and Optimization Techniques
Paper Code : M-402
Weekly Load : L: 3 T: 1 P: 0
Credit Unit : 03
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Numerical Methods:** Error Formulation Numerical Interpolation: Finite differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation, error analysis. Numerical Differentiation and Integration: Numerical differentiation using interpolating polynomial, Trapezoidal rule, Simpson's 1/3 rd rule of integration, error analysis.	**10L+4T**
2	Numerical solution of polynomial and transcendental equations: Bisection method, Regula-Falsi method, Fixed point iteration, Newton-Raphson method, Gauss-Jacobi iteration and Gauss-Seidel iteration for solving a system of linear equations. Numerical solution of ODE: Numerical solution of first order ODE with initial condition by Picard's, Euler's and Taylor's series method, Runge-Kutta method, Predictor-Corrector methods (Milne and Adams-Bashforth); Boundary value problems, Shifting and finite difference method.	**10L+3T**

3	I. Introduction: Historical Development, Engineering application of Optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems. II. Linear Programming: Graphical method, Simplex method, Big-M Method, Revised simplex method, Duality in linear programming (LP), Sensitivity analysis, Transportation, assignment and other applications. III. Game theory and its applications: Maximin,Minimax Principle, Two-person-zero-sum game, Dominance principle, Graphical Method.	**12L+4T**
4	IV. Non Linear Programming: Unconstrained optimization techniques, Direct search methods, Constrained optimization, Direct and indirect methods, Optimization with calculus, Kuhn-Tucker conditions. V.PERT and CPM	**10L+3T**
	Total:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International (P) Ltd., New Delhi, 2000.
2. J.K.Sharma "Operations Research", National Publishing House
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design – Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. An Introduction to Numerical Analysis (2nd edn.)-Atkinson, John Wiley and sons
6. Numerical Analysis-James Blaine Scarborough, Oxford University Press
7. Numerical Methods-S.A. Mollah, Books and Allied Publishers.

Paper Name : Electrical Machines-I
Paper Code : EE- 401
Weekly Load : L : 3 T : 1 P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**1-Phase Transformer:** Construction and basic principle of operation. Core type and shell type transformers. Materials used for core, winding and insulation. EMF equation. Core loss copper loss and leakage reactances. Harmonics in magnetizing current and magnetizing inrush current. Generalised derivation of electrical equivalent circuit from magnetic structure. Phasor diagram. Dry type and oil cooled type. Natural and forced type of cooling. Tank and radiator construction, operation. Transformer oil, transformer accessories e.g. conservator, breather, Buckholtz relay, bushings etc.	6L+3T

2	**Testing of Transformers:** Polarity of windings, OC and SC test. Separation of losses, derivation of equivalent circuit parameters. Regulation, efficiency, all-day efficiency. Parallel operation. Effects of changes of frequency and voltage on transformer performance **Single phase auto transformers:** Principle of operation, phasor diagram. Comparison of weight, copper loss, equivalent reactance with 2-winding transformer **Special Transformer:** Current Transformer, pulse transformer and high frequency ferrite core transformer with pulsed dc supply. Potential Transformer.	10L+5T
3	**Polyphase Transformer:** Construction and basic principle of operation. Core type 3-limb and 5-limb construction and shell type. Flux distribution. Star, delta, open delta and Zigzag connections. Tertiary windings. Vector groups. Graded insulation and shielding for HV. Harmonics in 3-phase transformers. Tap Changer principles, types and operation. Parallel operation, unbalanced loading, capacity calculations. Tests specified as per standards.	9L+4T
4	**Special Connections:** Scott and le Blanc connection, 3-phase to 6-phase and 3-phase to 1-phase transformation. Three phase auto transformers, principle of operation, phasor diagram.	5L+2T
	Total	**42L+14T**
	Total Week Required:	**14**
	No. of Week Reserved:	**02**

Text/Reference Books:

1. H. Cotton," Advanced Electrical Technology"
2.P S Bimbhra, " Electrical Machinery"
3. Puschtein & Lloyd,"Alternating Current Machines"
4. M.G.Say,"The Performance and design of alternating Current Machines"
5. P K Mukherjee , S Chakrabarty, " Electrical Machines"
6. P S Bimbhra, "Generalized Theory of Electrical Machine"

Paper Name : Power System-I
Paper Code : EE 402
Weekly Load : L: 03 T: 01 P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	Structure of Power System – Generation, transmission and distribution. Power generating stations – different types. Steam power stations: Main parts and working, types of boilers and their characteristics. Characteristics of steam turbines and some introductory parts of alternators. Main flow circuits of steam power station. Power station auxiliaries, cooling system of alternators. Starting up and shut down procedures of thermal units Gas-turbine power stations- Main parts, plant layout and Bryton cycle operation. Combined cycle generation & Co-generation	11L+4T

2	Nuclear power stations- Layout of nuclear power station, types of power reactors, main parts and control of reactors, nuclear waste disposal, radioactivity and hazards Hydroelectric stations: Arrangement and location of hydroelectric stations, principles of working, types of turbines and their characteristics, Pumped storage plants Coordination of operation of different power stations . Substation - Classification of substations, Major equipments in Substation, Busbar layouts	9L+3T
3	Power distribution system: Primary and secondary distribution, types of conductors in distribution system, comparison of distribution systems. Distributor design, radial and ring main, current and voltage profiles along a distributor, economics of feeder design Electrical wiring and installation - Domestic, commercial and industrial wiring, estimation of main, submain and subcircuit wiring. Earthing practice. Testing of installation. Special lighting connections. Conductors, Fuse and disconnecting devices	12L+3T
4	Administrative aspects of electricity supply- Development of power sector in India. Administrative set up and organisations in power sector. Stages involved in power planning- load analysis, load management & load forecasting. Legal aspects of electricity supply- Electricity acts, rules and codes. Standards followed in power supply, environmental and safety measures.	10L+4T
	Total	**42L+14T**
	Total Week Required	**14**
	No. of Week Reserved	**02**

Text/Reference Books:

1. Powerplant Technology by M.M.El-Wakil, McGraw Hill
2. Power Station Engineering & Economy by B.G.A. Skrotzki & W.A.Vopat, Tata McGraw Hill
3. A Course in Power Plant Engineering, by Arora & Domkundwar, Dhanpat Rai
4. Elements of Electrical Power Station Design, by M.V.Deshpande, Wheeler
5. Electric Power Distribution System Engineering , by Turan Gonen
6. Transmission & Distribution ,by H.Cotton
7. Elements of Power Systems by P.K.Sadhu & S.Das, CRC Press London.

Paper Name: Heat Power & Hydraulics Engineering
Paper Code: ME 401
Weekly Load: (L: 3, T: 0, P:0)
Credit Point: 02
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1	**<u>Heat Power</u>** **Internal combustion Engine:** Principle of operation, Classification, Engine components, Sequence of operations in a cycle, Working cycles, Scavenging, Air-Fuel ratio, Carburettor, Fuel pump, Injector, Spark plug, Combustion procedure (Basics only), Detonation in IC Engine, Rating of SI and CI Engine fuel – Octane & Cetane Number, Fuel injection and ignition, Cooling of IC Engine, Supercharging, Engine friction & Lubrication, Governing of IC Engines, Testing and performance of IC Engines.	10L
2	**Steam Generators:** Boilers , Important terms used in boilers , Selection of steam boilers , Selection of a steam boilers , Essentials of a good boilers , Classification of steam boilers .Boiler mountings and accessories , Performance of steam boilers - Equivalent evaporation , Boilers efficiency, Boiler trial, Heat loss, Heat balance sheet. Boiler draught – Objective, Classification, Height of chimney, Chimney efficiency	7L
	Steam Nozzles: Types, Flow of steam through convergent- divergent nozzle, Nozzle Efficiency, Velocity of steam flowing through a nozzle, Mass of steam discharged through nozzle, Condition for maximum discharge, Critical pressure ratio and its physical significance.	
3	**Steam Turbines:** Principle of operation, Classification. Impulse Turbine – Pressure compounded, Velocity compounded, Pressure velocity compounded, Pressure and velocity of steam in an impulse turbine, Velocity triangle, Forces on the blades, Work done, Power developed, Axial thrust, Effect of friction, Blade or diagram efficiency, Maximum efficiency, Energy converted to heat by blade friction, Stage efficiency, Velocity diagram for axial discharge, Velocity diagram for two stage impulse turbine. Reaction Turbine – Main components, pressure and velocity of steam in a reaction turbine, Comparison between Impulse and Reaction turbine, Velocity triangle, Power produced, Degree of reaction, Mean diameter of the drum and height of blades, Diagram efficiency, Condition and expression for maximum efficiency Governing of Steam Turbines.	14L
	Steam Power Cycle: Simple steam power cycle, Rankine Cycle, Actual Vapour cycle processes, Comparison of Rankine and carnot cycles, Mean temp. Heat addition, Reheat Cycle , Ideal Regenerative cycle, Regenerative cycle, reheat-regenerative cycle, feed water heaters, Binary power cycles	

4	**Hydraulics:** Basic of Fluid Mechanics, Kinematics and Dynamics Dimensional Analysis: Secondary quantities, Dimensional Homogeneity, Method of dimensional analysis, Rayleigh's Method, Buckingham's π Theorem, Solved Problems, Dimensionless Numbers	11L
	Hydraulic Machines I – Turbines: Head & Efficiency of a turbine, Classification of Hydraulic Turbines, Impulse Turbine- Pelton Wheel, Reaction Turbine, Radial flow reaction turbine – Francis Turbine, Axial flow reaction turbine – Kaplan Turbine, Draft tube, Specific speed, Unit quantities, Characteristic curves of hydraulics turbines, Governing of hydraulic turbines.	
	Hydraulic Machines II – Pumps: Centrifugal pumps(CP): Main parts and working principle, Work done, Head &Efficiency of CP, Minimum speed for starting a CP Multistage CP, Sp. Speed of CP, Priming of a CP, Characteristic curves of CP, Cavitations, Suction suction lift, NPSH Reciprocating Pumps(RP): Main parts and working principle, Slip of RP, Classification of RP, Velocity and acceleration, Indicator diagram, Comparison between CP & RP.	
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text and/or **Reference Books:**

1. P K Nag – Engineering Themodyamics – TMH Pub.
2 P K Nag – Power Plant Engineering. – TMH Pub.
3 P S Ballaney – Thermal Engineering – Khanna Pub.
4 Domkundwar & Arora – Power Plant Engineering – Dhanpat Rai & Co.
5 R S Khurmi & J K Gupta – Thermal Engineering – S Chand Pub.
6 Kothandaraman, Domkundwar - A Course in Thermodynamics(Thermal Engg.) - Dhanpat Rai & Co
7 R K Bansal – Fluid Mechanics & Hydraulics Machines- Laxmi Pub.
8 A R Basu – Fluid Mechanics & Hydraulics Machines – Dhanpat Rai & Co.
9 R K Rajput - Fluid Mechanics & Hydraulics Machines – S Chand Pub.
10 Som, Biswas - Fluid Mechanics & Hydraulic Machines – TMH Pub

Paper Name : Digital Electronics and Circuits
Paper Code : ECE 421
Weekly load : L: 3 T: 1 P: 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	**Number system and binary codes:** Digital Circuits, Definition of Analog &Digital Signals. Characteristics of Digital Circuits, Advantages and Disadvantages of Digital systems over Analog system. Brief overview of decimal, binary, octal and hexadecimal number systems and their arithmetic operations. Conversion of one number system to another. Complement methods of different number systems and their arithmetic operation. Signed and floating point representations of binary numbers. Arithmetic operation using signed binary numbers. Definition and signification of binary codes, classification of binary codes-weighted, non-weighted, error detecting and correcting codes, sequential, reflective, self-complementing and cyclic codes, alphanumeric codes. Arithmetic operation of BCD and Excess-3 code. Conversion of binary to gray code and vice versa. Error detecting and correcting code using Hamming and parity code. ASCII code.	11L+4T
2. .	**Logic gates and logic expressions:** Basic logic gates (NOT, AND, OR, NAND, NOR, XOR and XNOR) –operations, truth tables and Venn diagram representations. Universal gates and representation of basic logic gates using universal gates i.e. 7400 & 4000 series IC's. Different postulates and laws of Boolean algebra, De Morgan's theorem; Canonical forms representation of Boolean expressions-SOP and POS forms. Simplification and minimization of logic expressions using Boolean algebra, K-maps, and Quinn McClusky methods, simplification using don't care terms.	6L+6T
3.	**Digital circuits** **Combinational Logic Circuits:** Introduction, Design procedure of combinational logic circuits, Analysis and synthesis of different combinational logic circuits - Adder, Subtractor, Multiplexer, Demultiplexer, Decoder, Encoder, decoder driver, Parity generator/checker, Priority encoder, Code-converter etc. **Sequential Logic Circuits:** Introduction, Latch and Flip-flops, Analysis and synthesis of different types of Flip-flops- S-R, J-K, D and T type flip-flops. Triggering of a flip-flops, Master-slave F/F, Race Around condition of an F/F. Conversions of flip-flops. Application of flip-flops. Shift registers-Introduction, serial, parallel and universal shift register, applications. Counters-Introduction, Classification of counters, synchronous and asynchronous counters; binary, design and analysis of modulo-N and arbitrary sequence counters.	10L +2L

	Shift register counters (Ring and Johnson).	
4.	**Analysis and synthesis of synchronous sequential circuits and Interface Circuits:** Introduction, Basic models of sequential machine (Moore, Mealy), Use of Algorithmic State Machine, Analysis of Synchronous and Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits Design procedure of different synchronous sequential circuits, Synthesis of completely and incompletely specified synchronous sequential machines, Problems in Asynchronous Circuits, Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VHDL. Different parameters definitions such as resolution, accuracy etc. Analog to Digital converter (ADC) - flash type, counter type, tracking type, single and dual-slope type, successive approximation method. Digital to Analog converter (DAC) - weighted resistor method, R-2R ladder method.	15L+2T
	Total:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

[1] Digital design by Morris Mano (PHI).

[2] Fundamental of digital circuits by A.Anand Kumar (PHI).

[3] Digital Circuit & Design by S.Salivhanan, S.Aribazhagan-Vikas Publishing House.

[4] Digital Fundamentals by T.L.Floyd, R.P.Jain (Pearson)

[5] Digital design principles and applications (6/e) by D.P.Leach, A.P.Malvino, G.Saha (TMH)

[6] Comer- Digital Logic & State Machine Design, OUP.

Paper Name : Fundamentals of Signals and Systems
Paper Code : ECE-423
Weekly Load : L: 3 T: 0 P: 0
Credit Point : 02
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period

1.	**INTRODUCTION SIGNALS AND SYSTEMS** Definition of Signal, Classification of signals: Continuous & Discrete time, Even & Odd, Periodic & Aperiodic, Deterministic & Random, Energy & Power Signals. Discussion about elementary signal forms: Exponential, Sinusoidal, Unit Step, Unit Impulse, Unit Ramp etc. Transformation of independent variables: Time Shifting, Time Scaling & Time Inversion. Introduction to System and basic System Properties.	8L
2.	**FOURIER ANALYSIS OF CONTINUOUS AND DISCRETE TIME SIGNALS:** Introduction, Fourier series representation of continuous time periodic signals, Convergence of the Fourier series, Properties of Continuous time Fourier series, Aperiodic signal representation by Fourier Transform, Fourier Transform of some useful functions, Properties of Fourier Transform, Convolution: Tine and Frequency Convolution. Parseval's Theorem for Energy & Power Signals, Energy and Power Spectral Density Functions, Properties of ESD and PSD. Auto and Cross correlation properties of Energy and Power signals. Concept of distortion less transmission through LTI systems. Introduction, Discrete Time Fourier Transform of Aperiodic signals, Properties of Discrete Time Fourier Transform (DTFT). Discrete Time Fourier Transform of Periodic signals Discrete Time LTI systems characterized by Linear Constant-Coefficient Difference.	16L
3.	**SAMPLING :** Sampling theorem, impulse train sampling, zero order hold, interpolation, and aliasing. Discrete time sampling.	4L
4.	**CONTINUOUS AND DISCRETE TIME LTI SYSTEM:** Introduction, Continuous time Unit Impulse response and Convolution integral, Convolution sum for discrete time LTI systems. Properties of LTI Systems. Static & Dynamic LTI Systems, Invertibility of LTI Systems, Causality & Stability of LTI Systems, Paley-Wiener Criteria. **Z –Transform:** Introduction, The Z Transform, The Region of Convergence (ROC) for the z Transform, Properties of Z Transform. The Inverse Z Transform. Analysis and Characterization of continuous and discrete time LTI systems.	14L
	Total:	**42L**
	Total Week Required:	**14**
	No. of Week Reserved:	**02**

Text/Reference Books:

1. Signals & Systems :Alan V. Oppenheim & Alan S. Willsky, P.H.I.
2. Signals & Systems : Simon Haykin & Barry Van Veen, Wiley.
3. Digital Signal Processing: J.G.Proakis and Manolakis Pearson Edu.

Paper Name: **Electrical Engineering Materials**
Paper Code: **PH 402**
Weekly Load: **L: 3 T: 0 P: 0**
Credit Unit: **2**
Total Marks: **100**

Module	Detailed Description	Lecture / Tutorial Period

1	**Introduction:** Atomic Structure and dependency of element-characteristics on the position in periodic table, Inter atomic bonding (Covalent, ionic, metallic), Binding energy, force and inter-atomic distance. Classification of materials- Metals and alloys, Ceramics, Polymeric materials (Complex Structures (fiber, plastic elastomers)), Composites, Semiconductors. **Crystallography:** Crystal Geometry, Atomic Packing Factor, Coordination No., Space lattices, Unit cells, Bravais lattices, Miller Indices. **Diffusion in solids**: Fick's laws of diffusion; the atomic model of diffusion, factors influencing diffusion.	**10L**
2	**Insulating Materials**: State of insulating materials and their applications. Dielectric behavior, types of polarization. Dielectric constant, frequency and temperature dependence of relative permittivity, behavior of dielectric under alternating fields, dielectric losses, temperature dependence of insulating resistance, classification of insulating material, natural insulating materials, high polymer, XLPE, ceramics, plastics(thermosetting materials, thermo-plastic materials), gaseous materials. Meta Materials, Piezo-electric materials. **Conductors**: Electrical conductivity of metals, Resistance and factors affecting it such as alloying and temperature etc, Lorentz theory, free electron theory, electron scattering.	**11L**
3	**Magnetic Materials**: Introduction - ferromagnetic materials, permeability, B-H curve(magnetic saturation, hysteresis loop (including) coercive force and residual magnetism), Concept of Eddy current and hysteresis loss, curie temperature, magnetostriction effect. Atomic interpretation of ferromagnetic materials(Atomic exchange force, crystallographic forces, magnetic anisotropy, magnetostriction), Curie-Weiss law, Curie law, Curie temperature of ferromagnetic materials, soft magnetic material, hard magnetic materials, Ferrite-ferromagnetic materials and their applications,	**11L**
4	**Semiconductor:** Intrinsic and extrinsic semiconductor, Fermi-Dirac distribution, dependence of carrier concentration on temperature, mobility, degenerate semiconductors, tunnel diodes, Zener breakdown phenomena & tunneling effect., Hall effect. **Super conductivity**: Theory of super conductivities, Meissner's effect, critical field, critical current density, transition temperature normal and superconductivity states, types of super conductors, BCS theory, London Equations, High temperature superconductor and applications.	**10L**
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**01**

Ref. Books

1. Material Science by S.L. Kakani & Amit Kakani, New Age International Publishers.
2. Material Science & Engineering by Shashi Chawla, Dhanpat Rai & Co.
3. Solid State Physics by S.O. Pillai, New Age International Publishers.
4. Solid State Physics & Electronics by A. B. Gupta & Nurul Islam, Books and Allied (P) Private Ltd.
5. A Textbook of Material Science & Engineering by Er. R.K. Rajput, KATSON books
6. Semiconductor Physics and Devices by Donald A. Neamen, Tata McGraw Hill.
7. Solid State Physics by P.K.Palanisamy, Scitech.
8. Materials Science and Engineering by V. Raghavan, Prentice-Hall of India Private Limited
9. Principles of Materials Science and Engineering by W.F. Smith, McGraw Hill, New York.
10. An Introduction to Materials Science & Engineering by W.D.Callister, John Wiley & Sons.
11. Elements of Materials Science and Engineering by L.H. Van Vlack, Addison Wisley, New York.
12. D. W. Richardson, Modern Ceramic Engineering.

Paper Name : Electrical Machine-I Laboratory
Paper Code : EE-451

Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

1. O.C and S.C test of single phase transformer.
2. Parallel operation of single phase transformer.
3. Polarity test on single phase transformers and study of the different connections of three-phase transformers.
4. Study of the equivalent circuit of a single-phase transformer.
5. Experiment of Auto transformer.
6. Experiment of scott connection of transformer.

Paper Name : Power System-I Laboratory
Paper Code : EE 452
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of experiments

1) Determination of the generalized constants A,B,C,D of a long transmission line.
2) Determination of Transmission parameters for T and Π network.
3) Dielectric strength test of insulating oil (IS 4800).
4) Different parameter calculation by power circle diagram.
5) Study of different types of insulators, determination of physical parameters and also protected 3ph distance.
6) Power factor calculation of an alternator.
7) Measurement of earth resistance by earth tester.

Paper Name : Digital Electronics and Circuits Laboratory
Paper Code : ECE 471
Weekly load : L: 0 T: 0 P: 3
Credit Point : 02
Total Marks : 100

List of Experiments:

1. To Study and Verify the Truth Table of Different Basic Logic Gates (NOT, AND, OR, NAND, NOR, EX-OR).

2. To Study and Implementation of Different Basic Logic Gates using Universal Gates (NAND, NOR) and verification of De-Morgan's theorem.

3. Design and Verify the logic circuit of Half Adder and Full Adder Using Basic Logic Gates.

4. Design and Verify the logic circuit of Half Subtractor and Full Subtractor Using Basic Logic Gates.

5. Design and Verify of Binary to Octal Decoder Using Basic Logic Gates and Study of Decoder IC 74138.

6. Design of 4:1 Multiplexer Using Basic Logic Gates and Study of Multiplexer IC 74153.

7. Study of BCD to Decimal Decoder Driver by Using Decoder Driver IC 7447 and Seven Segment LED Display Device LTS-542.

8. Design and Verify of S-R, J-K, D and T type Flip Flop Using Basic Logic Gates.

9. Design and Study of four bit Shift Resistor using IC 7474 in different Modes: a) Serial in-Serial out; b) Serial in-Parallel out; c) Parallel in-Serial out; d) Parallel in-Parallel out.

10. Design and Study of Asynchronous (Ripple) Counter of given modulus by using IC 7476.

11. Study Decimal to BCD Priority Encoder & Encoder IC 74147.

12. Design of 8 bit Parity Generator/Checker circuit using IC 74180.

13. Design and Study of 8 bit A/D Converters.

14. Design and Study of 8 bit D/A Converters.

Semester-V

Paper Name : Electrical Machines-II
Paper Code : EE-501
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**DC Machines:** Detail construction. Operating Principle. Function of commutator and brush system. DC machine as motor and generator.. Shunt ,series and compound excitation. Voltage building up of DC shunt generator. DC motor general torque equation. No-load operation. Armature windings, equalizers. Armature reaction effects, mmf distribution, compensating windings, improvements. Commutation, sparking, brushes, interface film, interpoles. Various losses in the DC machine. Core loss.	12L+3T
2	**DC Generators:** Characteristics with different excitation systems, voltage regulation, parallel operations.	5L+3T
3	**DC Motors:** Characteristics with different excitation, methods of starting, speed control, torque characteristics, Permanent magnet DC machines. **Testing of DC machines:** Swinburne test, Hopkinson's test, Brake test. Tests specified as per standards.	8L+4T
4	**Three Phase Induction Motor:** Per Phase equivalent Circuit. Phasor Diagram. Types of windings. Deep bar and double cage rotor. Pole changing motor. Equations of torque. Torque-speed characteristics, crawling and cogging of induction motor. Effect of change of rotor resistance in slip-ring machine and slip power recovery. Circle diagram. Methods of starting and speed control. Tests as per standards. Separation of losses. Operation of induction machines as generator.	9L+4T
	Total	42L+14T
	Total week required	14
	No of week reserved	02

Books:

1.Clayton & Hancock,"Performance and Design of DC machines"
2. P. S. Bimbhra,"Electrical Machinery", Khanna Publishers
3. M.G.Say,"The Performance and Design of Alternating Current Machines"
4. S K Sen, " Electrical Machinery"

Paper Name : Power Systems -II
Paper Code : EE-502
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Transmission line structure-** Types of conductors, line supports – poles, towers, struts & Guy wires, sag and tension calculations, stringing chart, sag template. **Insulators –** Materials of insulators, types of insulators – Pin and Disc type – their applications, post, tie, strain suspension type insulator and Earthing Horn. **Underground Cables –** Construction of cables, single and multicore cables, different types, capacitance of belted cables, dielectric loss in cables, heating of cables, Breakdown failure of cable, XLPE cable.	11L+4T
2	**Calculation of line parameters–** Resistance, Inductance, Capacitance and Conductance. Inductance of single phase line, inductance of three phase line with symmetrical and unsymmetrical spacing, concept of GMD and GMR. **Capacitance of Transmission line conductors –** stranded conductors, bundle conductor and Double circuit lines. Capacitance of single phase line, capacitance of three phase lines with symmetrical and unsymmetrical spacings, capacitance calculation for double circuit line and bundle conductor. Effect of earth on capacitance calculation. Skin effect and proximity effect.	9L+4T
3	**Line representation –** Representation of short, medium and long lines , Pai and T models. A,B,C,D constants of transmission lines and their measurement. Traveling wave interpretation of long line equations, tuned lines. **Per-Unit representation of Power system:** Selection of base quantities, percent and per unit values, advantage of per unit system.	9L+2T
4	**AC Transmission:** Power flow through a line, power circle diagram, line charts, active power flow and voltage control in transmission system. Line loadability and voltage dependence.	5L+2T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1.Power System Analysis by J.J.Grainger & W.D.Stevension, McGraw Hill
2.Power System Engineering, by I.J.Nagrath & D.P.Kothari, Tata McGraw Hill
3.Electrical Power Systems, by Ashfaq Husain, Vani educational Books
4.Elements of Power System Analysis, by W.D.Stevension, McGraw Hill
5. Elements of Power Systems by P.K.Sadhu & S.Das, CRC Press London.

Paper Name : Power Electronics Devices and Applications
Paper Code : EE-503

Weekly Load : L: 03 T: 01 P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**Introduction:** Application of Power Electronics to : Motor control with emphasis on Traction and Industrial Process control, Power Supplies - Revolution in Personal Computers UPS, Power Transmission - Facts Technology, HVDC, Chemical Process, Battery charging, Power extraction from non-conventional energy sources, Automotive electronics. **Power Semiconductor Devices:** Construction, Principle of operation, Characteristics and applications of Power Transistor & Thyristor. Characteristics of GTO, DIAC, MCT, TRIAC, Power MOSFET and IGBT; Two-Transistor Model of Thyristor, Thyristor Commutation methods.	8L+2T
2	**SCR:** Construction and characteristics, specification and ratings, pulse transformer, optical isolators, methods of turn on, triggering circuits for SCR: R, RC, UJT relaxation oscillator. Rating extension by series and parallel connections, string efficiency. Protection of SCR-Protection against over voltage, over current, dv/dt, di/dt, Gate protection. **Rectifiers:** Diode rectifiers Applications: Power Supplies, Front end converter for ac motor drives, battery charger, chemical process. Single phase Half wave with R load, Single phase Half wave with R-L load, Single phase Full bridge rectifier with dc link capacitive filter, issue of harmonics, Three phase Full bridge rectifier with dc link capacitive filter, issue of harmonics.	12L+4T
3	**Converters-I:** Single Phase half & full wave converters with RL & RLE load, Single phase dual converters, Three phase half wave converters. Three phase full converters with RL load, Three phase dual converters. **Converters-II:** Single and three-phase semi converters with RL & RLE load. Power factor improvement-Extinction angle control, symmetrical angle control, pulse width modulation control and sinusoidal pulse width modulation control. Inversion operation. Effect of load and source impedances.	12L+4T
4	**DC-DC Converters:** Step Up/Down Copper, Control strategies, Chopper Configurations, Analysis of type A Chopper. Voltage, current and load commutated chopper. Multiphase Chopper. **DC- AC Power Converters:** Principle of operation of Inverters, Half bridge, full bridge, three phase- six step operation, voltage control, PWM techniques.	10L+4T
	Total	**42L+14T**
	Total Week Required	**14**
	No. of Week Reserved	**02**

Text/Reference Books:

1. M. H. Rashid: Power Electronics, Circuits Devices and Applications, Pearson. 2011
2. P. S. Bimbhra: Power Electronics, Khanna Publishers. 2012
3. Ned Mohan: Power Electronics, John Wiley. 2013
4. Krein P. T.: Elements of Power Electronics, Oxford. 1998

5. M. D. Singh and K. B. Khanchandani: Power Electronics 2/e, MGH.2008

Paper Name : Control Systems-I
Paper Code : EE 504
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Introduction to control system:** Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.	5L+ 1T
2	**Mathematical modeling of dynamic systems** Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. **Control system components:** Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.	11L+4T
3	**Transient analysis of closed loop systems**. Transient errors and their minimization, steady state error and their minimization, error coefficients, P, PI and P-I-D type controllers.	11L+ 5T
4	**Stability of Control Systems:** R-H criteria, Nyquist criteria, Bode Plot, Polar Plot. Construction of Root Loci for simple systems, effects of the movement of poles and zeros. **Control System performance measure:** Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation.	15L+ 4T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

BOOKS:

1. Kuo B.C.: Automatic Control System, PHI
2. Madan Gopal: Control Systems: Principles and Design, TMH
3. Das Gupta S : Control System Theory ; Khanna Pub.
4. Nagrath I J & Gopal M : Control Systems Engineering, New Age International Pub.
5. Ogata K : Modern Control Engg. PHI
6. Dorf R C & Bishop R.H.: Modern Control System ; Addison – Wisley
7. Bolton: Industrial Control & Instrumentation, Orient Longman
8. Nakra: Theory & Applications of Automatic Control, New Age International
9. Gopal: Modern Control System Theory, New Age International
10. Sinha: Control Systems, New Age International
11. R & P Ramesh Babu: Control System Engineering
12. B S Manke: Linear Control System
13. D Roy Choudhury: Modern Control Enginering

Paper Name : Electrical and Electronics Instrumentation
Paper Code : AEIE 521
Weekly Load : L: 3, T:1, P:0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	Measurement System: Unit, Dimensions, Standards, Errors, Instrument Characteristics, Testing, Compatibility, Calibration and Traceability Analog & Digital Instruments: voltmeter, ammeter, ohmmeter of both type, merits & demerits and applications	12L+4T
2	Electronic Wave Analyzer and Spectrum Analyzer: basic operation, classification, merits & demerits and applications Definition of sensor and transducer; transducers-classification; discussion of functional elements of transducer: primary sensing elements, signal conditioning units, signal manipulating units, signal executing units and output elements	10L+2T
3	Introduction to Electrical & Electronic Instruments for measurement of industrial non-electrical quantity like pressure, temperature, flow level etc. basic concept, working principle and applications	10L+2T
4	Megger, Q-factor & Q-Meter, Power Factor meter-working principle, classification, applications Grounding and Shielding: basic concept of Earth ground, explanation of earth return path, shock hazard protection, grounding consideration, shielding guideline considerations, electrostatic discharge. Intelligent Instrumentation & SMART Instrumentation-introduction, features, block schematic, applications and case studies.	10L+6T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Text/Reference Books:

1. Dr. N. K Datta, Electrical & Electronic Measurements and Instrumentation Engineering; Books and Allied (P) Ltd.
2. Alan S Morris; Measurements and Instrumentation Principles; Butterworth-Heinemann Pub.
3. J.W.Dally, W.F.Riley, K.G.Mcconnell, Instrumentation for Engineering Measurements Wiley Edition
4. Kalsi,H S ; Electronic Instrumentation, TMH
5. Anand MMS; Electronic Instruments and Instrumentation; PHI

Paper Name: Principles of Communication Engineering
Paper Code: ECE 522
Weekly Load: L: 3 T: 0 P: 0
Credit Point: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period

1.	**Signals, Fourier series and Fourier Transform:** Introduction to fundamental elements of communication systems. Concepts of signals and spectrum, spectrum allocation for different communication systems. Baseband and Bandpass transmission of signals. Discussions about communication channels and propagation characteristics. Introduction, brief discussions of Fourier series and Fourier transformations, properties of Fourier transformation with application.	12L
2.	**CW Modulation:** Basic concepts and necessity of Modulation. Classifications of CW modulation. Amplitude Modulation**:** Definition, time and frequency analysis for AM, basic concepts of DSB-SC, SSB-SC and VSB-SC modulation. Different types of modulator and demodulator circuits of Amplitude Modulation (e.g. Square law modulator, balanced modulator, ring modulator, envelope detector etc.) Angle Modulation: Principles and definitions, relationship between frequency and phase modulations, narrow and wide band FM. Different types of modulator and demodulator circuits of Frequency Modulation (e.g. Direct and Indirect modulator, Slope detector, PLL etc.)	10L
3.	**Pulse Modulation and Pass Band Data Transmission:** Sampling theorem, Nyquist criterion, Interpolation. Definitions and overview of PAM, PPM, PWM. Concepts of PCM, DM. Concept of digital carrier modulation, generation and detection of ASK, FSK, PSK, basic concepts of BPSK & QPSK.	13L
4.	**Information Theory and Coding:** Definition of information, entropy, channel capacity, different channel codlings i.e. Shannon fano, Huffman coding, linear block code, cyclic code etc.	7L
	TOTAL:	**42L**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

TEXT/ REFERENCES BOOKS:

1 Electronic Communications – Dennis Roddy and John Coolean , 4th Edition, PEA, 2004
2 Modern Analog and Digital Communication – B.P.Lathi, Oxford reprint, 3rd edition, 2004
3 Analog and Digital Communications – Simon Haykin, John Wiley, 2005.
4 Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.
5 B.Carlson, Introduction to Communication Systems (4/e), McGraw-Hill
6 Principles of Communication Systems – H. Taub & D. Schilling , TMH, 2nd Edition, 2003

Paper Name : Electrical Machines-II Laboratory
Paper Code : EE-551
Weekly Load : L:0, T:0, P:3
Credit Point : 02
Total Marks : 100

List of Experiments:

1. Study of the characteristics of a separately excited D.C generator.
2. Study of the characteristics of a compound generator.
3. Study of the characteristics of a D.C shunt motor.
4. Speed control of D.C shunt motor.
5. Study of the characteristics of a D.C compound motor.
6. Measurement of the speed of a D.C series motor as a function of load torque.
7. To make connection diagram of full pitch & fractional slot winding of a 36-slot squirrel cage induction motor for 6-pole, 4-pole & 2-pole operation.
8. Different method of starting of 3-phase squirrel-cage induction motor & their comparison [DOL, auto-transformer & star-delta starter].
9. Speed control of 3-phase squirrel-cage induction motor by different methods & their comparison [voltage control & frequency control].

Paper Name: Power Systems - II Laboratory
Paper Code : EE-552
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 02
Total Marks: 100

List of Experiments:

1. Study on (i) on load Time Delay Relay (ii) off load Time Delay Relay
2. Polarity, Ratio and Magnetization Characteristics Test of CT & PT
3. Testing on (i) Under Voltage Relay and (ii) Earth Fault Relay
4. Study of Different Characteristics of Over Current Relay
5. Dielectric constant, tan delta, resistivity test of transformer oil.
6. Study of VAR compensator.

Paper Name : Power Electronics Laboratory
Paper Code : EE-553
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

1) Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents.
2) To find out V-I characteristics of TRIAC and DIAC.
3) To find out output characteristics of MOSFET and IGBT.
4) To find out transfer characteristics of MOSFET and IGBT.
5) To find out UJT static emitter characteristics and study the variation in peak point and valley point.
6) To study and test firing circuits for SCR-R, RC and UJT firing circuits.
7) To study and test 3-phase diode bridge rectifier with R and RL loads. Study the effect of filters.

8) To study and obtain waveforms of single-phase half wave controlled rectifier with and without filters. To study the variation of output voltage with respect to firing angle.
9) To study and obtain waveforms of single-phase half controlled bridge rectifier with R and RL loads.To study and show the effect of freewheeling diode.
10) To study and obtain waveforms of single-phase full controlled bridge converter with R and RL loads. To study and show rectification and inversion operations with and without freewheeling diode.
11) Control the speed of a dc motor using single-phase half controlled bridge rectifier and full controlled bridge rectifier. Plot armature voltage versus speed characteristics.

Paper Name : Control Systems - I Laboratory
Paper Code : EE-554
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

Module 1: Familiarization with MATLAB control system tool box, MATLAB SIMULINK toolbox.

Module 2: Determination of step response for first order & second order system with unity feedback on CRO & calculations of control system specifications like time constant, percentage peak overshoot, settling time etc. from the response.

Module 3: Simulation of step response & impulse response for type-0, type-1 & type-2 system with unity feedback using MATLAB.

Module 4: Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system toolbox for 2^{nd} order system & determination of different control system specifications from the plot.

Module 5: Determination of PI, PD, PID controller action of first order simulated process.

Module 6: Determination of approximate transfer function experimentally from the Bode plot.

Module 7: Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin with addition of lead compensator & by compensator in forward path transfer function for unity feedback control system using PSPICE or otherwise.

Semester-VI

Paper Name : Electrical Machines-III
Paper Code : EE-601
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Single Phase induction motor:** Split phase capacitor –start-induction-run with centrifugal switch. Operating principles. Operating characteristics. Double revolving field theory, cross field theory. Equivalent circuit, phasor diagram.	8L+4T
2	**Synchronous Generator:** Armature reaction, its effect on load power factor. Alternator regulation, synchronous reactance. Prediction of regulation by various methods. Cylindrical pole rotor and salient pole rotor construction. Two reaction theory. Damper windings. Short circuit transient and subtransient reactances. Determination of Xs, Xd, Xq, X1, X2 , X0, Xd', Xq', Xd'', Xq''. Methods of voltage control, static excitation system. Synchronisation of alternators, power flow, power angle characteristics, operating chart, synchronizing power, stability. Excitation characteristics, V-curves, parallel operation.	12L+4T
3	**Synchronous Motors:** Power developed, circle diagrams for constant power developed and constant excitation. V-curves and O-curves. Starting methods. Operation as synchronous condenser.	10L+3T
4	**Special Electromechanical devices:** Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper motor, Tacho-generators, Synchros & resolvers. AC servo motors, Universal motor and A. C series motor, Principle, construction and operational characteristics of linear Induction motor.	12L+3T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. P. S. Bimbhra,"Electrical Machinery", Khanna Publishers
2. M.G.Say,"The Performance and Design of Alternating Current Machines"
3. Puschtein & Lloyd,"Alternating Current Machines"
4. E. O. Taylor,"The Performance & Design of AC Commutator Motors"
5. P.K.Mukherjee & S. Chakravorti,"Electrical Machines", Dhanpat Rai & sons.

Paper Name : Power Systems -III
Paper Code : EE-602
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Load flow Studies:** Classification of buses, Formation of Y_{bus}, SLFE, G-S and N-R method for solving load flow, Fast-decouple method and advantages of them. **Faults Analysis:** Analysis of symmetrical and asymmetrical faults in power system.	14L+4T
2	**Different types of circuit breakers** General requirements of circuit breakers, their relative merits and demerits. Specific field of usage Auto-reclosing feature – three pole & single pole auto-reclosing. Formation of electric arc. Arc build-up and quenching theory, recovery voltage and RRRV, Arc restriking phenomena. Problems of capacitive and low inductive current interruptions. Rating of circuit breakers and effect of transient current on it. Different types of arc quenching media and special devices for arc quenching. Testing of circuit breakers. D.C circuit breaking, operating mechanism of circuit breaker.	8L+3T
3	**Different types of relays :** Protective Relays; Basic requirements and type of protection, reviews of relay characteristics and operating equations, protective CTs, PTs, , phase and amplitude comparator, classification of Electromagnetic relays, Plug Setting Multiplier and Time Multiplier setting, Universal Torque Equation, Non Directional Relay, Directional relay, Distant relay, Differential relay.	8L+3T
4	**Protection of Alternators:** Protection against Stator fault (Phase to Phase and Phase to Ground), Balanced earth fault protection, Stator inter turn protection, Unbalanced loading of Alternator, Prime Mover failure, Overvoltage protection, Overloading (or over current) Protection, Restricted Earth fault and standby earth fault protection, Rotor Fault Protection. **Protection of Transformer:** Overcurrent and unrestricted Earth fault protection, Different CT connections, Balanced (Restricted) earth fault protection, Harmonic restraint, Frame leakage protection. **Bus bar, Feeder, Transmission line Protection:** Bus bar Protection: Circulating Current Protection, Frame Leakage Protection. Feeder protection: Time Graded protection, Differential Protection. Transmission Line Protection: Introduction to distance relay, Simple Impedance relay, Reactance relay, Mho relays, comparison of distance relay – Choice between Impedance, Reactance and Mho relay, High speed Impedance relay, setting of distance relays. Pilot Relaying Schemes: Wire Pilot Protection, Carrier Current Protection. **Power system stability:** Steady state and transient stability, Swing equation and its numerical solution, equal area criterion for transient stability, improvement of transient stability.	12L+4T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. Power System Engineering, by I.J.Nagrath & D.P.Kothari, Tata McGraw Hill
2. A. Chakrabarti,M.L. Soni, P. V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", Dhanpat Rai and Co.
3. Paithankar.Y.G and Bhide.S.R, "Fundamentals of Power System Protection", Prentice-Hall of India.
4. Badri Ram and Vishwakarma.D.N, "Power System Protection and Switchgear", Tata McGraw- Hill Publishing Company,2002.

5. Arun K. Phadke, James. S. Thorp, "Computer relaying for Power system", John Wiley and sons, New
York, 1998.
6. Patra, S P Basu, S K Choudhuri, "Power System Protection".

Paper Name : Control Systems-II
Paper Code : EE-603
Weekly Load : L: 03 T: 01 P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**Classical Control and Background of Modern control:** Concept of Linear vector space Linear Independence, Bases & Representation, domain and range. Concept of Linearity, relaxedness, time invariance, causality. **:** Modern Vs conventional control theory, PID Control and Classical compensator design using time and frequency domain tools.	7L+2T
2	**State Space Approach of Control System Analysis:** Concept of state, state variable state vector, state space, state space equations, Writing state space equations of mechanical, Electrical systems, Fluid systems, Analogous systems. State Space Representation using physical and phase variables, comparison form of system representation. Block diagram representation of state model. Signal flow graph representation. State space representation using canonical variables. Diagonal matrix. Jordan canonical form, Derivation of transfer functions from state-model. Eigen values and Eigen vector problems. Similarity transformations and diagonalization, Vandermonde matrix. State transition matrix, Properties of state transition matrix, Properties of linear transformation, Solution of state equation, Evaluation of state transition matrix using Caley-Hamilton theorem. concepts of controllability & observability, Pole placement by state feedback.	10L+4T
3	**Digital Control Systems:** Introduction, sampled data control systems, signal reconstruction, difference equations. The z-transform, Z-Transfer Function. Block diagram analysis of sampled data systems, z and s domain relationship. Modeling of sample-hold circuit, steady state accuracy, stability in z-plane and Jury stability criterion, bilinear transformation.	9L+4T
4	**Non-linear systems:** Non-linear systems. Characteristics of nonlinear systems Jump resonance, Chaos and bifurcation, Limit cycle, Various incidental and intentional nonlinearities, Describing functions of common Non-linearity, Stability Analysis by Describing Function method, Prediction of limit cycles using describing function technique, Phase plane analysis of linear and nonlinear second order systems, Methods of obtaining phase plane trajectories by graphical method, isoclines method, Qualitative analysis of simple control systems by phase plane methods, Stability concepts for nonlinear systems. BIBO Vs steady state stability. Definitions of Lyapunov functions. Lyapunov analysis of LTI systems, Asymptotic stability, Global asymptotic stability. The first and second methods of Lyapunov to analyze nonlinear systems, Popov's Circle Criterion. Introduction to variable structure control (VSC), Basics of Sliding Mode Control (SMC).	16L+6T
	Total	**42L+14T**
	Total Week Required	**14**
	No. of Week Reserved	**02**

Text/Reference Books:

1. M. Gopal: Digital Control and State Variable Methods, MGH. 2012
2. B. C. Kuo: Digital Control System, Oxford. 1980
3. Ogata K : Modern Control Engg. – PHI/ Pearson Education
4. Stefani, Design of feedback Control System, OUP

5. D. Roy, Choudhary: Modern Control Engineering, Prentice Hall of India.
6. Gibson J E : Nonlinear Control System - McGraw Hill Book Co.
7. Goodwin, Control System Design, Pearson Education

Paper Name: **Advanced Signal Processing**
Paper Code: **ECE 623**
Weekly Load: **L: 3 T: 1 P: 0**
Credit Point: **3**
Total Marks: **100**

Module	Detailed Description	Lecture/ Tutorial Period
1.	**INTRODUCTION TO DIGITAL SIGNAL PROCESSING AND DISCRETE TIME SYSTEMS** Signals, Signal Processing and Its benefits, Examples of Signals, Classification of Signals, Application areas, Typical Signal Processing Operations, Overview of real-time Signal Processing, Advantages Digital Signal Processing. Sampling of Continuous Signal, Signal Reconstruction, Practical Considerations for Signal Sampling: Anti-Aliasing Filtering, Practical Considerations for Signal Reconstruction: Anti-Image Filter and Equalizer, Analog-to-Digital Conversion, Digital-to-Analog Conversion, Quantization. Introduction, Discrete time Signals and Systems, Operations on Sequences, Classification of Discrete-time Systems, Convolution and Correlation, Linear Time Invariant (LTI) System, System described by Difference Equation, Recursive and Non-recursive Systems.	9L +2T
2.	**Correlation , convolution and discrete-time Fourier transform (DTFT)** Convolution: Introduction, Discrete-time LTI Systems: Impulse Response, Convolution Sum, Graphical Method for Convolution Sum, Analytical Method, Properties of Convolution, Circular Convolution, Fast Linear Convolution, Computational Advantages of Fast Linear Convolution. Correlation Description: Cross-correlation and Auto-correlation, Applications of Correlation, Fast Correlation, Relationship between Convolution and Correlation. Discrete-time Fourier Series: Evaluation of DTFS Coefficient, Magnitude and Phase Spectrum of Discrete-time Periodic Signals, Properties of Discrete Time Fourier Series Discrete-time Fourier Transform and its Inverse, Properties of Discrete-time Fourier Transform, Fourier Transform of periodic Signals	8L+4T

3.	**Discrete Fourier transform (DFT) and the z-transform** Introduction: Fourier Series, Fourier Transform, DFT and its Inverse, DFT as a Linear Transformation, Properties of DFT, Filtering of Long Data Sequences using DFT: Overlap-save Method, Overlap-add Method, Computational Complexity of DFT. Fast Fourier Transform (FFT): The Decimation-in-Time Fast Fourier Transform (DIT-FFT) Algorithm, Butterfly Diagram, Algorithmic Development, Computational advantage of the FFT, Inverse Fast Fourier Transform, The Decimation-in-Frequency Fast Fourier Transform (DIF-FFT) Algorithm, Comparison of DIT and DIF algorithm. Introduction, Region-of-Convergence and its Properties, Relationship between: z-Transform and DTFT, z-Transform and Laplace Transform, z-Transform and Discrete Time Fourier Series, Properties of z-Transform, The Inverse z-Transform: Power Series Method, Partial Fraction Expansion Method, Residue Method, Applications of z-Transform	11L+4T
4.	**Digital filter:** Introduction of digital filters, FIR, IIR filters, their representation advantages and disadvantages. Design of FIR filter: Linear phase filter, rectangular window technique, Gibbs phenomenon, different windows- Bartlett, Hamming, Hanning, Kaiser etc. Design of IIR filter from analog filter, Bilinear Transformation method, Impulse invariant method, Butterworth, Chebyshev. Elliptic IIR filters. Realization of IIR and FIR filters-structures, Direct form-I and II structures, cascade and parallel structures, Filter design using Pole-zero placements.	14L+4T
	TOTAL:	**42L+14T**
	Total Week Required	14
	No. of Week Reserved	02

Books recommended:

1. J.G. Proakis & D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, *Pearson/PHI*
2. R. Babu, Digital Signal Processing, *Scitech*
3. S.K.Mitra, Digital Signal Processing - A Computer based approach, *TMH.*
4. S. Salivahanan et al, Digital Signal Processing, *TMH*
5. E.C. Ifeachor et.al., Digital Signal Processing : A Practical approach, *Pearson Education.*
6. Hammimg R.W, Digital Filters, *Pearson/ PHI*
7. A.Oppenheim, R.Schafer , Digital Signal Processing, *Pearson/PHI.*
8. Roman Kuc, Introduction to DSP, *BS Publication.*
9. L.R. Rabiner & B.Gold, Theory and Application of Digital Signal Processing, *Pearson/PHI*
10. K.Padmanabhan, S.Ananthi & R.Vijayarajeswaran, A Practical Approach to Digital Signal Processing- *New Age*
11. Ingle, Digital Signal Processing using MATLAB, *Vikas Pub.*
12. Lyons, R.G. Understanding digital signal processing. *Pearson Education*

Paper Name : Microprocessors and Microcontrollers
Paper Code : ECE 621
Weekly Load : L : 3 T : 1 P : 0
Credit Point : 3
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	**Introduction and Architecture of 8085 microprocessor:** Definition of Microprocessor & Microcomputer System, The evolution of microprocessors (from 4 bits onwards). Basic functions of a microprocessor. Various sections of 8085 Microprocessor such as Register section, Arithmetic & Logic Unit, Timing control unit, Interface Section etc, Pin configuration of 8085, timing diagram & execution, Demultiplexing & buffering of system buses of 8085 CPU. Instruction set, classification of instructions, addressing modes, software model of 8085 CPU.	9L + 2T
2.	**Assembly Language Programming using 8085 CPU:** Program writing for different arithmetic operation with 8-bit & 16-bit binary numbers and BCD numbers, writing program using time delays & calculation of T-states, Concepts of Stack & Sub-routine, Program for searching & sorting using Stack & Subroutine. Code conversion, concept of look-up table.	10L +4T
3.	**Memory and Memory interfacing, Interrupt structure of 8085 and I/O interfacing technique:** Memory elements; RAM, ROM, PROM, EPROM, EEPROM, Memory constituents. Memory expansion; Interfacing of RAM, ROM, EPROM & DRAM etc, EPROM programming. **& their uses.** Different interrupts used for 8085, RIM, SIM. Peripheral mapped I/O & Memory mapped I/O, data transfer schemes-synchronous, asynchronous & interrupt driven data transfer, DMA data transfer, Use of SID and SOD pins of 8085.	11L + 3T
4.	**Interfacing Chips:** 8255, 8253, 8251, 8279, 8259 & 8237. Interfacing of DAC, ADC, keyboards, printer, and displays using 8255. Basic concept of RISC and CISC based machines. .	12L + 5T
	TOTAL:	42L +14T
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books: Text and/or **Reference:**

1. Microprocessor Architecture, Programming & Application-R. Gaonkar, Wiley.
2. Fundamental of microprocessor, Uday Kumar, Pearson.
3. 8085 Microprocessor Programming & Interfacing- N.K Srinath-PHI.
4. Microprocessor-Theory & Application-M. Rafiquezzaman;PHI.
5. Advanced Microprocessor & Peripherals-Ray & Bhurchnadi, Tata- McGrowHill.
6. Fundamentals of Microprocessors and Microcontrollers – B. Ram, Dhanpat Rai.

Paper Name : Industrial Management and Entrepreneurship
Paper Code : HS-601
Weekly Load : (L=3, T=0, P=0)
Credit Point : 02
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	Introduction: Management: Its Nature, Purpose and Importance, Management process: Planning, Organizing, Staffing, Directing and Controlling, Management Function: Marketing, HR and OB, Operation and Financial Management. Analytical and statistical Tools and techniques used in management: Forecasting based on cross sectional and longitudinal data as a part of managerial planning. Quantitative tools for Decision making. PERT and CPM as efficient controlling techniques.	10L
2	Motivation, Leadership and HRM in Organization: Maslow's Hierarchy' of Needs theory, Herzberg's Two factor theory, Broom's Expectancy Theory, Leadership: Trait approaches-Leadership Behavior and Styles(overview), Brief overview of HRM with emphasis on HR process. Marketing Management: Concept of customer centric marketing management, Basic Idea of Segmentation Targeting and Positioning. Understanding Marketing Mix.	10L
3	Financial Management: Importance and Scope of Financial Management. Overview of Working Capital management,CVP analysis and Capital Budgeting. Indian Financial Market emphasizing on Sensex Calculation. Operations Management: Basic Idea on Plant location and facility layout, Tools and Techniques for measuring productivity. Measurement of Quality for Product and Service. Basic understanding on Inventory Management. Overview of TQM and JIT.	10L
4	Business Environment and Strategic Management: Business Mission, Vision, Formulation of objectives, Assessment of the external environment with the help of SWOT, EAD including Portor's Industry Analysis, Assessment of Internal competences, Strategic alternatives, Portfolio Analysis. Innovation and Entrepreneurship: Enterpreneurship: Opportunity identification, Market Potential Estimation, Business plan development and feasibility analysis. Managing new innovation: new product development, intellectual property management. Brief idea about different types of venture capitalist and investors including financial organisation	12L
	Total	42L
	Total week required	14
	No. of week reserved	02

Books:

1. Industrial Management By S C jain, W S Bawa, Dhanpat Rai & Co (P) Ltd

2. Discourses of Strategic Management , Dilip Roy,Asian Book Private Limited
3. Strategic Management & Business Policy , Azhar Kazmi, McGraw Hill Education
4. Industrial & Business Management , Martand T. Telsang, S Chand Pub.
5. Management Theory & Practices , C B Gupta, S Chand Pub
6. Fundamentals of Entrepreneurship Development & Business Communication , Pranam Dhar, ABS Pub House.
7. Production & Operation Management , S Anil Kumar & N Suresh, New Age International pub.
8. Marketting Management , Kotler & Keller, Perason Pub.
9. Human Resource Management , Gary Dessler & Biju Varkkey, Pearson Pub.
10. Business Organization & Management , Tulsian, Pearson Education Asia Pub.

Paper Name : Electrical Machines-III Laboratory
Paper Code : EE-651
Weekly Load : L:0, T:0, P:3
Credit Point : 02
Total Marks : 100

List of Experiments :

1) Determination of regulation of an alternator by synchronous impedance method.
2) Determination of magnetization characteristics of an alternator. a) at no load, rated speed b) at no load, half of the rated speed c) at full load (non-inductive), rated speed.
3) Load test on 1-ph induction motor & deriving its performance characteristics.
4) Study of various connections of 6-coil alternator & its operation at no load.
5) To determine the direct axis reactance $[X_d]$ & quadrature axis reactance $[X_q]$ of a synchronous generator
6) Synchronization of alternators.
7) Determination of equivalent circuit parameters of a 1-phase induction motor.
8) Study of the equivalent circuit of three-phase induction motor by No-Load & Blocked-Rotor tests.
9) Study of the performance of wound rotor induction motor under load.
10) Study of the performance of three-phase Squirrel-cage induction motor-Determination of iron loss, Friction & wind-age losses.

Paper Name : Power System-III Laboratory
Paper Code : EE-652
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of experiments
1. Study on DC load flow
2. Study on AC load flow using Gauss-Seidel method
3. Study on AC load flow using Newton Raphson method.
4. Study on Economic load dispatch.
5. Study of different transformer protection schemes by simulation.
6. Study of different generator protection schemes by simulation.
7. Study of different motor protection schemes by simulation.
8. Study of different protection scheme for feeder.

Paper Name : Control Systems-II Laboratory
Paper Code : EE 653
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

1. Study of a practical position control system in closed loop.
2. Study of a practical temperature control process.
3. Characteristics of synchro Pair.
4. Tuning of P, PI and PID controller for first and second order plant with dead time using Z-N method. Design of PID controller for disturbance rejection.
5. Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.
6. **Simulation of physical systems in state space form:** Transfer Function to from State Variable model and vice versa. State variable analysis of a physical system - obtain step response for the system by simulation. State variable analysis using simulation tools. Obtain step response and initial condition response for a single input, two-output system in SV form by simulation.
7. **Simulation of physical systems in discrete state space form:** Study of closed response of a continuous system with a digital controller and sample and hold circuit by simulation.
8. Study of effect of nonlinearity in a feedback controlled system using phase plane plots. Determination of phase plane trajectory and possibility of limit cycle of common nonlinearities.
9. Simulation of Temperature Control System of a Heat Exchanger.

Paper Name: Microprocessors & Microcontrollers Lab
Paper Code: ECE 671
Weekly Load: L: 0 T: 0 P: 3
Credit Point: 2
Total Marks: 100

UNIT	Detailed Description
1.	**Basic assembly language programs writing and execution using 8085 and 8086 Microprocessors Trainer kit like:** a) Addition of two numbers or block of numbers. b) Subtraction of two numbers / difference calculation of two numbers. c) Sorting of data blocks (Ascending / Descending). d) Searching maximum and minimum number from a block of data. e) Multiplication and division of 8 bit data. f) Series calculation. g) Code Conversion (BCD to Binary or reverse) h) Square, Square Root & Factorial calculation of a given no etc

2.	**Basic experiments with Intel 8279, 8255, 8259 chips available on the trainer kit board.**
3.	**Interfacing of Microprocessor Trainer Kits with PC:** Interfacing through RS -232 cables and downloading the Hex code for the Assembly language programs from PC to kit and execution and verifying the programs from PC. Uploading the programs in RAM from microprocessor kit to PC and storing as a Hex file in the hard disk of a PC. Familiarization with different 8085 simulator on PC.
4.	Study of Traffic Light Control, Intel 8237 DMA controller, Intel 8259 Programmable Interrupt Controller through the help of different study kits.
5.	**Study of 8051 Micro controller kit and writing of basic programs:** a) Table look up b) Basic arithmetic and logical operations c) Interfacing of Keyboard and stepper motor

Semester-VII

Paper Name : Electric Drives
Paper Code : EE-701
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Electric Drive:** Concept, classification, parts and advantages of electrical dives. Types of Loads, load toques characteristics, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multiquadrant operation of drives. Load equalization. **Motor Control components and Basic Terminologies:** DOL starters, contactors, limit switches, relays etc. and example of motor control circuit like start -stop control star-delta starter, forward-reverse change –over principle and characteristics of the schemes. Base speed, speed ratio, constant torque drive, constant hp drive etc. **Regeneration in Drives:** Dynamic braking, regeneratine braking, Drive specifications. Four quadrant representations, dynamics of loading of motors with different types of load.	11L+4T
2	**Motor power rating:** Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors. **Power electronic control:** Power electronic control of starting of DC and AC motors. Accelerating time, energy loss in starting. Effect of flywheels. Realisation of the total converter system of AC and DC drives using choppers. Phase controlled rectifiers. Dual converters, Voltage Source inverters (VSI), Current Source Inverter (CSI). Current controlled VSI and cycloconverters. Basic operation of DC injection, plugging.	11L+3T

3	**Protection schemes:** Protection schemes for overall drive systems. **Electric Traction:** General introduction and requirements, speed-time curve mechanics in train movement. DC and AC traction supplies. Current collectors. Traction motors. Linear motors and magnetic levitation. Boosters in traction supplies.	9L+3T
4	**Solid state control of DC motors**: Basic principles. Drive schemes with armature voltage feedback and IR-compensations together with tacho feedback for both constant flux and field weakening. Modeling of the DC power converter system. **Solid state control of AC motors:** Basic principles. Drive schemes with stator voltage control. V/f control with constant flux and field weakening with and without tacho feed-back, slip compensation. Modelling of different AC converter system. Solid state control of synchronous motors.	11L+5T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books :

1) G. K. Dubey.'Fundamentals of Electrical Drives", Narosa Publishing House
2) N. K. De & P. K. Sen,"Electric Drives", Prentice Hall of India Ltd.

3) P.K.Sadhu & S.Das, "Modern Utilization of Electric Power: Including Electric Drives and Electric Traction". CBS Publication.

4) H. Partab,"Modern Electric Traction", Dhanpat Rai & Sons

Paper Name : High Voltage Engineering
Paper Code : EE-702
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period

1	Testing of cables, Thermal characteristics of cables Non-condenser and condenser bushings. Field distribution in and around bushings. Technical and economic considerations Corona discharge, Corona Loss and radio interference, Suppression of corona and its ill effects.	10L+4T
2	Travelling wave equations, Reflection and refraction of travelling waves, Line terminations, Ladder diagram, Travelling waves in multi-conductor systems. Causes of lightning over voltages, Interaction between lightning and power system, Causes of switching surges and power-frequency over voltages, Estimation of switching surges in power system Basic idea about protection against over voltages, Lightning arresters and surge suppressors, Ground wires, Grounding practices, Insulation coordination scheme of open-air substation. Basic Impulse Level, Statistical Methods Generation of High AC Voltage – Testing transformer and its cascade connection, single-phase series resonance circuit.	11L+6T
3	Generation of High DC Voltage – Single-stage and multi-stage symmetric as well as asymmetric voltage multiplier circuits, Generation of Impulse Voltage – Single-stage and multi-stage impulse generators circuits, Triggering and synchronization with CRO. Measurement of Peak value of high AC Voltage – Frequency dependent method: Chubb & Fortescue Method, Frequency independent methods: Davis-Bowdler Method, Rabus Method, Sphere-Gap Method.	10L+4T
4	Measurement of RMS value of high AC Voltage – Capacitive Voltage Transformer, Potential Dividers, Electrostatic Voltmeter. Measurement of High DC Voltage – Ammeter in series with high resistance Measurement of Dielectric Loss-factor – High Voltage Schering Bridge. High Voltage type tests of insulators, Impulse test of transformers as per relevant Indian standards.	8L+2T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. High Voltage Engineering Kuffel and Zaengl
2. High Voltage Measurement Techniques A.J.Schwab
3. High Voltage Engineering D.V.Razevig
4. High Voltage Engineering Naidu & Kamaraju

Paper Name : Power Station Practice
Paper Code : EE-703
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Introduction**: One line diagram of different cycles. Single line electrical layout diagram of Switchyard, Generators, Transformers, Bus bars, Feeder bays, Main bus, Transfer bus, Bus coupler, Bus tie, Bus bar operations with merits and demerits.	6L+2T
2	**Alternator:** Active and reactive power control, Capability curve, under and over excitation control, choice of excitation system, synchronization, Power System Stabiliser and its role towards power system dynamics, Rotor and stator temperature monitoring, cooling and Hydrogen pressure control, rating of alternator, significance of Short Circuit Ratio, present and future trend in alternator design. **Process Control and Instrumentation:** Types of control and instrumentation in generating station viz combustion control, total Air control, Drum Level control, Furnace Draught control, Deaerator control, Heater control, Super heater Temperature control etc.	15L+4T
3	**Different types of Electrical control panels:** Electrical Control room, unit control room, local control room, their instruments and protection interlock, Annunciation system, Generator-Transformer-feeder protection interlock, Bus duct. **Plant Auxiliaries:** Switch Gear, Motor Control Centers, auxiliaries, their ratings, location, interlock, Cooling Water pump house, Intake pump house, Auxiliary Cooling Water Pump. Ash water pump, Boiler Feed Pump, I.D. fans F/D Fan, Primary Air Fan, Mill motor interlock etc. **Cooling System:** Direct and indirect cooling, size and requirements, DM Plant.	9L+4T
4	**Ash Handling System:** Electrostatic Precipitator, duty, requirements. **Coal Handling Plant:** Control room, crusher room, conveying arrangement. **Testing & Commissioning :** Routine test and pre commissioning test of Transformer, Generator, motor etc. **Start up:** Shut down and maintenance.	12L+4T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1. Deobelin E O: Measurement System - Application and Design; TMH.
2. Arora S C & Domkundwar S: Power Plant Engg.; Dhanpat Rai & Co. (P) Ltd.
3. Johnson C: Process Control Instrumentation Technology; PHI/Pearson Education
4. Watt Boyes (Editor): Instrumentation Reference Book, 3rd ed.; Butterworth Heineman
5. Douglas M. Considine: Process / Industrial Instruments & Controls Handbook, 4th Ed.; McGraw Hill International Edition.
6. Modern Power Station Practice (Control & Instrumentation), Vol-F; Pergamon Press.

Paper Name: Process Instrumentation and Control
Paper Code: AEIE 721
Weekly Load: L: 3 T: 0 P: 0
Credit Points: 2
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	Basic concepts of instrumentation system: General Instrumentation system with block diagram representation, static and dynamic characteristics of instruments, statistical analysis, different types of errors. Measurement of temperature.	9L
2.	Measurement of pressure, flow, mass flowmeter, level, humidity, viscosity, Density & specific gravity.	9L
3.	The basic process control loop: Different blocks in the loop. Generation of control action in pneumatic, electric/ electronic, hydraulic, construction of different controllers (P,PI,PD and PID controllers). Tuning of Controller – open loop & closed loop methods.	10L
4	Schemes and analysis : Feedback control , cascade control, feed forward control, Ratio control, override control, split-Range control, batch and continuous process control, multi variable control schemes, adaptive control, Final control elements: Actuators, Control valve construction, valve sizing, valve characteristics and valve positioner. Introduction to Programmable Logic Controller and Distributed Control System.	14L
	Total	42L
	Total Weeks Required:	**14**
	No. of Weeks Reserved:	**02**

Textand/or**Reference Books:**

1. Doebelin E O - Measurement System : MGH
2. Murthy DVS - Transducer & Instrumentation : PHI.
3. Harriot – Process zcontrol, MGH
4. Conghanowr D.R. – Process System Analysis & Control. MGH,
5. Curtis D. Johnson – Process Control Instrumentation Technology, - Pearson Education/PHI
6. Luyben W. L – Simulation & Control for Chemical Engg.
7. Stephanopoules G – Chemical Process Control – An Introduction to theory & Practice, PHI
8. Considine Doglas M – Process /Industrial Instruments and Control Handbook, MH
9. Bequette – Process Control – Modeling, Design and Simulation,PHI
10. Patranabis – Principles of Process Control, TMH
11. Patrick, Industrial Process Control Systems, Vikas
12. S K Singh – Industrial Instrumentation and Control, TMGH
13. Jones Instrument Technology : Noltingk ; Vol, Butterworth Sc. Pub .

Elective-I (Appendix-I)

Paper Name : Optimal Control
Paper Code : EE-711(a)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period

1	Formulation of optimal control problem: Minimum time, minimum energy, minimum fuel problem, state regulator, output regulator & tracking problems. Statement of Linear quadratic regulator (LQR) problem and mathematical framework to solve this problem. Optimal solution of LQR problem. Different techniques for solution of algebraic Riccati equation. Role of state and input weighting matrices on the system performance, Frequency domain interpretation of LQR problem. Stability and robustness properties of LQR design.	12L+4T
2	Calculus of variations: Constrained fixed point and variable point problems, Euler Lagrange equations. Problems with equality and inequality constraints. Engineering application, Lagrange, Mayer & Bolza problems, pontryagins Maximum (minimum) principle.	12L+4T
3	Multiple decision process in discrete and continuous time - The dynamic programming.	6L+2T
4	Numerical solution of two point boundary value problems - the steepest descent method and the Fletcher -Powell Method.	6L+2T
	Total	**36L+12T**
	Total week required	**12**
	Total week reserved	**02**

Books:

1. Hestenas M C: Calculus of Variations and Optimal Control. Theory; Wiley.
2. Athems M & Falb P. L.: Optimal Control; McGraw Hill
3. Anderson & Moore, Optimal Control, PHI
4. Boltyanskii V G; Gamkrelidge R V; Pontryagin L S; On the theory of Optimal process
5. Stefani, Design of feedback Control System,OUP
6. Goodwin, Control System Design, Pearson Education
7. Glad, Control Theory, Vikas

Paper Name : Special Electrical Machines and Drives
Paper Code : EE-711 (b)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Permanent Magnet Brushless DC Motors:** Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics and control	7L+2T
2	**Permanent Magnet Synchrounous Motors:** Principle of operation – EMF and Torque equations - Phasor diagram - Power controllers – Torque speed characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor. **Switched Reluctance Motors:** Constructional features –Principle of operation- Torque prediction–Characteristics-Power controllers – Control of SRM drive- Sensorless operation of SRM – Applications.	14L+5T
3	**Stepper Motors:** Constructional features –Principle of operation – Types – Torque predictions – Linear and Nonlinear analysis – Characteristics – Drive circuits – Closed loop control –Applications. **Other Special Machines:** Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.	14L +4T
4	**Industrial Application:** Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive**,** Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.	7L+2T
	Total	**42L+13T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Claredon press, London, 1989.
2. R.Krishnan, ' Switched Reluctance motor drives' , CRC press, 2001.
3. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000
4. T.Kenjo and S.Nagamori, 'Permanent magnet and Brushless DC motors', Clarendon press, London, 1988
5. R.Krishnan, ' Electric motor drives' , Prentice hall of India,2002.
6. D.P.Kothari and I.J.Nagrath, ' Electric machines', Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2004.
7. Irving L.Kosow, "Electric Machinery and Transformers" Pearson Education, Second Edition, 2007.

Paper Name : Advance Instrumentation I
Paper Code : EE-711(c)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period

1	Measurement of Pressure and Vacuum: Pressure: Manometers – U tube, Inclined Tube and Well type Manometers Elastic Pressure Sensor Instruments – Bourdon Tube Pressure Gauge, Capsule Gauge, Differential Pressure Gauge, Pressure Switch Electronic Pr / DP transmitters : capacitive, piezo - resistive and resonating wire type Vacuum: Mcleod Gauge, thermal conductivity gauge, ionization gauge Installation Requirements Installation of pressure measuring instruments with accessories like seals, snubbers, 2 valve manifolds Installation of DP measuring instruments with head producing devices – pressure tappings, isolation valves, 3 valve manifolds, etc. Straight run requirements for flowmeters Installation of Temp elememts – Thermowells Pneumatic Instrumentation Flapper nozzle system - pneumatic force balance and motion balance system Pneumatic Transmitter	11L+4T
2	Flow rate Measurement: General concepts - Laminar flow, Reynolds's number, Effect of temperature and pressure on flow rate measurement, Calibration of flow meters. Head type flow measurement – analysis and calculation, and head producing devices - orifice, venturi, pitot tube, multiport averaging pitot Variable Area Flowmeters – Glass and metal tube rotameters Electromagnetic type, Ultrasonic type, Vortex type, Positive displacement type Mass flow meters : Coriolis, Thermal, Impeller type Weirs, Flumes and open channel flow measurement.	12L+3T
3	Level Measurement : Gauge glass, Bi-Colour, Magnetic and Reflex Level Gauge Float and displacers type instruments – Gauge and Switch D/P type sensors and their installation arrangements Capacitive type level instrument Ultrasonic and Microwave type level instruments Hazardous Area Instrumentation, Basic Concepts Classification based on site, material and temperature – IEC and North American system Methods of Protection – Explosion proof, Intrinsic safety, Purging and Pressurization, Non-Incendiary ; IEC Equipment Protection Level (EPL) NEMA and IP codes	10L+3T
4	Temperature Measurement: Temperature scale, ITS 90, fixed points and interpolation equations Filled in systems: liquid, gas and vapour, ranges, media, errors, construction details and comparison, classification Bimetal elements, Thermostats RTD: review of materials, construction, types; measuring circuits, ranges, errors and minimization of errors Thermocouples including MI thermocouples: types, thermoelectric power, circuits, ranges, errors, cold junction compensation, compensating cables Radiation Thermometer sensors used, spectral and other characteristics, Optical Pyrometers	10L+2T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. D. Patranabis, Principles of industrial Instrumentation, TMH, New Delhi, 2nd Ed.
2. B. G. Liptak, Instrument Engineers Handbook, vol-I and vol-II, Chilton Book Co. Philadelphia
3. D. M. Considine and G. D. Considine (Eds.) Process Instruments and controls Handbook, Mc Graw
4. Ernest O. Doeblin, Measurement Systems – Application and Design, Tata-McGraw Hill
5. A. Barua, Fundamentals of Industrial Instrumentation, Wiley India
6. M.M.S. Anand, Electronic Instruments and Instrumentation Technology, PHI, Delhi
7. C. R. Alavala, Principles of Industrial Instrumentation and Control Systems, Cengage Learning

Paper Name : Advanced Power System Analysis
Paper Code : EE-711(d)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Network matrix:** Physical interpretation of bus admittance and impedance matrices, introduction to admittance matrix formulation, formation of admittance matrix due to inclusion of regulating transformer, development of admittance matrix using singular transformation, modification of admittance matrix for branch addition/ deletion.	8L+3T
2	**Complex power flow:** Analytical formulation of complex power flow solution, Gauss-Seidal method of power flow, Newton-Raphson method of power flow, algorithm for solving power flow problem using N-R method in rectangular form, algorithm for solving power flow problem using N-R method in polar form, fast decoupled load flow method.	10L+3T
3	**Power System Stability:** Definitions, classification of stability-rotor angle and voltage stability, synchronous machine representation for stability study. Transient stability: Assumptions for transient stability, derivation of swing equation, swing equation for synchronous machine connected to infinite bus, swing equation for a two machine system, solution of swing equation by Euler and Runge-Kutta method, equal area criterion, critical clearing angle, application of critical clearing angle to transient stability of synchronous machine. Methods of improving transient stability: reducing fault clearance time, automatic reclosing, single phase reclosing, electric braking, voltage regulators, fast governor action, high speed excitation system.	12L+4T
4	**Voltage stability:** Definition and classification of voltage stability, mechanism of voltage collapse, analytical concept of voltage stability for a two bus system, expression for critical receiving end voltage and critical power angle at voltage stability limit for a two bus power system, PV and QV curves, L index for the assessment of voltage stability. **Load Forecasting:** Load Forecasting Categories-Long term, Medium term, short term, very short term Applications of Load Forecasting, Factors Affecting Load Patterns Medium and long term load forecasting methods- end use models, econometric models, statistical model based learning. **Short Term Load Forecasting (STLF):** Applications of Load Forecasting, methods- similar day approach, regression methods, time series, ANN, Expert systems, Fuzzy logic based method, support vector machines ANN architecture for STLF, Seasonal ANN, Adaptive Weight, Multiple-Day Forecast.	12L+4T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1. A. Chakrabarti, M.L. Soni, P. V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", Dhanpat Rai and Co.
2. Power system Analysis by Hadi Saadat: Tata McGraw-Hill Publishing Company Limited.
3. Power system Analysis by Charles A. Gross: John Wiley & Sons.
4. Power system Analysis by John J. Grainger & William D. Stevenson, JR: Tata McGraw-Hill Edition.
5. Markey operations in electric power systems Forecasting, Scheduling, and Risk Management, Shahidehpour M, Yamin H, Li z, John Wlley & sons
6. Neural Network, Fuzzy logic and Genetic Algorithm, S Rajasekaran, G A Vijayalakshmi Pai

Paper Name : Illumination Engineering-I
Paper Code : EE-711(e)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks :100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Light and Electromagnetic radiation:** Light and electromagnetic radiation; sources of light- thermal radiator-blackbody radiator, laws of thermal radiation; daylight and artificial light, spectral power distribution (SPD) of light sources. Radiometric and photometric quantities, visual response curve of standard observer, relation between lumen and watt, photometric standards. Laws of illumination, perfect diffuser, Lambert's law. **Photometry:** Visual & physical photometry, Bench photometer, Luxmeter, Integrating sphere, Distribution photometer, Computation of lumen output from luminaire from luminous intensity distribution- zone factor, zonal lumen.	12L+6T
2	**Lamp, Ballast & Luminaire:** Its function and classification, Ballast-its function, electromagnetic and electric type- principal of operation Lamp- its general classification, incandescent, tungsten halogen, fluorescent, compact fluorescent – construction, principal of operation, features etc.	10L+3T
3	**Elementary lighting design:** design parameters, BIS recommendation, general indoor lighting design by Lumen method. Concept of energy efficient lighting design and payback calculation.	10L+2T
4	**Day lighting:** characteristics and features of daylight; Sky models – Indian clear sky, CIE standard overcast and standard clear sky; day lighting concepts-side lighting, top lighting; window design formula; Daylight Factor method; physical scale modeling of day lighting system, daylight linked artificial lighting.	10L+3T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1. Wadha C L: Utilization of Electric Power - New Age International Ltd.
2. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd.
3. Singh, Electric Power Generation, Transmission & Distribution, PHI
4. Partab H: Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons.
5. Fink & Beaty - Standard Hand Book for Electrical Engineers - McGraw Hill International.

Paper Name: Advanced Optimization Techniques
Paper Code: M-711(e)
Weekly Load: L: 3 T: 1 P: 0
Credit Unit: 3
Total Marks: 100

Module	**Detailed Description**	Lecture / Tutorial Period
1	Dynamic Programming and Applications: Introduction, Value and Policy Iterations, Stochastic Gradient Algorithm, Q-learning and Temporal Differences, Value Function Approximation and Monte-Carlo Sampling	**8L+3T**
2	Integer Programming and Applications: Introduction, Enumerative Methods and Disjunction, Polyhedral Theory and Convexification, Advanced Computational Methods	**8L +3T**
3	Goal Programming and Applications: Introduction, General Goal Programming Model, Weighted Goal Programming Model, Lexicographic Goal Programming Model, Chebyshev Goal Programming Model, Goal Programming for Multiple-Objective Decision Analysis , Goal Programming Solution Methodology, Interval Goal Programming, Fractional Goal Programming, Duality Soution	**10L+3T**
4	Fuzzy based Optimization Techniques: Introduction to Fuzzy Logic, Fuzzy Set, Membership Function, Application in Optimization Heuristic Optimization Algorithms: Neighborhood Search, Hill Climbing Methods, Greedy Algorithms, Simulated Annealing, Evolutionary Algorithms, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization	**16L+5T**
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books:
Text and/or **Reference:**

1 Operations Research- Hamdy A., Taha, Macmillan
2. Operations Research: Principles and Applications- G. Srinivasan, Prentice Hall India
3. Introduction to Fuzzy Set Theory and Fuzzy Logic-Chander Mohan, Viva Books Pvt. Ltd.
4. Optimization: Algorithms and Applications-Rajesh Kumar Arora, CRC Press
5. Z. Michalewicz and D. B. Fogel, "How to Solve it: Modern Heuristics", Springer, 1999.
6. J. Dreo, P. Siarry, A. Petrowski and E. Taillard , "Metaheuristics for Hard Optimization", Springer, 2005.
7. S. N. Sivanandam and S. N. Deepa, "Introduction to Genetic Algorithms", Springer, 2008.
8. R. L. Haupt and S. E. Haupt, "Practical Genetic Algorithms", 2nd edition, Wiley Interscience, 2004.
9. D. Simon, Evolutionary Optimization Algorithms, Wiley, 2013.
10. Fred Glover, Manuel Laguna, "Tabu Search", Klawer Academic Publishers, Norwell, MA, 1997.
11. M. Dorigo and T. Stutzle, "Ant Colony Optimization", MIT Press, 2004.
12. M. Clerc, "Particle Swarm Optimization", ISTE Ltd, 2006.
13. S. S. Rao, "Engineering Optimization: Theory and Practice", 3rd edition, John Wiley & Sons, Inc., 1996.

Paper Name: Embedded Systems and It's Applications
Paper Code: ECE 711(e)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture/ Tutorial Period
1.	**Review of advanced Microprocessors:** Overview of Intel 8086 through Pentium series of Microprocessors.	8L+3T
2.	**Different type of Microcontrollers with Programming:** • Overview of 8051 family of Microcontrollers, Architectures, I/O Ports, Memory organization, Timer Counter, Serial Communication, Interrupt Programming etc in assembly and C language. • PIC family of Microcontrollers Architecture, memory organization, addressing modes, I/O port, Data Conversion, RAM & ROM Allocation, Timer, Programming in Assembly & C Language. • Introduction to AVR RISC Family architecture, Register File, The ALU, Memory access and Instruction execution, I/O memory EEPROM, I/O ports, Timers etc. • Fundamentals of ARM Processor: Architecture of ARM Processor Families, Registers, Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, ARM Instruction Set, Thumb Instruction Set etc.	10L+3T
3.	**Microcontroller Interfacings:** Interfacing technique with LCD, ADC, DAC, RTC, Stepper Motor, Key Board, Different Sensors, Communication Protocols etc with different microcontrollers.	12L+3T
4.	**Embedded Systems:** Embedded system overview, Design challenges, Fundamentals of Real Time Operating Systems, Process management, Real time scheduling, Basic Programming of RTOS.	12L+5T
	Total	**42L +14T**
	Total Week Required	14
	No. of Week Reserved	02

Text/Reference Books:

1. The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro Processor Architecture, programming and interfacing, By Barry B. Brey; PHI.
2. The 8051 Microcontroller and Embedded Systems By Mazidi & Mazidi; PHI.
3. Programming and customizing the 8051 microcontroller, By Myke Predko; Tata McGraw Hill 2000.
4. PIC Microcontroller and Embedded Systems using Assembly and C for PIC18 By Muhammad Ali Mazidi, Rolin D. Mckinlay; Pearson Education, 2008.
5. PIC Microcontroller Project Book, By John Iovine; McGraw Hill 2000.
6. The PIC Microcontroller, Your Personal Introductory Course, By John Morton; Newnes Publication.
7. The AVR Microcontroller and Embedded Systems:Using Assembly and C, By Janice Mazidi; PrenticeHall PTR, 2011.
8. ARM Assembly Language: Fundamentals and Techniques, By William Hohl; CRC Press, ISBN-10: 1439806101.
9. Embedded System Design A Unified HW.SW Introduction, By Vahid G Frank and Givargis Tony; John Wiley & Sons, 2002.
10. Embedded Systems Architecture, Programming and Design, By Raj Kamal; TMH-2003.

Paper Name: Photonics and Optoelectronics
Paper Code: ECE 711(f)
Weekly Load: L: 03 T: 01 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**OPTICAL FIBER:** Overview of optoelectronic devices and optical communication Materials and Fabrication of fiber strip, Fiber Optic Cable, Different Types of Fiber, Fundamental laws and transmission characteristics, Parameters for characterization.	10L + 2T
2.	**OPTICAL SOURCES** and **DETECTORS**: LEDs: Electrolumescent Process, Calculation of optical power, Materials, Homojunction and Heterojunction LEDs, Different characteristics, Drive Circuits. LASERs: Principle of operation, population inversion, gain, lasing threshold condition, semiconductor laser structures – Buried heterostructure laser, distributed feedback laser, quantum well laser, and tunable semi-conductor lasers for WDM. Drive Circuits. Basic Principle of optical detection using semiconductors, Characteristic parameters, PN, PIN, APD, Phototransistor type detectors: operation, structures, biasing, speed of response, noises, comparison. Receiver circuits.	12L + 8T
3.	**OPTICAL DEVICES and NETWORK SYSTEMS:** LED, LCD & TFT as display devices, CCD & Fiber as sensor devices, Solar Cell as energy device. Network Architecture, FDDI, SONET, SDH based systems for LAN, MAN and WAN**.**	10L+2T
4.	**PHOTONICS COMMUNICATION SYSTEMS:** Block diagram of Digital System, System Design issues, Intensity modulation/ direct detection system, Coherent system. Multiplexing technique: OTDM and WDM. Coupling and Active Devices: Optical couplers, circulators, Bragg grating filters, add/drop multiplexers, fiber optic repeaters and amplifiers.	10L + 2T
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

[1] John. M. Senior, Optical fiber communications: principles and practice, Prentice Hall of India.
[2] Ghatak and Thyagaragan, Introduction to Fiber Optics, Cambridge.
[3] R. P. Khare, Fiber optic and optoelectronics, Oxford University press.
[4] D. K. Mynbaev, L. L. Scheiner, Fiber optic communication technology, Pearson Technology.
[5] Gerd Keiser, Optical fiber communications, McGraw Hill.
[6] Jasprit Singh, Optoelectronics – an introduction to materials and devices, McGraw Hill.

Paper Name: Electrical Drives Laboratory
Paper Code : EE-751
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 02
Total Marks: 100

List of Experiments:

1. Study of thyristor controlled DC Drive.
2. Study of Chopper fed DC Drive
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed 3 phase Induction Motor control using MATLAB / PSIM Software.
5. VSI / CSI fed Induction motor Drive analysis using MATLAB /PSIM Software.
6. Study of V/f control operation of 3Φ induction motor drive.
7. Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.
8. Regenerative / Dynamic braking operation for DC Motor - Study using software.
9. Regenerative / Dynamic braking operation of AC motor - study using software.
10. PC/PLC based AC/DC motor control operation.

Paper Name : Electrical Machine Design-I Laboratory
Paper Code : EE-781
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

Problem 1: Design of single phase transformer.

Problem 2: Design of DC Machine.

Books:

1. Sawhney A K: A Course in Electrical Machine Design; Dhanpat Rai & Co.
2. Clayton A E & Hancook N N: The Performance and Design of Direct Current Machines; CBS Publishers and Distributors.
3. Say M G: The Performance and Design of Alternating Current Machines; CBS Publishers and Distributors.
4. Sen S K : Principles of Electrical Machine Design with Computer Programs; Oxford & IBH Pub. Co.
5. Norton, Machine Design, Pearson Education.

Paper Name : Digital Signal Processing Laboratory
Paper Code : ECE 771
Weekly Load : L: 0 T: 0 P: 3
Credit Point : 2
Total Marks : 100

Unit	Detailed Description	Practical Period
1.	Familiarization with MATLAB software and general functions.	3P
2.	Write a MATLAB program to develop some elementary continues time (CT) signals: Sinusoidal, Complex waveform, Unit Impulse, Unit Step, Unit Ramp, Exponential, Noise.	3P
3.	Write a MATLAB program to find the sum of sinusoidal signals and understanding of the concept of harmonics.	3P
4.	Write a MATLAB program to develop some elementary sequences or discrete time (DT) signals: Sinusoidal, Complex waveform, Unit Impulse, Unit Step, Unit Ramp, Exponential, and Noise.	3P
5.	Write a MATLAB program to find the impulse response of a LTI system defined by a difference equation and to plot the Frequency response of a given LTI sequence	3P
6.	Write a MATLAB program to compute linear convolution and circular convolution of two given sequences.	3P
7.	Write a MATLAB program to find the Discrete Time Fourier Transform DTFT of the given sequence.	3P
8.	Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.	3P
9.	Write a MATLAB programs for auto correlation and cross correlation.	3P
10.	Using TMS320C5X 1. Study of various addressing modes of DSP hardware using simple programming examples 2. Sampling of input signal and display 3. Implementation of FIR filters 4. Calculation of FFT	15P
	Total	42P
	Total Week Required	14
	No. of Week Reserved	02

Text/Reference Books:

1. Digital Signal and Image Processing Using MATLAB by Blanchet and Charbit
2. Ingle, Digital Signal Processing using MATLAB, Vikas Pub.
3. S.K.Mitra, Digital Signal Processing - A Computer based approach, TMH.
4. J.G. Proakis & D.G. Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, Pearson/PHI
5. Alex Palamides & Anastasia Veloni, Signals and Systems Laboratory with MATLAB

Paper Name: Project-I
Paper Code : EE 791
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 04
Total Marks: 100

- A project group made up of Students (preferably not more than four in each group) under the guidance of a faculty member need to complete one project during the Final Year (Semester VII & VIII). Project-I is the first part covered in Semester-VII.
- Total marks of the project work are 200 and Credit Points are 7. Marks and Credits are distributed over the Semester VII & VIII. In Semester-VIII credit point is 4.
- At the beginning of the Semester-VII each project group have to submit their project Synopsis. At the end of Semester-VII students have to submit an Intermediate Project Report. Each group should submit at least two extra copy of Intermediate Project Report other than their individual copy, one for their Project guide and one for the departmental record.
- Progress of each project group should be demonstrated and presented in front of Board of Experts and evaluation will be made on that. 50% of total marks will be evaluated by the project guide and rest 50% of total marks will be evaluated by the Board of Experts.

Paper Name: Seminar-I
Paper Code : EE 792
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 02
Total Marks: 100

- Each student have to give 10 minutes' individual presentation / lecture on any topic (advanced technology, research or development, new emerging field etc.) followed by 5 minutes interaction / discussion session.
- The presentation should be in front of teachers and students of the class.
- Evaluation should be based on the following parameters of the students: Presentation skill, Delivery of the speech, Depth and breadth of the subject matter presented.
- The attendance of other students in the seminar will be recorded and their participation should also be assessed for evaluation of their participations.
- Each student has to submit technical reports for each presentation they have delivered. Those who have attended Vacational Training should submit a Report at the completion of the training to the departmental in-charge. The Training Report should be authorized by the institutions/organizations where the training has been made.
- Marks will be given based on evaluation throughout the year and a final evaluation at the end of Semester based on either evaluating what students have performed during the Vacational Training (If student have attended that kind of training) or based on a final presentation

Semester-VII

Paper Name: Utilization of Electrical Power
Paper Code : EE-801
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Electric heating and Dielectric Heating:** Basic principle, Basic advantages, classification of furnaces and ovens. Industrial application areas. **Storage Batteries:** common types and their characteristics. Principles of charging, modes of charging, eg., float, boost, constant current, constant voltage, etc. Temperature compensation of charging voltage.	7L+3T
2	**Electric Furnaces and Heating:** basic principles of direct and indirect heating types. **Control of Heating:** on-off control, graded resistance, tapped inductor. Solid state control - SCR on-off control, ac phase control, integral cycle control **Arc Furnaces:** basic principles of direct and indirect heating types. 1-phase and 3-phase AC and DC arc types. Their power supply regulator system. Electrode position control system. **Induction Furnaces:** basic principles of coreless and core types. Their power supply systems. SCR resonant inverters for induction heating	10L+3T
3	**Electric welding:** Classification, Electric arc welding, Four Positions of Arc Welding, Bare metal arc welding, Coated electrodes, Types of Joints and Types of Applicable Welds, goad weld, Atomic Hydrogen Welding, Submerged arc welding, Inert gas metal arc welding, Carbon arc welding, Electric Supply for arc welding, Machines for Arc Welding, Resistance welding, Spot welding, Seam Welding, Projection welding, Butt welding, Electron beam welding, Electroslag Welding, Electrogas Welding, Plasma Arc Welding, Laser Welding, Ultrasonic Welding, Power Supply for Resistance Welding, Machines for Resistance Welding, Electronic welding control, Energy Storage Welding.	14L +2T
4	**Electrolytic Processes:** Electrolysis-Basic Principle, Laws of Electrolysis, Terms connected with electrolytic processes, Applications of Electrolysis. Electro Deposition, Manufacture of chemicals, Anodizing, Electro polishing, Electro cleaning or Pickling, Electro parting or stripping, Electro extraction, Electro Refining, Power Supply For Electrolytic Processes. **Refrigeration and Air conditioning:** Applications of refrigeration, Refrigeration Systems, Co-efficient of Performance, Unit of refrigeration, Refrigerants, Domestic refrigerator, Trouble shooting of refrigerator, Water cooler, Desert Cooler, Air Conditioning, Types of air conditioning, Window air conditioner	11L+6T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1) H. Partab, "Art & Science of Utilisation of Electrical Energy", Dhanpat Rai & Sons.
2) G.W. Vinal, "Storage Batteries", John Wiley & Sons Inc.
3) P.K.Sadhu & S.Das, "Modern Utilization of Electric Power: Including Electric Drives and Electric Traction". CBS Publication.

Paper Name : Power System Operation and Control
Paper Code : EE-802
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Speed Governing System:** Description of Speed Governor, Speed changer and main components of speed governing system, principle of operation.	8L+3T
2	**Load frequency control:** Representation of speed governing system, effect of governor droop on load sharing among generators, dependence of load on frequency, system inertia. Modeling and analysis of single area load-frequency control, supplementary control, concept of control area.	12L+4T
3	**Power system voltage control:** Basic concept of active and reactive power control of Synchronous generator. Interdependence of active power with frequency and reactive power with voltage and concept of decoupling, Role of excitation system, main & pilot exciters, description of different types of excitation systems.	12L+4T
4	**Economic operation of power plant:** cost curves, heat rate, incremental rate, economic load sharing among generating units.	10L+3T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1. Power System Analysis, by J.J.Grainger & W.D.Stevension, McGraw Hill
2. Power System Engineering, by I.J.Nagrath & D.P.Kothari, Tata McGraw Hill
3. Electric Energy System Theory, by O.I.Elgard, Tata McGraw Hill
4. Elements of Power System Analysis, by W.D.Stevenson, McGraw Hill.
5. Power System Analysis, by A.R.Bergen & V.Vittal, Pearson Education

Elective-I (Appendix-I)

Paper Name : Electrical Machine Modeling and Analysis
Paper Code : EE-811(a)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Generalised theory:** Generalised theory of machines. **Transient analysis:** Transient analysis of DC and AC machines.	8L+4T
2	**Space vectors and its application:** Space vectors and its application to the analysis of electric machines, specially of induction motors. Principle of vector decoupled control. **Motor behaviors:** Motor behaviors under asymmetrical supply voltages. **Analysis of 3-phase induction motor:** Analysis of 3-phase induction motor with AC phase controlled supply.	15L+3T
3	**Motor problems:** Motor problems associated with non-ideal power supplies from converter. **Commutation problem:** Commutation problem in dc motor. Harmonic effects on induction motor – harmonic equivalent circuit and harmonic torques.	12L+4T
4	**Application of simulation tools:** Application of simulation tools for machine modeling, analysis and design.	7L+3T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1) R. Krishnan, "Electric Motor Drives", Prentice Hall of India (P) Ltd.
2) B. K. Bose, "Modern Power El;ectronics and AC Drives", Pearson Education.
3) J.M.D. Murphy & F.G. Turnbull,"Power Electronic Control of AC Motors", Pergamon Press.
4) P.S. Bimbhra,"Generalised Theory of Electrical Machines", Khanna Publishers
5) W. Shephard, L.N. Hulley & D.T.W. Liang,"Power Electronics and Motor Control", Cambridge University Press.

Paper Name : Advance Instrumentation - II
Paper Code : EE-811(b)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Concepts of Power plants of different types:** Setups, energy conversions and measurement requirements, examples of Thermal, Hydal, and Nuclear plants. Thermal power plant and system instrumentation.	8L+2T
2	**Instrumentation for** : (i) Turbines (ii) Condensers (iii) Generators (iv) Coal handling (v) Water treatment (vi) Feed water, combustion air and flue gases	12L+3T
3	**Control:** Boiler Control - Steam pressure control, combustion control, Furnace Draft control, Steam temperature control, Feed water control, Data logger and computer control, supervisory control and monitoring system. Instrumentation for safety interlocks - protective gears, emergency measures, Alarm systems and Analysis etc. Pollution measurement, monitoring and control.	12L+2T
4	Data handling-processing, logging, acquisition, accounting, display and storage. Instrumentation for Generator and Busbar coupling. Introduction to power plant modeling/simulation	10L+2T
	Total	**42L+14T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. Principles of Industrial Instrumentation, D. Patranabis, TMH New Delhi
2. Electric Power Engineering Handbook – Edited by L. L. Grigsby.
3. Instrument Engineers Handbook, B. G. Liptak, Chilton Book Co., Philadelphia

Paper Name : Energy Audit and Management
Paper Code : EE-811(c)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks: 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Introduction:** Energy – concept, sources & availability, situation, conversion, energy and society, energy and environment, energy analysis and potential in nation, energy utilization and identification of conservation in different sections. **Energy Audit:** Objective, systems, boundary definitions, types of auditing.	9L+2T
2	**Organization:** Methodology finalization, sources of numerical data, instruments required, precautions, tests carried out, presentation. **Forecasting and Energy Conservation:** Technological forecasting methodology of electrical energy demand, institutional role of energy conservation, related case studies.	8L+4T
3	**Improvement in Energy utilization:** Review of energy efficiency and the improvement of - electrical appliances and mechanical devices, generation, transmission and distribution.	10L+3T
4	**Case Studies of energy audit:** Power plant, metallurgical industry, local electrical distribution network, office/shopping complex and residential colony. **Policy and implementation:** National planning and policy, awareness - general, industry and rural user, analysis of previous audit report.	15L+5T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1. Albert : Plant Engineers & Managers Guide to Energy Conservation
2. Wayhe C.Tuner : Energy Management Handbook
3. Anthony J. Pansini. : Engineering Economic Analysis Guide Boo
4. D. Paul-Mehta : Handbook of Energy Engineering.
5. Paul O'Callaghan : Energy Management.

Paper Name : Illumination Engineering-II
Paper Code : EE-811(d)
Weekly Load : L:3, T:1, P:0
Credit Point : 03
Total Marks :100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Quality and quantity assessment of lighting systems :** BIS recommendation of lux level; factors affecting the required quantity; evaluating the quantity of illuminance; procedures of field measurements; quality of illuminance – discomfort & disability glare – evaluation method, veiling reflection, Visual Comfort Probability (VCP).	6L+3T
2	**Indoor lighting:** zonal cavity method for general lighting design - CU determination for zonal cavities and different shaped ceilings, Residential, office, industrial, hospitals etc. – Indian Standard recommendation for indoor lighting, selection criteria of lamps and luminaire, design considerations, design procedure. **Emergency lighting:** escape lighting, standby lighting; maintained & non-maintained lighting systems – transport lighting.	9L+3T
3	**Outdoor lighting:** road lighting – road classifications according to BIS, pole arrangements, terminology, lamp & luminaire selection, different design procedures – beam lumen method, point-by-point method, isolux diagram method; tunnel lighting; **Floodlighting:** selection of floodlights-NEMA classifications, design procedure **Sports lighting:** special lighting requirements for football, cricket, badminton ground – BIS recommendation, selection criteria of lamp and luminaire, design considerations, design procedure. **Marine & aviation lighting:** basic ideas, lamp & luminaire selection, special requirements etc.	15L+5T
4	**Lighting energy management and economics:** lighting power budget; lighting power limit; evaluation of existing system; different options for consideration; simple payback analysis; life cycle cost analysis; components of cost and savings. **Computer application in lighting design:** computation of lumen package, luminous efficacy, correlated colour temperature, chromaticity coordinate, dominant wavelength, purity of a lamp from lamp SPD data; plotting of isolux diagram, indoor general lighting design, roadlighting design etc.	12L+3T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

6. Wadha C L: Utilization of Electric Power - New Age International Ltd.
7. Wadha C L: Generation, Distribution and Utilization of electrical energy - New Age International Ltd.
8. Singh, Electric Power Generation, Transmission & Distribution, PHI
9. Partab H: Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons.
10. Fink & Beaty - Standard Hand Book for Electrical Engineers - McGraw Hill International.

Paper Name: Advanced Topics in Power Systems
Paper Code : EE-811(e)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks: 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Static & Digital Relaying:** Generalised approach for two input and multi input comparators, derivation of inputs for different types of static distance protection, hard- ware for static relays, concept of digital relaying, derivation of fundamental component of voltage and current for digital protection.	10L+3T
2	**Different control loops in a power station:** Different types of measurements and control , viz. Override control, selective control, ratio control, boiler drum level control, combustion control, main steam temperature control, plant annunciation system, **Introduction to FACTS:** Brief description of various FACTS devices and their principle of operation, role of FACTS in active and reactive power control.	14L+4T
3	**HVDC transmission:** Advantages and applications, configuration of DC transmission link, disadvantages, CIA, CC and CEA control. Determination of stable operating point.	9L+2T
4	**Economic operation of power plant:** cost curves, heat rate, incremental rate, economic load sharing among generating units.	9L+3T
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1.HVDC Power Transmission Systems – Technology & System Interaction by K.R.Padiyar, Willey Eastern
2. High Voltage Direct Current Transmission, J.Arrillaga, Peter Peregrinus Ltd.
3. Power System Protection by S.P.Patra, S.K.Basu, S.Choudhuri, Oxford & IBH
4. Power System Harmonic Analysis, by J.Arrillaga, B.Smith, N.R.Watson, A.R.Wood,John Willey
5. Direct Current Transmission, by E.W.Kimbark, Wiley Interscience
6. Understanding Facts, by N.G.Hingorani & L.Guygyi, IEEE Press
7. Power System Protection, Vol - IV, by The Electricity Training Association, IEE
8. Computer Aided Power System Analysis, by G.L.Kusic, Prentice Hall of India.

Paper Name: Soft Computing
Paper Code: CSE 811 (g)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction** Definition of Artificial Intelligence (AI), Approaches to AI, soft computing and hard computing; elements of soft computing and hard computing.	**3L+2T**
2.	**Fuzzy Sets & Fuzzy Reasoning:** Notations of Set Theory, Operations, Properties, Rules. Difference between Fuzzy and Crisp sets, Difference between Fuzzy and probability, Discrete and Continuous Fuzzy Sets, Fuzzy Membership. Definitions: α-cut, Support, Scalar cardinality, Core, Height, Normal and Sub-Normal fuzzy set. Operations of Fuzzy Sets , Properties of Fuzzy Sets, Fuzzy Logic Controller, Mamdani Approach, Takagi and Sugeno's Approach, Methods of defuzzification,, Advantages and Disadvantages of Fuzzy Logic Controller.	**13L+4T**
3.	**Introduction to Artificial Neural Networks (ANN):** What are neural networks? Artificial Neural Network, McCullogh-Pitts model, Activation Functions, Different Learning Rules and associated networks. Learning rate and momentum, Kohonen network, Adaptive resonance theory (ART), Bidirectional Associative Memory (BAM), Hopfield network, Hamming Networks.	**13L+4T**
4.	**Evolutionary Computing:** Principle of Optimization, Optimization Problems, Definition of GA, Differences with traditional method, Various operations of GA, Elitist Model of GAs, Single Objective Optimization Problem (SOOP), Constraints Handling in GA, Scheduling GA, Multi Objective Genetic Algorithms (MOGA), Multi-Objective Optimization Problem (MOOP), Evolutionary Multi objective Optimization (EMO), Hybridization with Local Search.	**13L+4T**
	Total:	**42L+ 14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books: Text and/or Reference:

1. **S**. Rajasekaran and G. A. Vijayalakshmi Pai - Neural networks, fuzzy logic and genetic algorithms synthesis & applications-PHI
2. D. K. Pratihar - Soft Computing: Fundamentals and Applications- Alpha Science International Ltd
3. S.N. Sivanandam and S.N. Deepa – Principles of Soft Computing – Wiley India (P) Ltd
4. S. Haykin- Neural networks- A comprehensive foundation- Pearson.
5. D. Fausett - Neural networks - Pearson.
6. B. Kosko- Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence-PHI.
7. T. J. Ross - Fuzzy logic with engineering applications - McGraw-Hill.
8. G. J. Klir and B. Yuan - Fuzzy sets & Fuzzy logic:Theory & Applications- PHI.
9. D.E. Goldberg -Genetic algorithm in search, optimization & machine learning-Pearson Edu.
10. K. Deb - Multi-Objective Optimization using Evolutionary Algorithms - Wiley

Paper Name : Mathematical Modelling and Stochastic Processes
Paper Code : M811(e)
Weekly Load : L: 3 T: 1 P: 0
Credit Unit : 3
Total Marks : 100

Module	Detailed Description	Lecture / Tutorial Period
1	**Mathematical Modeling:** Introduction to mathematical modeling-its significances and utilities. **Modeling in nonlinear phenomena:** Modeling in biological ecosystem, Epidemiology, Pharmacology, Socio-economic sectors, Demography; Logistic map, Dynamical system, Stable and unstable equilibrium points, Node and focus, Concept of bifurcation and chaos, Different forms of Bifurcation.	**15L+5T**
2	**Modeling in time series data analysis:** Filtering of time series data, Kalman Filter, Simple exponential smoothing; Searching for periodicity in a time series data by Ferraz-Mello's Date compensated Discrete Fourier Transform, Lomb-Scargle Method of Periodogram, Maximum Entropy Method, Maximum Likelihood Method, Rayleigh Power-Spectrum Analysis and Simple Denoising Algorithm using Wavelet Transform; Scaling analysis of a time series data, Hurst Exponent, Finite Variance scaling method; Autocorrelation, stationary and non-stationary time series, Autoregressive and moving average method, chaos in a time series; Persistent and Anti-Persistent data; Fractals and Fractal Dimensions, Higuchi's Method to determine the fractal dimension for a time series data. .	**11L+4T**
3	**Soft Computing Techniques:** Basics of Fuzzy Logic, Difference between crisp set and fuzzy set, Concept of membership function, Application of fuzzy logic in engineering systems: an introduction. Introduction to neural network, concept of perceptron, Introduction to artificial neural network, Forward bias and feedback model in neural network, Applications in engineering systems	**8L+3T**
4	**Stochastic processes:** Introduction; Stationary, Ergodic and Markov processes; Markov chains and Absorbing Markov chains.	**8L+2T**
	TOTAL:	**42L+14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Text/Reference Books:

1 Non-Linear Dynamics: Integrability, Chaos and Patterns-M. Lakshmanan, Springer India Pvt. Ltd.
2 Mathematical Modelling-J.N. Kapoor, New Age Publishers
3 Time series analysis: Forecasting and Control: Box, Jenkins & Reinsel, John Wiley and Sons
4 Probability, Statistics and Random Processes: T. Veerarajan, Tata McGraw Hill Publishing
5. Neural Networks-S. Haykin, Macmillian Publishing Company
6. Fuzzy Logic and Neural Networks: Basic Concepts and Application- Chennakesava R. Alavala, New Age International Pvt. Ltd.
7. Introduction to Fuzzy Set Theory and Fuzzy Logic-Chander Mohan, Viva Books Pvt. Ltd., 2015.

Elective-III (Appendix-III)

Paper Name : Advanced High Voltage Engineering
Paper Code : EE-812(a)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	**Breakdown:** Breakdown in gases, Townsend Mechanism, Paschen's Law, Streamer breakdown, Breakdown under Surge Voltages, Different types of breakdown in solid dielectrics, Different types of breakdown in liquids, Partial discharge and its measurement techniques.	10L+3T
2	**Electric field analysis:** Basic Equations of Electric field analysis. Electric Field Analysis by Finite Difference Method – in 2D and Axi-Symmetric Systems with equal and unequal nodal distances, Formulations for homogeneous and multi-dielectric media, Basic 3D formulations. Electric Field Analysis by Finite Element Method – in 2D and Axi-Symmetric systems, Formulations for homogeneous and multi-dielectric media	13L+4T
3	**Electric Field Analysis by Charge Simulation Method:** Basic formulations for homogeneous and multi-dielectric media, Types of charges and Accuracy Criteria.	9L+3T
4	**Analytical Method of Electric Field Analysis:** Cylinder and Sphere in uniform field. Field Utilisation factors for fields around cylinders and spheres. Graphical Field plotting for 2D and Axi-Symmetric systems. Techniques of electric stress control.	10L+3T
	Total	**42L+13T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. High Voltage Engineering by Peter Kuffel & W S Zaengl.
2. An Introduction to High Voltage Engineering by Subir Ray
3. An introduction to high voltage experimental technique by Dieter Kind
4. Extra high voltage ac transmission engineering by R.D. Begamudre

Paper Name: Robust Parametric Control
Paper Code : EE 812(b)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks: 100

Module	Detailed Description	Lecturer/ Tutorial Period

1	**Revisit Classical Control:** Root locus, Nyquist plots, Robustness and Disturbance rejection in SISO systems. Multivariable Linear Systems: Continuous time State space models, Discrete time state models. Transfer-functions, Frequency response, Poles, Zeros and Modes. Stability.	6L+2T
2	**Introduction to Robust Control:** Disturbance effects on the plant, Measurement noise, Modeling errors due to nonlinearities, Modeling errors due to time- varying parameters. Disturbance and noise sensitivity analysis of feedback control system, Robust stability, Robust performance, Structured and unstructured uncertainties, Controllability Observability and Observer Feedback, General Models of Feedback Control Systems. Norms and Cost functions.	8L+2T
3	Internal Model Control, IMC performance analysis, Two degree of freedom IMC system. Case studies on IMC.	8L+2T
4	Parametric uncertainty and Kharitnov's method for stability test. Stability function, complementary sensitivity function and return difference. Additive and multiplicative perturbation models. Small gain Theorem. Stability robustness measures in frequency domain. Robust performance, tracking problems and disturbance rejection control H_2-and H_∞-optimal control: Linear quadratic H_2-optimal control, H∞ Control : Full information control, H∞ Estimation, H∞ Output. Finite time control, Steady State Control and μ Synthesis. Introduction to Quantitative Feedback Theory	14L+6T
	Total	**36L+12T**
	Total week required	**12**
	Total week reserved	**02**

Books:

8. J. B. Burl, Linear Optimal Control H2 and H∞ Methods, Addison Wesley, California, US.1999
9. K. Zhou, J. C. Doyle and K. Glover, Robust and Optimal Control, Prentice-Hall, 1999
10. S. Skogstad and I. Postlethwaite, Multivariable Feedback Control, John Wiley and Sons,2005
11. T. Glad and L. Ljung, Control Theory: Multivariable and Non-linear methods, Taylor and Francis, London, 2009.
12. Bhattacharyya, S. P., H. Chapellat, and L. H. Keel. Robust control: the parametric approach. *Upper Saddle River* 1995.

Paper Name : Non-Conventional Energy Systems
Paper Code : EE-812(c)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecturer/ Tutorial Period

1	**Introduction to Energy sources:** Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development; strategy for meeting the future energy requirements Global and National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol. **Solar Energy: Solar radiation -** beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, Solar air heaters-types, solar driers, storage of solar energy-thermal storage, solar pond , solar water heaters, solar distillation, solar still, solar cooker, solar heating & cooling of buildings, photo voltaics - solar cells, different types of PV Cells, Mono-poly Crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems & its applications. PV hybrid systems.	13L+5T
2	**Wind Energy:** Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations	9L+2T
3	**Energy from Biomass:** Biomass conversion technologies, Biogas generation plants, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas **Geothermal Energy:** Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India. **Energy from Ocean:** Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Energy from tides, basic principle of tidal power, single basin and double basin tidal power plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of wave energy	9L+3T

4	**Magneto Hydrodynamic power generation:** Principle of MHD power generation, MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects. **Hydrogen Energy:** Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles. **Fuel cell:** Introduction, Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, application of fuel cells	9L+3T
	Total	**42L+13T**
	Total week required	**14**
	No of week reserved	**02**

Books:

1. Non-Conventional Energy Resources by N K Bansal
2. Non-Conventional Resources of Energy by G S Sawhney
3. Renewable Energy Sources and Emerging Technologies by D P Kothari, K C Singal, Rakesh Ranjan.

Paper Name: Process Automation and Robotics
Paper Code : EE 812(d)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks: 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	Introduction to automation-Definition, types, merits and criticism-Architecture of industrial automation systems-Manufacturing plants and operations-Automation strategies-Basic elements of automated system-Advanced automation functions-Levels of automation	8L+3T
2	Industrial control systems-Process, Discrete manufacturing industries-Continuous and Discrete control systems- An overview of computer process control- Fundamentals of automated assembly system, Actuators & Sensors, Fluid Power and Electrical Actuators-Piezoelectric Actuator; Sensors for position, motion, force, strain and temperature.	8L+3T
3	Introduction to Robotics-Robotics System-Classification of Robots-Robot Characteristics- Kinematics of manipulator-Frames and Transformations-Forward and inverse kinematics-DH representation-Derivation of forward and inverse kinematic equation for various types of Robots-Applications of Robots.	10L+3T
4	Introduction to manipulator Jacobian- Tool Jacobian-Velocity Propagation from link to link-Static forces in manipulators-Jacobian in Force domain-Introduction to dynamic anyalisis-Lagrangian formulation-Trajectory planning-Joint space and Cartesian space.	10L+3T
	Total	**36L+12T**
	Total week required	**12**
	Total week reserved	**02**

Books:

1. John J Craig: Introduction to Robotics, Mechanics and Control, second Edition, Addison-Wesley, 1999.
2. Saeed B Niku: Introduction to Robotics, Analysis, Systems and applications. Prentice Hall India, 2002.
3. Groover, Mikell, P: Automation, Production systems and Computer Integrated Manufacturing ,PHI,2004.
4. Mark W Spong & M Vidyasagar: Robot Dynamics and Control, Jhon Wiely & Sons, 1989.
5. K. S. Fu, R. C. Gonzales, C. S. G. Lee: Robotics Control, Sensing, Vision and Intelligence, McGraw Hill, 1987.

Paper Name : Advanced Power Electronics
Paper Code : EE-812(e)
Weekly Load : L: 03 T: 01 P: 0
Credit Point : 03
Total Marks : 100

Module	Detailed Description	Lecture/ Tutorial Period
1	**Non-isolated and Isolated DC-DC Converters:** buck, boost, buck-boost, fly back, forward, Cuk, SEPIC, Zeta, half bridge, push-pull and bridge in DCM and CCM, single-phase, single-stage converters (SSSSC), power factor correction at ac mains in these converters, their application in SMPS, UPS, welding and lighting systems. **Improved Power Quality AC-DC Converters**: single-phase buck, boost, buck-boost ac-dc converters, PWM (Pulse width modulated) based single phase, three-phase VSC (Voltage source converters), multilevel VSCs, multi-pulse VSCs, PWM CSC (Current voltage source converters), multi-pulse ac-dc converters.	12L+4T
2	**Power Quality Mitigation Devices:** passive filters, active filters, hybrid filters, DTSTCOM (Distribution static compensator), DVR (Dynamic voltage restorers) and UPQC (Universal power quality conditioners). **Cyclo-Converters:** Principle of Cyclo-Converter Operation, Single –Phase To Single-Phase Circuit, Step-Up Cyclo-Converter, Mid-Point Cyclo-Converter, Bridge-Type Cyclo-Converter, Single-Phase To Single-Phase Circuit Step-Down Cyclo-Converter, Three-Phase Half-Wave Cyclo-Converters, Three-Phase To Single-Phase Cyclo-Converters, Three Phase To Three-Phase Cyclo-Converters, Load-Commutated Cyclo-Converter.	12L+4T
3	**AC to AC controlled Converters:** Principle of AC Voltage Controller, Integral Cycle Control, Phase Angle Control, Sequential Control, Various Configurations, Analysis With R and R-L Loads, PWM AC to AC Converter.	6L+2T
4	**FACTS devices:** TCR (thyristor controlled reactor), TSC (thyristor switched capacitors), STATCOM (Static synchronous compensator), SSSC (Static series synchronous compensator), UPFC (Unified power flow controller), IPFC (Interline power flow controller) etc. **HVDC (High voltage direct current):** 12-pulse converter based HVDC systems, HVDC light, HVDC PLUS (Power universal link), multi-pulse and multilevel VSC based flexible HVDC systems.	12L+4T
	Total	**42L+14T**
	Total Week Required	**14**
	No. of Week Reserved	**02**

Text/Reference Books:

1. M. H. Rashid: Power Electronics, Circuits Devices and Applications, Pearson. 2011
2. P. S. Bimbhra: Power Electronics, Khanna Publishers. 2012
3. Ned Mohan: Power Electronics, John Wiley. 2013
4. Krein P. T.: Elements of Power Electronics, Oxford. 1998
5. M. D. Singh and K. B. Khanchandani: Power Electronics 2/e, MGH.2008
6. K.Billings,"Switch Mode Power Supply Handbook", McGraw-Hill, 1999,Boston.
7. N. G. Hingorani and L. Gyugyi, "Understanding FACTS", IEEE Press, Delhi, 2001.
8. Vijay K.Sood,"HVDC and FACTS Controllers - Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Massachusetts, 2004.

Paper Name: Introduction to System Biology
Paper Code : M 812(a)
Weekly Load: L: 3, T: 1, P: 0
Credit Point : 03
Total Marks: 100

Module	Detailed Description	Lecturer/ Tutorial Period
1	System Biology - Concepts and working principles of System Biology - Practical applications of System Biology in Life Sciences - Introduction to System Biology platforms, Proprietary system Biology platform. Microarray data analysis - Microarray analysis platforms - Introduction to Concepts and principles of Microarray technology - Application of Microarrays in Life Sciences. Different Markup languages used in systems biology. Introduction to NGS technology.	**14L+4T**
2	Dynamic model, Basics of Genetic algorithms. Dynamic model parametric sensitivity analysis.	**14L+4T**
3	Mathematical Modeling of protein-protein interactions	**7L+3T**
	Mathematical Modeling of bio-chemistry with Petri Nets.	
	Mathematical Modeling of molecular biology using Kappa.	
4	The stochastic Pi-calculus and Mathematical Modeling of bio-chemistry in the Stochastic Pi- Calculus	**7L+3T**
	Methods and Software Platforms for Systems Biology- A modeling example: Actin Polymerization-SPIM.	
	Mathematical Modeling of molecular biology using Bio-Pepa.	
	Total	**42L+14T**
	Total week required	**14**
	Total week reserved	**02**

Books:

1) Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Molecular Biology of the Cell, Garland Science
2) Choi Sangdun, Introduction to Systems Biology. Humana Press (2010).
3) Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Second Edition (Chapman & Hall/CRC Mathematical & Computational Biology).

Paper Name: Introduction to Robotics
Paper Code: IT 812 (a)
Weekly Load: L: 3 T: 1 P: 0
Credit Point: 3
Total Marks: 100

Module	Detailed Description	Lecture / Tutorial Period
1.	**Introduction** Definitions, Law of Robotics, Robotic systems – Its role in automated manufacturing, Robot anatomy, Robot classification and specifications. **Robot Kinematics** Forward and reverse transformation, Homogeneous transformations.	**10L+2T**
2.	**Robot Drives, Actuators and Control** Function of Drive System, Types of fluid, pump classification, Pneumatic System, Electrical drives, DC Motors and Transfer Functions, Stepper Motor, Drive Mechanisms. **Robot End Effectors** Classification of End-effectors, Mechanical, Magnetic and Vacuum Grippers, Gripper force analysis and gripper design, Active and passive grippers. **Robot Sensors** Need of Sensing systems, Different types of contact and non-contact sensors, Robot vision.	**12L+4T**
3.	**Workspace Analysis and Trajectory Planning** Path description and generation, collision free path planning **Linear Control of manipulators:** Feedback and closed loop control, control of second order system, trajectory-following control, continuous vs. discrete time control, architecture of an industrial robot controller	**10L+4T**
4.	**Robot Language and programming technique** Classification of robot languages, Computer control and robot software, VAL II, robot intelligence and task planning, AI and robotics **Application of Robots in Material Handling** Machine loading/ unloading, Inspection, Welding, Spray painting and finish coating, assembly etc	**10L+4T**
	TOTAL:	**42L +14T**
	Total Week Required:	**14**
	No. Of Week Reserved:	**02**

Books: Text and/or **Reference:**

1. M.P. Groover - Industrial Robotic: Technology, Programming and Application – McGraw Hill publications.
2. Y Koren – Robotics for Engineers –McGraw Hill publications.
3. K. S. Fu, R. C. Gonzalez, C. S. G. Lee - Robotics: Control, Sensing, Vision and Intelligence – McGraw Hill publications
4. S .R. Dev – Robotics Technology and Flexible Automation –Tata McGraw Hill publications.
5. P. G. Ranky and C. Y. Ho – Robots Modelling Control and Applications with Software - Springer Verlag, Berlin.

Paper Name : Electrical Machine Design II Laboratory
Paper Code : EE-881
Weekly Load : L : 0 T : 0 P : 3
Credit Point : 02
Total Marks : 100

List of Experiments:

Problem 1: Three phase Induction machine Design.

Problem 2: Design of Synchronous machine.

Books:

1. Sawhney A K: A Course in Electrical Machine Design; Dhanpat Rai & Co.
2. Say M G: The Performance and Design of Alternating Current Machines; CBS Publishers and Distributors.
3. Sen S K : Principles of Electrical Machine Design with Computer Programs; Oxford & IBH Pub. Co.
4. Norton, Machine Design, Pearson Education.

Paper Name: Project-II
Paper Code : EE 891
Weekly Load: L: 0, T: 0, P: 6
Credit Point : 06
Total Marks: 100

- This is the continuation of Project-I. started at Semester-VII.
- Each project group should complete their project in this Semester and finally prepare a comprehensive Project Report. Each group should submit at least three extra copy of Project Report other than their individual copy, one for their Project guide, one for the departmental library and one for Institute's main library.
- Project work and Project report of each project group should be demonstrated and presented in front of Board of Experts and evaluation will be made on that. 50% of total marks will be evaluated by the project guide and rest 50% of total marks will be evaluated by the Board of Experts.

Paper Name: Seminar-II
Paper Code : EE 892
Weekly Load: L: 0, T: 0, P: 3
Credit Point : 02
Total Marks: 100

- Each student have to give 10 minutes' individual presentation / lecture on any topic (advanced technology, research or development, new emerging Field etc.) followed by 5 minutes interaction / discussion session.
- The presentation should be in front of teachers, students of the class.
- Marks will be given based on evaluation throughout the year and a final evaluation at the end of Semester based on a final presentation.
- Evaluation should be based on the following parameters of the students: Presentation skill, Delivery of the speech, Depth and breadth of the subject matter presented.

- The attendance of other students in the seminar will be recorded and their participation should also be assessed for evaluation of their participations.
- Each student has to submit a technical report for each presentation they have delivered.

Paper Name: Grand Viva
Paper Code : EE 893
Weekly Load: L: 0, T: 0, P: 0
Credit Point : 03
Total Marks: 100

Viva-Voce based on all the **Theoretical as well as Practical Papers** starting from **Semester-I** to **Semester-VIII** will be conducted at the end of Semester-VIII. Board of experts will evaluate the performance of each individual student.

The board should consist at least one External Expert from the same discipline, Members from corresponding department and experts for all non-departmental subjects.