w.e.f. : 2011-12

2MA209: MATHEMATICS – III **L T P C**
3 1 - 4

Fourier Series - Periodic functions, Dirichlet's conditions, Fourier series, Euler's formulae, Fourier expansion of periodic functions with period 2π, Fourier series of even and odd functions, Fourier series of periodic functions with arbitrary periods, half range Fourier series, Harmonic analysis.

Laplace Transforms : Motivation, Definition, Linearity property, Laplace transforms of elementary functions, Shifting theorem Inverse Laplace transforms of derivatives and integrals, Convolution theorem, Application of Laplace transforms in solving ordinary differential equations, Laplace transforms of periodic, Unit step and Impulse functions.

Ordinary Differential Equations : Linear differential equations of higher order with constant coefficients, complimentary function, particular integral, method of variation of parameters, Higher order linear differential equations with variables coefficients (Cauchy's and Legendre forms), Simultaneous linear differential equations, Models for the real world problems and their solutions in particular, Modelling of electric circuits, Deflection of beams, Free oscillations, Forced oscillations, Resonance.

Partial Differential Equations : Formation of Partial differential equations, Directly integrable equations, Models of Engineering problems leading to first order partial differential equations. Langrange's equation. Applications to the Wave equation, one-dimensional heat and Laplace equation. **Telegraphic and telephone equation.**

Numerical Methods – Motivation, Errors, Truncation error, Rounded off error, Absolute error, Relative error and Percentage error, Solution of algebraic and transcendental equations by Newton-Raphson, Bisection, False position, iteration methods, Convergence of these methods.

Text Books:

1. Dr. K.R. Kachot - Higher Engineering Mathematics (Third Edition) Vol-II, Mahajan Pub. House, Ahmedabad
2. Erwin Kreyszig - Advanced Engineering Mathematics (Fifth Edition), Publisher: John Wiley

Reference Books:

1. Dr. B.S. Grewal - Higher Engineering Mathematics, Publisher: Khanna, New Delhi.
2. W.E.Boyce and R.Diprima - Elementry Differential Equations, Publisher: John Wiley
3. S.C. Chapra and R.P. Canale - Numerical Methods for Engineers with Programming and Software Applications, Publisher: McGraw-Hill, Newyork
4. R.V. Churchill & J.W. Brown - Fourier Series & Boundary Value Problems, Publisher: McGraw-Hill

2ME224: THERMAL AND HYDRAULIC PRIME MOVERS **L T P C**
3 - 2 4

Properties of Steam: Steam formation, enthalpy, internal energy and specific volume of steam, steam tables.

Steam Boilers: classification, construction, working, mountings and accessories.

Steam Turbines: Classification, compounding, velocity diagrams, work done, diagram and stage efficiency in impulse turbine, impulse reaction turbine, degree of reaction, diagram efficiency, optimum operating condition, governing of steam turbines.

Condensers: Introduction, types of condensers, vacuum efficiency, effect of vacuum, effect of air leakage, condenser efficiency, Dalton's law of partial pressure, amount of cooling water.
Diesel Power Plant: Working principle, fuels, main components, performance.
Gas Turbines: Introduction, applications, types of gas turbines, cycles, specific output, thermal efficiency, air rate, work ratio, effect of operating variables on thermal efficiency, methods to improve thermal efficiency, starting of plant, comparison with steam power plants.
Hydraulic Prime Movers: Principles of impact of jet, classification of hydraulic turbines, work done, power produced, efficiency of Pelton wheel, francis turbine, Propeller and Kaplan turbine, governing of impulse & reaction turbines, operating characteristic of impulse turbine, draft tube.

Laboratory Work:
This shall consist of at least 10 laboratory experiments based on the above syllabus.

Text Books:
1. R. K. Rajput - Power plant engineering
2. R. K. Rajput - A text book of Hydraulic Machinery

2EE201: ELECTRONIC DEVICES AND CIRCUITS **L T P C**
3 - 2 4

Rectifiers: Brief review of theory of PN junction diode: half wave, full wave & bridge rectifiers and their analytical treatment, design of filters.
Bipolar Junction Transistor: Construction, operation, transistor amplifying action, CE, CB, CC configuration, their specification sheet, testing, limits of operation.
Biasing of BJT: Operating point, fixed bias, emitter stabilized bias, voltage divider bias, collector to base bias, bias compensation techniques.
BJT Transistor Modelling: BJT transistor modelling, the *r*- parameter model, the hybrid equivalent model, graphical determination of h-parameters, approximate h-parameter model.
BJT Small Signal Analysis: Analysis of CE fixed bias, voltage divider bias, configuration, emitter follower configuration.
FET and FET Biasing: Construction and characteristics of JFETs, specification sheet, MOSFETs, VMOS, CMOS, biasing of JFET, depletion type & enhancement type MOSFETs.
FET Small Signal Analysis: FET small signal model, JFET self-bias & voltage divider bias configuration, JFET source follower configuration, depletion type & enhancement type MOSFETs.
BJT & JFET Frequency Response: Effect of load impedance, effect of source impedance, CE networks, low frequency response of BJT & FET amplifier, Miller effect capacitance, high frequency response of , BJT & FET amplifier, multistage frequency effects.
Compound Configuration: Cascade, cascode & darlington connection, current source, and current mirror circuits.
Power Amplifiers: Class A, class B and class AB amplifiers, operation & circuits, amplifier distortion, power transistor heat sinking, class C & D amplifiers.
Feedback Amplifier & Oscillator Circuits: Feedback concepts, types of feedback connection, practical feedback circuits, and feedback amplifier - phase & frequency considerations, oscillator operation, phase shift, Wien bridge & tuned oscillator circuit.
Optical Devices: Photo diodes, phototransistors, optocoupler, photo conductors, LCD with their construction, characteristics & major applications.

Laboratory Work: This shall consist of at least 10 laboratory experiments based on the syllabus.

Text Book:
1. R. Boylestad & L. Nashelsky - Electronics devices & Circuit Theory, PHI Publication

Reference Books:

1.	A. Mottershed	-	Electronics devices and circuits an introduction, PHI Publication.
2.	Millman and Halkias	-	Integrated Electronics, Mc Graw Hill
3.	A. P. Malvino	-	Electronic Principles, TMH Publishers
4.	U. A. Bakshi and A. P. Godse	-	Electronic Devices and Circuits-I, Technical Publishers (Pune).

2EE209: NETWORK ANALYSIS AND SYNTHESIS L T P C
3 1 2 5

Network Topology: Network topology, tie set & cut set schedule, source transformation, principle of duality, dot convention.
Network Equations: Mesh/loop current and node voltage analysis, equations for coupled circuits.
Initial Conditions: Initial conditions in elements, procedure for evaluating initial conditions.
Laplace Transform: Solution of circuit equations by Laplace transform, transient analysis of R-L, R-C and R-L-C circuits.
Waveform Synthesis: Laplace transform of step, ramp and impulse function, Laplace transform of special signals, initial & final value theorems.
Network Theorems: Thevenin, norton, superposition, maximum power transfer, reciprocity, Millman, Tellegen, etc.
Impedance Functions: Concept of complex frequency, transform impedance and transform circuits.
Network Functions: Network functions for one port and two ports, calculation of network functions, poles and zeros, time domain behaviour from pol- zero plot.
Two-port Parameters: Relationships of two port variables, impedance, admittance transmission and hybrid parameters, relationship between parameter sets, series / parallel combinations of two port networks.
Network Synthesis: Properties of positive real function, necessary and sufficient conditions, basic synthesis procedure, synthesis of L-C, R-L and R-C driving point functions.

Laboratory Work:
This shall consist of at least 10 laboratory experiments based on the above syllabus.
Tutorial:
This shall consist of solution of minimum 20 problems based on above syllabus.

Text Books:

1.	M. E. Van Valkenberg	-	Network analysis, PHI India
2.	U. A. Patel	-	Network Analysis and Synthesis, Mahajan Publishers

Reference Books:

1.	F. F. Kuo	-	Network analysis
2.	M. E. Van Valkenberg	-	Network synthesis, PHI India
3.	G. K. Mithal	-	Network analysis, Galgotia Publication

2EE210: ELECTRICAL POWER SYSTEM – I L T P C
3 1 - 4

Generating Stations: Schematic arrangement, choice of site, equipments and efficiency of thermal, hydro, nuclear, gas turbine, combined cycle power plants, comparison.
Economics of Power Generation: Important terms and factors, load duration curves, tariff, desirable characteristics of tariff, types of tariff

Power factor Improvement: Power factor, disadvantages of low power factor, causes of low power factor, power factor improvement equipments, calculations of power factor correction, most economical power factor

Supply Systems: Comparison of conductor efficiencies for various systems, choice of transmission voltage, economic size of conductor

Distribution System: Primary and secondary distribution systems, concentrated and uniformly distributed loads on distributors fed at one and both ends, ring distribution, tapered or stepped distributor, voltage drop and power loss calculation.

Mechanical Design of Overhead Lines: Different type of towers, sag – tension calculations, sag template, effect of ice covering and wind, overhead line with different levels, methods for measuring and checking the sag during erection, stringing chart.

Overhead Line Insulators: Types of insulators, materials of insulators, potential distribution over suspension insulator string, string efficiency, methods of improving string efficiency: longer cross arm, grading of insulators, guard ring; failure of insulators, preventive maintenance.

Cables: Construction, classification, insulation resistance, capacitance, dielectric stress, most economical diameter of conductor, grading, methods of laying, causes of failures, calculations of insulation resistance and capacitance, manufacturing processes**.**

Transmission Line Parameters: Transmission line parameters, skin effects and proximity effect, calculation of inductance and capacitance of a single-phase transmission line and three-phase single & double circuit transmission lines, concept of self-GMD and mutual GMD, transposition, effect of earth on capacitance of line, stranded and bundled conductors, Ferranti effect.

Substation: Types of substations, various substation equipments and layout, various busbar arrangements, busbar design.

Tutorial:

This shall consist of solution of minimum 20 problems based on above syllabus.

Text Books:

1. Soni, Bhatnagar & Gupta - A Course in electrical power system, Dhanpat Rai Publishers
2. S. Ray - Electrical Power Systems: Concept, Theory and Practice, PHI Publication

Reference Books:

1. J. B. Gupta - A Course in electrical power, Dhanpat Rai Publishers
2. H. Cotton - Transmission & Distribution C. B. S. Publishers
3. A. Hussain - Electrical Power Systems, C. B. S. Publishers
4. S. L. Uppal - Electrical Power, Dhanpat Rai Publishers
5. U. A. Patel - Electrical Power, Atul Prakashan

2EE211: ELECTRICAL AND ELECTRONICS MEASUREMENTS **L T P C**
3 - 2 4

Concepts of Measurements & Measurement Systems: Introduction to measurement and instrumentation, S. I. system, methods of measurement, static and dynamic characteristics of instruments, definitions – true value, accuracy, error, precision, sensitivity, resolution etc.

Analog Electromechanical Instruments: Classification of analog instruments, principle of operation, operating forces, errors in ammeters and voltmeters, permanent magnet moving coil, moving iron, dynamometer type, induction type, electrostatic type instruments

Measurement of Power and Energy: Electrodynamometer type wattmeter, measurement of power in three phase circuits, three phase wattmeter, measurement of reactive power, energy meter for A.C. circuits, induction type energy meter

Miscellaneous Measuring Instruments: Maximum demand indicator, tri-vector meter, power factor meter, frequency meters, synchroscope.

Measurement of Resistance: Measurement of low, medium & high resistances, insulation resistance measurement, localization of cable fault, Loop tests.
Measurement of Inductance and Capacitance: A. C. bridges for inductance measurement- Maxwell, Hays, anderson and owen bridges, capacitance measurement – Desauty and Schering Bridge. measurement of frequency by Wien's bridge
Potentiometers: Principle of D. C. potentiometer, direct reading potentiometers, accurate forms of potentiometers, A. C. potentiometer principle, polar and Co - ordinate type A. C. potentiometer, applications of A. C. and D. C. potentiometers.
Magnetic Measurement: Determination of B. – H. Curve, A. C. magnetic testing, methods of measurement of iron losses, methods of measurement of air gap flux and field strength.
Electronic Instruments: Introduction, essentials of an electronic instruments, advantages of electronic instruments, types of electronic voltmeters, transistor voltmeter (TVM), differential voltmeter, rectifier type A.C. voltmeter, true r.m.s. reading voltmeter, vector voltmeter, electronic multimeter, advanced electronic energy meter, LCR meter.
Digital Instruments: Analog and digital systems, basic concepts of digital instruments, digital voltmeters, digital LCR meter, digital multimeter, digital tachometer.

Laboratory Work: This shall consist of at least 10 laboratory experiments based on the syllabus.
Text Books:

1.	J. B. Gupta	-	A course in Electronic and Electrical measurements and Instrumentation, S. K. Kataria Publication
2.	R.K.Rajput	-	Electrical and Electronic Measurements and Instrumentation

Reference Books:

1.	A. K. Sawhney	-	A course in Electrical Measurement and Measuring Instruments
2.	E. W. Golding	-	Electrical & Electronic Measurements & Instrumentation
3.	A. D. Helfrick and W. D. Cooper	-	Modern Electronic Instrumentation and Meas. Techniques
4.	U.A.Bakshi	-	Electrical and Electronic Measuring Instruments

2SP201: CAREER ORIENTATION-I **L T P C**
[0 1 0 0]

The objective of the supplementary course of Career Orientation – I is to sensitize each student about one's own potential, and this in turn will enable one to be self driven so as to improve one's performance and achieve one's life goals.

The topics covered are: Self start, dedication, confidence, motivation, discipline, study, progress, evaluation, appreciation, criticism, improvement, reliance, control, respect, satisfaction, awareness, fulfillment and realization, inwardly directed towards oneself.

Basically the course is an in-depth exposure of a booklet on "Gateways to Self Realization" by Shri G. Narayana. The methodology is of self learning in which the students go through the book (in depth) and make presentations before their class, carry out given exercises and interesting activities; keeping the content in focus

w.e.f. 2011-12

2MA203: VECTOR CALCULUS AND NUMERICAL TECHNIQUES **L T P C**
3 - 2 4

Vector Calculus : Reorientation, Differentiation of vectors, scalar and vector fields, Gradient of a scalar function, Directional derivative, Divergence and Curl of vector function and their physical meanings. Line, Surface and Volume integrals, Green's theorem in plane, Gauss's and Stoke's theorem (Without Proof). Irrotational, Solenoidal and conservative vector fields.
Functions of Complex Variables : Reorientation, Analytic function, Cauchy – Riemann equations (Cartesian and Polar forms), Harmonic functions, Conformal mappings, Application of Conformal mappings to fluid mechanics, Complex integration, Cauchy's integral theorem, Cauchy's integral formula.
Finite Differences And Interpolation : Finite differences, Interpolation, Finite difference operators (Forward, backward and Central differences), Interpolation formulae: Newton's forward, Newton's backward, Lagrange's and Sterling's, Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule. Simpson's $3/8^{th}$ rule.
Numerical Solutions of Ordinary and Partial Differential Equations : Solution of initial value problems of first order ordinary differential equations, Picard's method, Taylor series method, 4^{th} order Runge – Kutta method, Finite difference methods of solving second order partial differential equation with boundary conditions (Poisson equation, Laplace's equation).
Solution of System of Linear Equations: Direct methods: Gauss elimination, Gauss-Jordan and Crout's LU Factorization methods, Indirect methods: Gauss-Seidel and Jacobi's methods.

Text Books:

1. Dr. K.R. Kachot - Higher Engineering mathematics (Second Edition) Volume – III Mahajan Publishing House, Ahmedabad
2. Erwin Kreyszig - Advanced Engineering Mathematics (Fifth Edition), Publisher: Wiley Eastern Ltd., New Delhi.

Reference Books:

1. Dr. B.S. Grewal - Higher Engineering Mathematics, Khanna Pub., New Delhi.
2. S.C. Chapra and R.P. Canale - Numerical Methods for Engineers with Programming and Software Applications, Publisher: McGraw-Hill – New york – 1998
3. M.J. Ablowitz & A.S. Fokas - Complex variables – Introduction & Application Publisher: Cambridge University Press - 1998

2HM203: ENGINEERING ECONOMICS & BUSINESS MANAGEMENT **L T P C**
2 1 - 3

Basic Economic Concepts: Definition, micro and macroeconomics, concept of utility, national income concepts, concepts and types of economic planning, factors of production.
Market Demand Analysis: Demand function and law of demand, factors influencing demand, demand forecasting.
Cost Concepts: Concepts of costs and revenues, break even analysis
Management: Concept, importance & nature, functions and skills
Management: Taylor's scientific management theory, Fayol's administrative theory, planning, decision making, organizing, coordination, directing, motivation, controlling
Human Resource Management: Functions of human resource management, recruitment, selection, training & development, discipline, performance appraisal, grievance handling, industrial relation, communication, leadership.

Text / Reference Books:

1.	R. D. Agrawal	-	Organization and Management
2.	J. Massie	-	Essential of Management
3.	O. P. Khanna	-	Industrial Economics and Management
4.	A. Monnapa & Saiydden Mirza		Personnel Management
5.	K. K. Dewett	-	Modern Economic Theory
6.	H. L. Ahuja	-	Advanced Economic Theory

2EE212: LINEAR INTEGRATED CIRCUITS **L T P C**
3 - 2 4

Differential Amplifier: Basics of differential amplifier, differential amplifier circuit configurations, D.C & A.C analysis of dual input balanced output differential amplifier, differential amplifier with swamping resistor, constant current bias, current mirror & level translator.
Introduction to Operational Amplifier: Block diagram & schematic symbol of typical op-amp, integrated circuit package types, pin identification & temperature ranges, ordering information, device identification, interpreting typical set of data sheets, elect parameters of op-amp, equivalent circuit of an op-amp, Ideal voltage transfer curve, the ideal op-amp, open loop configurations of op-amp.
Op-amp with Negative Feedback: Voltage series, voltage shunt feedback amplifier & its analysis, differential amplifier with one, two & three op-amp & its analysis, frequency response of op-amp, closed loop frequency response.
General linear applications of Op-amp: D. C. & A. C amplifier, peaking amplifier, summing, scaling & averaging amplifier, instrumentation amplifier, voltage to current & current to voltage converter, integrator & differentiator, current driver circuits.
Active Filters & Oscillators: First order & second order low pass & high pass Butterworth filter & its analysis, band pass & band reject filter & its analysis, phase shift and Wien bridge oscillator & its analysis, voltage controlled oscillator, square wave & triangular wave generation.
Comparators & Converters: Basic comparator, zero crossing detectors, Schmitt's trigger, Limitations of op-amp comparator, window detector, voltage to frequency & frequency to voltage converters.
Specialized IC Applications: The 555 timers as monostable multivibrator & as astable multivibrator, application of 555 as voltage controlled oscillator (VCO), ramp generator and Schmitt trigger, monolithic VCO IC – 566 or its equivalent.
Fixed voltage regulators using three terminal regulators 78xx and 79xx, adjustable volt regulators LM317/337 or equivalent, protection circuits of voltage regulators, principle of switching regulator, audio power amplifiers using TBA810, precision temperature sensor LM35.
Analog Computation: Use of OpAmp in solution of simultaneous equations and for simple differential equations.
Laboratory Work:
This shall consist of at least 10 laboratory experiments based on the above syllabus.

Text Books:

1.	R. Gayakwad	-	Operational amplifiers and linear integrated circuits, PHI Publications

Reference Books:

1.	R. Coughlin & Driscoll	-	OpAmp & Linear integrated circuits, PHI publications
2.	A. P. Malvino	-	Electronics Principles, TMH Publishers
3.	A. P. Godse and U. A. Bakshi	-	Linear Integrated Circuits and Applications – Technical Publications (Pune)

2EE213 - ELECTRICAL POWER SYSTEM-II **L T P C**
3 1 - 4

Performance of Transmission lines – Classification of transmission lines, performance of short, medium and long transmission lines, generalized constants for transmission line, regulation and efficiency of the lines.
Power Circle Diagram - Receiving and sending end power circle diagrams, universal power circle diagram
Representation of Power System Components - One line diagram, impedance/ reactance diagram, per unit system representation, modelling of power system components.
Symmetrical Fault Analysis - Transients on a transmission line, short circuit of an unloaded and loaded synchronous machine, reactances of a synchronous machine, short circuit current computations, current limiting reactors, bus impedance matrix, algorithm for short circuit studies.
Symmetrical Components - Symmetrical transformation, phase shift in star-delta transformers, sequence impedances of power system components, sequence networks, sequence networks of power system
Unsymmetrical Fault Analysis - Symmetrical component analysis of unsymmetrical faults like L-G, L-L, L-L-G faults, bus impedance matrix method
Corona – Introduction, phenomenon, corona formation, calculation of potential gradient, **c**ritical disruptive voltage, critical visual disruptive voltage, corona loss, Peek's formula, Peterson's formula, factors affecting corona loss, methods of reducing corona loss, radio interference, inductive interference between power and communication lines
Neutral Earthing - Introduction, isolated neutral, earthed neutral systems, solid, resistance, reactance, arc suppression coil, voltage transformer earthing and earthing transformer, equipment earthing - plate earthing, pipe earthing, substation earthing, introduction to insulation coordination
Reactive power and voltage control - Production and absorption of reactive power, voltage control methods, shunt reactors, shunt capacitors, series capacitors, synchronous condensers, static var systems, principles of transmission systems, modelling of reactive compensating devices, distribution system voltage regulation, modeling of transformer OLTC control scheme, power flow analysis procedures etc.

Tutorial:
This shall consist of solution of minimum 20 problems based on above syllabus.

Textbooks:

1.	Nagrath & Kothari	-	Modern Power System Analysis, Tata McGraw Hill
2.	S. Sivanagaraju and B. V. Rami Reddy	-	Electrical Power System Analysis

Reference Books:

1.	S. S. Vadhera	-	Power System Stability and Control, Dhanpat Rai
2.	C.L Wadhwa	-	Electrical Power System, New Age International
3.	A. Chakrabarti and S. Halder	-	Power System Analysis: Operation and Control
4.	P. S. R. Murthy	-	Power System Analysis

2EE214: CONTROL SYSTEM ENGINEERING L T P C
3 1 2 5

Introduction: Open loop and closed loop control systems, servomechanism.
Mathematical Modelling of Physical Systems: Differential equations of electromechanical systems, transfer function, analogous systems, gear trains, block diagram reduction techniques,

signal flow graph; Mason's gain formulae, applications, transfer function of D.C. and A.C servomotors, Synchros, potentiometer, tacho-generator.

Time Response Analysis: Standard test signals, time response of first order and second order control systems, time domain specifications, steady state error and error constants, various types of controller.

Stability: Concept of stability, necessary and sufficient conditions, Hurwitz criterion, Routh criterion relative stability analysis, applications to control systems

Root Locus Techniques: Root locus concept, construction of root locus, and determination of relative stability, effect of adding poles and zeros.

Frequency Response Analysis: Introduction, frequency domain specifications, correlation between time and frequency domain specifications. Polar plots, Bode plots, phase margin and gain margin, Nyquist stability criterion, and assessment of relative stability.

State Variable Analysis: Introduction, state variables, state – space formulation, state space methods from transfer functions, Relation between transfer function and state variable, solution of state equations.

Laboratory Work:

This shall consist of at least 10 laboratory experiments / assignments based on the above syllabus.

Tutorial:

This shall consist of solution of minimum 20 problems based on above syllabus.

Text Book:

1. Nagrath and Gopal - Control System Engineering, New Age International

Reference Books:

1. K. Ogata - Modern control system, PHI
2. U. A. Patel - Control System Engineering, Mahajan Publishers

2EE215: ELECTRICAL MACHINES – I

L	T	P	C
3	-	2	4

Electromechanical Energy Conversion Principles: Principles of energy conversion, singly excited magnetic system, doubly excited magnetic systems.

D. C. Generators: Principle of D. C. generator, construction, types of generators, E.M.F. equation, voltage build up process, critical resistance and critical speed, characteristics of generators, performance calculations, effect of armature reaction on terminal voltage.

D. C. Motors: Principle of D. C. motor, type of motors, torque equation, characteristics, losses and efficiency, starting of D.C. motors, methods of speed control, armature reaction and commutation.

Single-Phase Transformer: Construction and principle of single phase transformer, operation at no load and on load, vector diagram, equivalent circuit, losses, efficiency and regulation, determination of regulation**,** efficiency by direct load test and indirect test methods, parallel operation of single phase transformers, auto-transformer.

Polyphase transformers: Construction and types, different connections and their vector diagrams, parallel operation, Scott connection, tertiary winding, tapping and tap changers, transients in transformer, voltage regulation, cooling of transformers.

Laboratory Work:

This shall consist of at least 10 laboratory experiments based on the above syllabus.

Text Book:

1. Nagrath and Kothari - Electrical Machines, TMH

Reference Books:

1. E. Fitzgerald - Electric Machinery, Tata McGraw-Hill
2. P. S. Bhimbra - Electrical Machinery, Dhanpat rai Publishers
3. B. L. Theraja - Electrical Technology, Vol. – II, S. Chand & Co.

2SP202: CAREER ORIENTATION-II **L T P C**
[1 0 0 0]

The objective of this course is to continue previous course and enhance efforts for individual development. The course also aims to provide information on different topics related to their career planning and preparation. Topics include:-

-Goal Setting
-Stress Management
-Emotional Intelligence
-Career Prospects
-Industry Expectation
-Communication skills (Practical sessions)
    a. Presentation skills
    b. Interview Techniques
    c. Group discussions
    d. Non-verbal communications
-Overview of different tests for competitive exams
-Ethics for engineers
-Interpersonal relations
-Team works

Methodology of learning will be based on lecture-cum-interaction, workshops, expert lectures from industry people, assignments etc.

2EE301: ENGINEERING ELECTROMAGNETICS **L T P C**
3 1 - 4

Vector Analysis: Vector algebra, Cartesian coordinate system, vector components unit vectors, dot and cross product, circular, cylindrical and spherical co-ordinate systems, transformation of systems.
Coulomb's Law: Coulomb's law, electric field intensity, field of n-point charges, field due to line charge, continuous volume charge and sheet charge.
Gauss's Law and Divergence: Electric flux density, Gauss law-application divergence, Maxwell's first equation, vector operator and divergence theorem.
Energy & Potential: Energy in moving a point charge in electric field, potential and potential difference, potential gradient, the dipole.
Conductors, Dielectrics & Capacitance: Current and current density, continuity of current, conductors and semiconductors, dielectric, capacitance.
Poisson's and Laplace's Equations: Poisson`s and Laplace`s Equations and its solution for magnetic and electric field.
Magnetic Field: Biot-Savart's law, Ampere's law, curl, Stokes theorem, magnetic flux and flux density, magnetic potential, derivation of magnetic field's laws.
Magnetic Forces, Materials & Inductance: Force on moving charge and differential current element- nature of magnetic materials, permeability, boundary conditions, magnetic circuit and inductance.
Faraday's Laws: Faraday's laws, Maxwell's equations in point form and integral form.
Uniform Plane Wave: Wave motion in free space and dielectrics, the poyinting vector, propagation in conductors, skin effect, reflection of uniform plane waves.
Transmission Lines of Audio, Radio and UHF Frequencies: Transmission line equations, transmission line parameters, transients on transmission line, practical problems.

Tutorial:
This shall consist of solution of minimum 20 problems based on above syllabus.

Textbook:

1. William H. Hayt and John A. Buck - Engineering Electromagnetics, Tata McGraw-Hill Publishing Company Ltd., New Delhi , 7th Ed. 2006

Reference Books:

1. Matthew N.O. Sadiku - Elements of Electromagnetics, Oxford University Press, New Delhi, 3rd Ed. 2001
2. Nathan Ida - Engineering Electromagnetics, Springer (India) Pvt. Ltd., New Delhi, 2nd Ed. 2005
3. John D. Kraus - Electromagnetics, McGraw-Hill Inc., New York, 4th Ed. 1991
4. J. P. Tewari - Engineering Electromagnetics: Theory, Problems and Applications, Khanna Publishers, Delhi, 1st Ed. 2004
5. Joseph A. Edminister - Theory and Problems of Electromagnetics, McGraw-Hill Inc., New York, 2nd Ed. 1993

2EE302: HIGH VOLTAGE ENGINEERING **L T P C**
3 - 2 4

Breakdown in Gases: Mechanisms of breakdown in gases, related ionization processes, townsend and streamer theory, Paschen's law, breakdown in non-uniform fields, effect of wave shape of impressed voltage on the breakdown strength, breakdown of sphere gap and rod gap.
Breakdown in Liquid and Solids: Mechanisms of breakdown in liquids, effect of suspended particles, various breakdown theories, mechanisms of breakdown in solid including electro-mechanical, erosion, surface, thermal effects and streamer theory, relation between electric strength of solids and time, intrinsic breakdown strength
Impulse Generation: Specifications of an impulse voltage wave, standard impulse, reasons for adopting the particular shape, analysis and control of simple circuit of impulse generator, multistage impulse generator (Marx's circuit) circuit – working, earthing and tripping, techniques to observe wave front on C.R.O, specifications of an impulse current, generation of high impulse current.
Generation of High Voltage: Methods of generation of power frequency high voltage, cascade transformers and resonance methods, generation of high voltage d.c., voltage stabilization, tesla coil.
Measurement of High Voltage and Current: Potential dividers-resistive, capacitive and mixed dividers for high voltage, sphere gap; construction, mounting, effect of nearby earthed objects, humidity and atmospheric conditions, effect of irradiation and polarity, electrostatic voltmeter; principle and classification, constructional details of an absolute electrostatic voltmeter; oscilloscopes and their applications in high voltage measurement, impulse current measurement.
High Voltage Testing: Measurement of insulation resistance of cables, wet and dry flashover test of insulators, testing of insulators in simulated polluted conditions, testing of transformers and rotating machines, measurement of break-down strength of oil, basic techniques of non-destructive testing of insulators; measurement of loss angle, high voltage schering bridge, and partial discharge measurement techniques
Over Voltages and Insulation Co-ordination: Lightning, switching and temporary over voltages, traveling wave phenomena, Bewley's lattice diagram. BIL, SIL, methods of insulation coordination, graded insulation in a power system.

Laboratory Work:
This shall consist of at least 10 experiments based on the above syllabus.

Text Books:

1. M.S. Naidu and V. Kamaraju - High Voltage Engineering, Tata McGraw Hill, 4th Ed. 2009
2. C.L. Wadhwa - High Voltage Engineering, New Age International, 3rd Ed. 2010

Reference Book:

1. E. Kuffel, W.S. Zaengl, J. Kuffel - High Voltage Engineering Fundamentals, Newnes, 2nd Ed. 2000

2EE305: ELECTRICAL MACHINES – II **L T P C**
3 - 2 4

Polyphase Induction Motors: Rotating magnetic field, construction, types of motors, principle of operation, basic equations, vector diagram, equivalent circuit, torque and power equations torque/slip characteristics, performance calculations, circle diagram, high torque motors, speed control, manual and automatic starting, crawling and cogging, unbalanced operation of 3-phase induction motors.

Single-phase Induction Motor: Types, double field revolving theory, equivalent circuit, determination of motor parameters, methods of starting.

Alternator: Principle of operation, constructional features and types, emf. equation, distributed a.c. windings, distribution and coil span factors, effect of harmonics on emf and its elimination, armature reaction in cylindrical and salient pole machines, two reaction theory, equivalent circuit of cylindrical and salient pole machines, voltage equation, input / output equations, condition for maximum power, synchronizing power and torque, synchronizing methods, operation of alternators on infinite bus, voltage regulation by synchronous impedance, MMF and ZPF method, transient and sub-transient reactances, stability consideration, sudden short circuit of an alternator.

Synchronous Motor: Principle of reversibility, voltage equation, phasor diagram, torque and power equations, steady state operating characteristic, 'V' curves and 'O' curves, circle diagram, starting, hunting, damper windings and its effect, synchronous condenser

Auto Synchronous Motor: Construction, principle of operation, different connection schemes for excitation and its equivalent a.c. current, circle diagram

A.C. Commutator Motors: Types of windings, emf by transformer and rotation action, action of commutator as frequency converter, effect of emf injection, 1-phase a.c. commutator motors, 1-phase a.c. series motor, universal and repulsion motors.

Laboratory Work:
This shall consist of at least 10 experiments based on the above syllabus.

Textbooks:

1. M. G. Say - Performance and design of alternating current machines, CBS Publishers, Delhi, 1983
2. I.J. Nagrath and D. P. Kothari - Electrical Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 3rd Ed. 2004

Reference Books:

1. E. Clayton - Performance and design of direct current machines, CBS, Delhi, 3rd Ed. 1990
2. B. L. Theraja - Electrical Technology, Vol. – II, S. Chand & Co., Vol. – II, New Delhi, 2005
3. E. Fitzgerald - Electric Machinery, Tata McGraw-Hill, 6th Ed. 2003

2EE314 - POWER ELECTRONICS DEVICES & CIRCUITS **L T P C**
3 - 2 4

Introduction: Introduction to power electronics, advantages and disadvantages, characteristics, construction and symbol of power diodes, power transistors, GTO, TRIAC, DIAC, Power MOSFET, IGBT, LASCR, Fast recovery diode, Schottkey diode, MCTs, SIT and SITH.
Thyristor: Principle of operation of SCR, two transistor analogy, brief idea of construction of SCR, static characteristics of SCR, condition of turn on & off of SCR, gate characteristics, method for turning on of SCR, turnoff methods.
SCR rating & protection: SCR over voltage, over current protection, design of snubber circuit, heating, cooling & mounting of SCR, series and parallel operation of SCR, string efficiency & problem associated with series and parallel operation of SCR.
Various Triggering Circuits for Power Devices :R & R-C triggering, DIAC trigger circuits, UJT-based trigger circuits, advanced triggering circuits for thyristors, gate drive circuits for power MOSFET, driver circuits for IGBT
Phase-controlled Converters: Uncontrolled rectifiers- single phase and three phase, analysis with R and R-L loads, analysis with capacitive filter- line current distortion, THD, DPF, PF, line voltage distortion, effect of source inductance, effect of single phase rectifiers on neutral currents in a Three Phase Four-wire System.
Controlled Rectifiers: Single phase and three-phase fully controlled and semi-controlled, analysis with R-L, R-L-C loads-performance, voltage conversion ratio, effect of source inductance-power factor.
Choppers: Principle of chopper operation, various control strategies in chopper, step up & step - down choppers, steady state analysis of chopper circuits, current & voltage commutation of chopper circuits, Jones & Morgen's chopper.
DC to DC Converter: Switching voltage regulator, buck, boost and buck-boost regulators, simple UPS and SMPS.
AC Voltage Controllers: Single phase and three phase AC voltage controllers-principle of operation-analysis with R and R-L loads, thyristor controlled inductor
Introduction to cycloconverters and inverters: circulating and non circulating type cyclo-converters, analysis with R and R-L loads, introduction to inverter.
Laboratory Work:
This shall consist of at least 10 experiments based on the above syllabus.

Text books:

1.	M. H. Rashid	-	Power Electronics Circuits Devices & Application, Pearson Education, 2nd Ed. 2001
2.	M. S. Jamil Asghar	-	Power Electronics, Prentice Hall of India, New Delhi, 1st Ed. 2004

Reference Books:

1.	Ned Mohan	-	Power Electronics, Wiley, , 3rd Ed. 2008
2.	P C Sen	-	Power Electronics, Tata McGraw Hill , 2nd Ed. 2005

2EE315 - POWER SYSTEM OPERATION AND CONTROL **L T P C**
3 1 2 5

Formation of Network Matrices: Bus impedance and bus admittance matrices, algorithm for formation of Z-bus matrices, modification of bus impedance, matrix, sparsity oriented inversions for Y-bus short circuit studies using Z-bus matrix.
Load Flow Study: Introduction, classification of buses, solution techniques for load flow problem, various constraints, static load flow equations (SLFE), Gauss-Seidel method, Newton-Raphson method, fast decoupled method, comparison of methods, acceleration of convergence.
Stability Study: Introduction, classification, power angle characteristics, stability limits, dynamics of synchronous machines, swing equation, synchronizing coefficient, equal area criterion of stability and its applications, critical clearing angle and critical clearing time, numerical solution of swing equation, factors affecting steady state and transient stability
Economic Operation of Power System: Economic operation of generators within the plant, transmission loss as a function of plant generation, economic distribution of load between the plants coordinating transmission losses, Kron's method of evaluating loss coefficients, penalty factor, algorithms of different schemes automatic load dispatching.
Load Frequency Control: Introduction, single area load frequency control, modelling of speed governing system, turbine and generator, steady state analysis, dynamic response, proportional plus integral control, load frequency control and economic load dispatch control, principle of frequency control, flat frequency, selective tie line control.
State Estimation of Power Systems: Introduction to power system state estimation, the method of least square, estimation statistics, error, estimates.

Laboratory Work:
This shall consist of minimum 10 simulations based on the above syllabus.

Tutorial:
This shall consist of solution of minimum 20 problems based on above syllabus.

Text Book:
1. I. J. Nagrath and D.P. Kothari - Modern Power System analysis, Tata McGraw Hill, 2nd Ed. 2007

Reference Books:
1. J Grainger and W. D. Stevenson - Power System Analysis, McGraw Hill, 4th Ed. 2005
2. S. S. Vadhera - Power System Analysis and Stability, Khanna Publisher, 4th Ed. 2004
3. Sivanagaraju, Sreenivasan - Power System Operation and Control, Pearson, 1st Ed. 2010

2EE316 - DIGITAL INTEGRATED CIRCUITS **L T P C**
3 - 2 4

Number Systems and Codes - Binary, octal, decimal and hexadecimal number systems, their conversion, representation of signed numbers and binary arithmetic in computers, weighted and non-weighted binary codes, grey code, BCD code, alphanumeric codes, error detecting & error correcting codes.

Boolean Algebra and Logic Gates - Introduction, logic operations: AND, OR, NOT, Logic Gate: AND, OR, NOT, NAND, NOR X-OR & X-NOR, Axioms & laws of boolean algebra De morgan's theorem, NAND and NOR as universal gates. 7400 series integrated circuits, AOI Gates, introduction to PAL, GAL

Karnaugh Map and Quine – McClusky Method - Expression of boolean function to SOP & POS forms, two, three and four variable Karnaugh map, merging & minimization of SOP & POS expressions, don't care combinations, five & six variable Karnaugh map. Quine McClusty method, implementation of boolean equation using logic gates.

Combinational Circuits - The half and full adder, the half & full subtractor, parallel binary adders,the looks ahead carry adders, subtraction using parallel adders. BCD adders, code converters, parity bit generators/checkers, decoders, display devices, encoders, multiplexers, demultiplexers.

Flip Flops - S-R latch, gated latches, edge triggered S-R flip flop, JK flip flop, D flip flop, T flip flop. flip flop operating characteristics, master – slave flip flops, application of flip flops

Shift Registers - Buffer registers, controlled buffer register, 3-state buffer register, data transmission in shift register, serial in - serial out and parallel in - parallel out shift register, bi-directional shift register, application of shift register

Counters - Asynchronous and synchronous counters and their design, counters ICs.

Logic Families - Digital IC specification terminology, logic families: RTL, DTL, TTL, I^2L, ECL & CMOS, TTL sub families, open collector gates, CMOS sub families, interfacing TTL to CMOS, interfacing ECL to other logics.

Analog to Digital and Digital to Analog Converters - Digital to analog conversion, R-2R ladder type DAC, weighted resistor type DAC, the switched current source type DAC, counter type A/D converter, dual slope type A/D converter, successive approximation type A/D converter.

Memories - Role of memory in computer system, memory types & terminology, ROM organization, types of ROM, semiconductor RAMS, memory extension, sequential memories, programmable logic devices and charge coupled devices.

Laboratory Work:
This shall consist of at least 10 practicals based on the above syllabus.

Text book:

1. A. Anandkumar - Fundamentals of Digital Circuits, PHI publication 2nd Ed. 2010

Reference book:

1. Bignell and Donovan - Digital Electronics, Delmar (Thomson) Publication 4th Ed. 2000
2. R.P. Jain - Modern Digital Electronics, TMH Publications 4th Ed. 2010

2EE310 - MICROPROCESSOR AND MICRO CONTROLLERS **L T P C**
3 - 2 4

Introduction to Microcomputer – Evolution, history of microprocessors and microcontroller, block diagram of microcomputer and organization, concept of system bus (address bus, data bus).
Microprocessor Architecture and Organization - 8085 microprocessor architecture and organization, pin diagram and function of each pin.
Programming of 8085 - 8085 programming model, instruction classification, instruction format, concept of assembly language programming, addressing modes, data transfer instructions, arithmetic instruction, logical group of instructions, branching instructions, special instructions & their applications, timing diagram, code converters, assembly language programming, stack operations for push – pop, use of subroutines and monitor subroutines, time delay calculations and its applications, code conversion.
Interfacing Memory and I/O Devices - Memory interfacing & mapping, data transfer schemes, use of programmable peripheral interfacing devices- 8255, basics of serial I/O.
Interrupts - Multiple interrupts, device polling, vectored interrupts, 8085 interrupts, enabling, disabling & masking of interrupts, interrupt controller-8259.
Advanced Microprocessor: Basic features of 16 bit and higher microprocessors, comparison of 8 bit and 16 bit microprocessors.
The 8051 Architecture - Introduction, 8051 microcontroller hardware, I/O pins, ports and circuits, counter & timers, interrupts, serial data input/output, special function registers, timing diagram.
Microcontroller 8051 - Assembly language programming addressing modes, instructions for data transfer, logical operations, arithmetic operations, jump & call instructions, assembly language programming based on these instructions.
Applications - Use of microcontroller/microprocessors based system for interfacing A/D & D/A converters, microprocessor based relay applications.

Laboratory Work:
This shall consist of at least 10 practical based on the above syllabus.

Textbooks:
1. R.S. Gaonkar - Microprocessor architecture, Programming and Applications with 8085, Penram International Publishing, 5th Ed. 2007
2. K.J.Ayala - The 8051 micro controller architecture, programming and applications, Penram International Publication, 3rd Ed. 2008

Reference Book:
1. Mazidi, Mazidi - 8051 microcontroller & embedded system, pearson publications, 2nd Ed. 2006.
2. Ajit Pal - Micro processor TMH publication , 2nd Ed. 2004

2EE317 – ENERGY UTILIZATION AND ELECTRICAL DESIGN **L T P C**
3 - 2 4

Energy Utilization

Electric Heating: Advantages of electric heating, resistance heating, types of furnaces, temperature control of furnaces, induction heating, types of induction furnaces, dielectric heating, arc –furnaces.

Electric Welding: Welding and its classification, electric supply for arc welding, choice of welding time, welding techniques, methods of obtaining drooping characteristic.

Electrolytic Process: Basic principle of electro-deposition, application of electrolysis, electric supply for electrolytic process.

Illumination: Nature of light, definition and units, basic laws of illumination, determination of luminous flux, light sources and their characteristics, light production by excitation and ionization, sources of light, filament lamp, halogen lamp, discharge lamp, fluorescent lamp, incandescent lamp, arc lamp and their applications.

Light Control: Direct, diffused and mixed reflection, reflection factor, transmission factor, refractors, light fittings, street lighting, flood lighting, factory lighting etc.

Electric Traction: General features of electrical traction, different systems of traction, systems of track electrification, transmission of power from motor to driving wheel, mechanics of train movement, speed-time curves, tractive effort for acceleration and propulsion, power and energy output from driving axles, train resistance, adhesive weight and coefficient of adhesion, feeding and distribution system for tramways and railways, control of electric motors for traction.

Elements of Electrical Design

Design of Armature Windings: Simplex lap and wave dc armature windings, Dummy coils, Equalizer connections.

A.C. Windings: Single layer, concentric, hemitropic, whole coil and mush winding, double layer, integral and fractional pitch winding.

Design of Small Single Phase Transformers, Inductors and Heating Elements: Small Single Phase Transformers-core and winding designs, Inductor design calculations, design of round and square rectangular wire heating elements

Design of Starters: Types of starters for ac and dc motors, design of starting resistances for DC and AC starters.

Laboratory Work:

This shall consist of minimum 5 design problems and at least three design sketches/sheets, based on the above syllabus.

Text Books:

1. E.O. Taylor - Utilization of electric energy, Orient Longman 1st Ed.
2. H. Pratab - Art and Science of Utilisation of Electrical Energy, Dhanpat Rai & Sons, 3rd Ed. 2003
3. A.K. Sawhney - A Course in Electrical Machine Design, Dhanpat Rai and Sons, 7th Ed. 2002

Reference Books:

1 G. C. Garg - Utilization of Electrical Power and Electrical Traction, Khanna Publication, 1st Ed. 2009
2. J. G. Jamnani - Elements of Electrical Design, Mahajan Publishers, 2nd Ed. 2010

2EE318: POWER SYSTEM PRACTICE AND DESIGN **L T P C**
3 - - 3

Design of Power System: Introduction, selection of sizes and location of generating stations, selection and specifications of transmission lines, sizes and location of sub-stations, Interconnections.

Design of transmission lines:

Electrical Design: Requirements of transmission lines, selection of voltage, choice of conductors, spacing of conductors, corona, insulators, specifications of transmission lines, surge-impedance loading, design problem, overview of EHV-AC and HVDC transmission line design

Mechanical Design: Main considerations, loading on conductors, span, sag and tension, clearance from ground, stringing, design of towers, design problem

Design of Substation: Introduction, classification, selection and location of site for substations, site acquisition, selection and rating of various equipments used in a substation, key diagrams of typical substations, gas-insulated substation, design, construction and commissioning process.

Distribution Substation: Calculation of distributor size, calculation of voltage drops and size of distributor in ring system, voltage regulation and lamp flicker.

Design of Distribution System: Types of distribution systems arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design, HV distribution design concept, load balancing, design of rural distribution, planning and design of town electrification scheme, design of industrial distribution systems.

Economics of Distribution Systems: Economic selection of a distribution system, transmission and distribution costs, energy losses in a distribution system

Power System Grounding (Power Station and Sub-station Grounding): Objectives, definitions, tolerable limits of body currents, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, step and touch voltages, design of earthing grid and behaviour of earthing systems.

Power System Improvement: Introduction, methods of power system improvement, power system improvement scheme, determination of voltage regulation and losses in a power system, shifting of distribution transformer centre, financial aspects of the power system improvement scheme.

Text Book:

1. M. V. Despande - Electrical Power System Design, Tata McGraw-Hill Co Ltd., 1st Ed. 2008

Reference Books:

1. B. R. Gupta - Power System Analysis and Design, S. Chand, 3rd Ed. 1998
2. Satnam and Gupta - Substation Design and Equipments, Dhanpat Rai Publications, 3rd Ed. 2008

2EE320: ELECTRICAL MODELING AND SIMULATIONS LAB **L T P C**
- - 2 1

Introduction to Matrix Manipulation: General description about matrix based coding, **Expression:** Variables, numbers, operators, functions, **Matrices**: functions, matrix sum, transpose and diagonalization, subscripts, colon operator, generating and manipulating matrices (e.g., concatenation, adding and deleting rows, columns), arrays, multivariable data, scalar expression, logical subscripting, use of available functions, creating and using user defined functions and files, **Input / Output:** commands for user input, generating graphical output basic plots, their commands and interpretations.
Introduction to Electrical Modeling: Introduction to modeling, creating and using models to understand dynamic behavior of d.c. shunt motor and polyphase induction motors, modeling and simulation of controlled rectifier circuits with different nature of load, examples
Circuit Simulations: Introduction to circuit simulation, simulation of R, R-L, R-C, L-C and R-L-C circuits, simulation for half-wave, full-wave and bridge rectifier with different nature of load, two port network analysis, simulations with ideal amplifier based circuits, thyristor family based circuit simulations, polyphase transformer connections, simulations including induction machines and dc machines.

Laboratory Work:
This shall consist of at least 10 simulation assignments based on the above syllabus.

Text Books:

1. Rudra Pratap - Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford Press , 7th Ed. 2005
2. Mohmmad Rashid - Introduction to PSPICE Using ORCAD for Circuits and Electronics, Prantice Hall, 3rd Ed. 2003
3. S. L. Campbell, Jean-Philippe Chancelier et al - Modeling and Simulation in Scilab/Scicos, Springer, 1st Ed. 2005

2EE321: TESTING, COMMISSIONING AND MAINTENANCE OF ELECTRICAL EQUIPMENT **L T P C**
3 - 2 4

Transformer:
Types of transformers and their rating, terms related to testing, classification of testing methods, commissioning steps, ratio test, phase shifting/phase group, polarity testing, load losses, insulation resistance and HV test, noise level and vibration test, drying out of transformers, over voltage inter turn test, testing of accessories and safety devices, cooling and rating, temperature measurement and protection, troubleshooting and maintenance, transformer oil analysis using gas-chromatograph PH measurement.
Induction Motor:
Commissioning steps, testing of induction motors as per IS -insulation test, vibration and noise level test, slip measurement, air gap, testing of auxiliaries, temperature measurement and protection, degree of protection (IP Grade), drying out methods, troubleshooting and maintenance, commissioning of induction generator.
DC Machine:
Commissioning steps, voltage build up of DC machine, parallel operation, voltage regulation test, open circuit test, insulation test, drying out process, vibration and noise level test, direct test,

indirect tests: Swinburne's test, Hopkinson's test, Field's test, temperature rise test & heat run test, separation of iron losses, troubleshooting and maintenance.

Synchronous Machine:

Commissioning steps, voltage build up, excitation circuit test, insulation test, air gap, HV test, drying out process, loss measurement, temperature measurement and protection, vibration and noise level test, current balance, phase sequence, synchronizing and load sharing, voltage control, pf control, frequency control, harmonic analysis, troubleshooting and maintenance.

Earthing:

Earthing resistance measurement, substation grid earthing, soil resistivity measurement.

Circuit Breaker:

No load mechanical operation, impulse and surge testing, short time current test, short circuit braking and making test, time for fault clearing, fire protection, oil and compounding filling, electrical and mechanical endurance testing of LT switch gears viz. MCB, MCCB and ELCB, troubleshooting and maintenance.

Remnant Life Assessment (RLA): Non-destructive testing of electrical equipments using transducers.

Laboratory Work:

This shall consist of at least 10 practicals based on the above syllabus.

Text Book:

1. S.S.Rao - Testing, Commissioning , Operation & Maintenance of Electrical Equipment, Khanna Publishers,6th Ed. 2010

Reference Books:

1. RCH Richardson - The Commissioning of Electrical Plants & Associated Problems, Chapman & Hall, 4th Ed. 1962
2. Robert Rosenberg - Electric Motor Repair Holt, Rinheart and Winston,3rd Ed. 1987

2EE3E8-ELECTIVE–I **[3 - 2 4]**

2EE328 - POWER SYSTEM DYNAMICS AND CONTROL **L T P C**
3 - 2 4

Modelling of Power System Components: Introduction, synchronous machine modelling, load modelling, selected models of excitation systems, prime-mover and governing system

Dynamic Stability Analysis: Eigen value analysis, small signal stability for Single Machine Infinite Bus (SMIB), effect of AVR gains, power system stabilizers, techniques for the improvement of stability

Different Levels of Power System Control : Generating Unit Controls - excitation and prime mover controls, p-f and q-v loops, speed governing system dynamics, load frequency control, automatic generation control (AGC)

Laboratory Work:

This shall consist of at least 10 simulations/practicals based on the above syllabus.

Textbooks:

1. P. S. Kundur - Power System Stability and Control, McGraw Hill, 1st Ed. 2009
2. K.R. Padiyar - Power System Dynamics: Stability and Control, Interline Publishing Pvt. Ltd, 2nd Ed. 2008

Reference Books:

1. P. M. Anderson & A. A. Foaud - Power System Control and Stability, IEEE press, 2nd Ed. 2002
2. S. S. Vadhera - Power System Analysis and Stability, Khanna Publisher, 4th Ed. 2004
3. E. W. Kimbark - Power System Stability, Volume-III, John-Wiley, 1st Ed. 2004

2EE338 – ADVANCED ELECTRICAL MACHINES **L T P C**
3 - 2 4

Permanent Magnet Material and Magnetic Circuits: Characteristics, B-H loop and demagnetization characteristics, temperature effects, mechanical properties, applications

Permanent Magnet Machines: Features, construction and excitation pattern for square wave Permanent Magnet Brushless (PMBL) motors, sine wave PMBL motors and PM synchronous motors, characteristics and control, different types of converters.

Switched Reluctance Motor (SRM): Poles, phases and windings, inductance profile, static torque production, partition of energy and the effects of saturation, dynamic torque production, converter circuits, control, bearing less SRM.

Linear Induction Motors: Introduction, construction, classification and basic topologies, operational aspects, transient and control of linear induction motor.

Induction Generator: Construction, operating principle and equivalent circuit, phasor diagram, advantages, disadvantages and application.

High Performance Energy Efficient Machines: Technology of energy efficient motors, selection and application of energy efficient motors.

Laboratory Work:

This shall consist of at least 10 practicals based on the above syllabus.

Text Book:

1. T.J.E. Miller - Brushless PM and Reluctance Motor Drives, Clarendon Press Oxford, 1st Ed.1989

References Books:

1. Jacek Gierasewing - Permanent Magnet Motor Technology: Design and Applications, CRC Press, 3rd Ed., 2009
2. R. Krishnan - Electric Motor Drives, PHI. Prentice-Hall of India Pvt. Ltd., New Delhi, 1st Ed. 2001
3. O Kelly Denis - Performance and Control of Electrical Machines, McGraw-Hill Book Company, New York, 1st Ed. 1991
4. P.C. Sen - Principles of Electrical Machines and Power Electronics, Wiley India, 2nd Ed. 2007

2EE348: DYNAMICS AND MODELLING OF ELECTRICAL MACHINES **L T P C**
3 - 2 4

Basic principles for Electric Machine Analysis: Magnetically coupled circuits, electromechanical energy conversion, machine windings and air-gap mmf, winding inductances and voltage equations.

Reference Frame Theory: Basic concept of a reference frame, equations of transformation: change of variables, stationary circuit variables transformed to the arbitrary reference frame, commonly used reference frames, transformation between reference frames, transformation of a balanced set, balanced steady state phasor relationship, balanced steady state voltage equations.

Modelling of D.C Machines: Elementary direct current machine, voltage and torque equations, basic types of direct current machines, dynamic characteristics of permanent magnet and shunt dc motors, time-domain block diagrams and state equations.
Modelling of Synchronous Machines: Voltage and torque equations in machine variables, stator voltage equations in arbitrary reference frame variables, voltage equations in rotor reference frame variables: Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit systems, dynamic performance during a sudden change in input torque, dynamic performance during a 3-phase fault at the machine terminals, computer simulation.
Modelling of Induction Machines: Voltage and torque equations in machine variables, equations of transformations for rotor circuits, voltage and torque equations in arbitrary reference frame variables, commonly used reference frames, per unit system, analysis of steady state operation, free acceleration characteristic viewed from various reference frames, computer simulation to predict dynamic response during sudden change in load torque, computer simulation of induction motors in the arbitrary, stationary, rotor reference frames.
Modelling of Permanent Magnet Brushless (PMBL) DC Machines: Introduction, voltage and torque equations, steady state analysis.

Laboratory Work:
This shall consist of at least 10 practical/ assignments based on the above syllabus.

Text Book:

1. Paul C. Krause - Analysis of Electric Machinery, McGraw Hill, New York 1st Ed. 1986

Reference Books:

1. Bernard Adkins - The General theory of Electrical Machines, Chapman & Hall Ltd. London, 1st Ed. 1979
2. C.V. Jones - Unified Theory of Electrical Machines, Butterworth Publishers,1st Ed., 1967
3. D. C. white and H. H. Woodson - Electromechanical Energy Conversion, McGraw Hills, True 1st Ed. 1957
4. I. P. Kopylov - Mathematical Models of Electric Machines, Mir Publisher Moscow, 1st Ed. 1984

2EE358: ADVANCED APPLICATIONS OF POWER ELECTRONICS **L T P C**
3 - 2 4

Review of Solid State Devices: SCR, TRIAC, GTO, BJT, IGBT, MOSFET, SIT, MCT; their characteristics, gating requirements, protection, triggering circuits and applications.
Multilevel Inverters: Multilevel concepts, types of multilevel inverters; such as diode clamped, flying-capacitors, cascaded, applications and comparison.
Resonant Converter: Series and parallel resonant, class E, ZCS and ZVS resonant converters.
Advanced Converters: Unity power-factor rectifiers for bucking and boosting dc voltage, ac voltage regulators using IGBTs with input unity power-factor, current controlled voltage source inverters and PWM current source inverters, resonant converters, DC to DC converter-forward, flyback, bridge converter.
Power Supplies: SMPS, converters, design and analysis, closed loop control (voltage mode and current mode control), EMI and EMC problems and reduction techniques, magnetics including inductors and high frequency transformer design, UPS; on line, off line, line interactive, chargers, inverters, transfer switch, transformer, control, design etc., power supplies for telecommunication systems and automobiles.

Electrical Utility Applications: Active filters, wind generator connected to utility grid, induction heating, electric welding, ballast and other applications, electric vehicle, power electronics for photovoltaic power system

Laboratory Work:
This shall consist of at least 10 experiments based on the above syllabus.

Text Book:

1. M. H. Rashid - Power Electronics: Circuit -Devices and Applications, Prentice Hall, New Delhi., 2nd Ed. 2001

Reference Books:

1. Ned Mohan, T. M. Undeland, W. P. Robbins. - Power Electronics: Converters - Applications and Design, John Wiley and Sons, Singapore., 3rd Ed. 2008
2. M. D. Murphy, F. G. Tumbull - Power Electronic Control of AC Motors, Pergamon, Oxford Press, 1st Ed. 1991
3. B. K. Bose - Power Electronics and AC Drives, Prentice Hall, New Jersey, 3rd Ed. 2008
4. G. K. Dubey. S. R. Doradla, A. Joshi, R. M. K. Sinha - Thyristorised Power Contorllers, Wiley Eastern, 2nd Ed. 2001
5. D. A. Paice - Power Electronic Converter Harmonies: Multipulse Methods for Clean Power, IEEE Computer Society Press, 1st Ed. 1999.

2EE368: ELECTRONIC SYSTEM DESIGN **L T P C**
3 - 2 4

Design and selection of active and passive components

1. Design of iron cored and ferrite cored inductor for given current ripple & its control, design consideration of pulse transformers with multiple secondaries, special design consideration of flyback transformer for multiple output, selection of capacitor as filter and ripple rejectors, improvement of voltage regulation using suitable capacitor, types of power capacitor with their specifications.
2. Design of SMPS using discrete components and ICs, design of flyback converter with multilevel output.
3. Design of 1-ϕ and 3-ϕ inverter for emergency application, U.P.S. and motor drive, use of standard procedure of selection of components, check heal-sink requirements with analysis of harmonic contents.
4. Design of a PWM drive D-C compound motor, details of parameters of the components selected.
5. Design of a differential amplifier, design of the basic differential amplifier, practical gain control and balance control. Increasing the input impedance requirement of cascoding stages of the difference amplifier.
6. Design of P, I, D, PI, PID controllers for closed loop autoset of converters.
7. Design of power amplifiers, direct coupled class A amplifier, improving the performance of the class A amplifier, design of complementary symmetry power amplifier. The quasi-complementary symmetry amplifier.
8. System design guide lines:

(a) Power distribution: Component power connections, voltage drop power supply-to-mother board connections, decoupling capacitors, techniques for minimizing transient current effect in power distribution system.
(b) Signal Inter connections: Signal categories & their connections electrical interconnections, signal response, dynamic load, cross talk, transmission line effect.
(c) Unused inputs: Unused TTL inputs, unused CMOS inputs, pull-up resistance current limited pall up or full-down voltages.

Laboratory Work:
This shall consist of at least 05 design problems and testing based on the above syllabus.

Text Book:

1. Jai P. Agrawal - Power Electronics Systems: Theory and Design, Pearson Asia, 1st Ed. 2001

Reference Books:
1. Gerald E. Williams - Practical Transistor Circuit Analysis and Design, McGraw Hill Publication, 1st Ed. 1973
2. Jame E. Buchanan - CMOS/TTL digital System Design, McGraw Hill Publishing Company, 1st Ed. 2001

2EE378: SIGNALS AND SYSTEMS **L T P C**
3 - 2 4

Representation of Signals: Continuous and discrete time signals, classification of signals i.e. periodic, aperiodic, even, odd , energy and power signals, deterministic and random signals, complex exponential and sinusoidal signals, periodicity, properties of discrete time complex exponential unit impulse, unit step impulse functions, transformation in independent variable of signals: time scaling, time shifting.
Determination of Fourier series representation of continuous time and discrete time periodic signals, explanation of properties of continuous time and discrete time Fourier series.
Analysis of Continuous Time Signals and Systems: Continuous time Fourier transform and Laplace transform analysis with examples – their properties, Parseval's relation, convolution in time and frequency domains.
Basic properties of continuous time systems: linearity, causality, time invariance, stability, magnitude and phase representations of frequency response of LTI systems, analysis and characterization of LTI systems using Laplace transform, computation of impulse response and transfer function using Laplace transform.
Sampling Theorem and z-Transforms Representation of Continuous Time: Signals by its sample, sampling theorem, reconstruction of a Signal from its samples, aliasing, discrete time processing of continuous time signals, sampling of band pass signals Basic principles of z-transform, z-transform definition, region of convergence, properties of ROC, properties of z-transform, poles and zeros, inverse z-transform using contour integration - residue theorem, power series expansion and partial fraction expansion, relationship between z-transform and Fourier transform.
Discrete Time Systems: Computation of impulse response and transfer function using z-transform, DTFT properties and examples, LTI-DT systems, characterization using difference equation, block diagram representation, properties of convolution and the interconnection of LTI Systems, causality and stability of LTI Systems.

Systems with Finite and Infinite Duration Impulse Response: Systems with finite duration and infinite duration impulse response – recursive and non-recursive discrete time system – realization of structures – direct form – I, direct form – II, transpose, cascade and parallel forms.

Laboratory Work:
This shall consist of at least 10 simulations / practical based on the above syllabus.

Text books:

1.	Alan V. Oppenheim, Alan S.Willsky, S .Hamid Nawab	-	Signals and Systems, Pearson, 2nd Ed. 1996
2.	John G.Proakis and Dimitris G.Manolakis	-	Digital Signal Processing, Principles, Algorithms and Applications, Pearson, 4th Ed. 2007

Reference books:

1.	M. J. Roberts	-	Signals and Systems: Analysis using Transform method and MATLAB, Tata McGraw-Hill Co Ltd., 1st Ed. 2003
2.	S. Haykin, Barry Van Veen	-	Signals and Systems, Wiley India, 2nd Ed. 2007
3.	M. H. Hayes	-	Digital Signal Processing, Schaum's outline series, Tata McGraw-Hill Co Ltd., 1st Ed. 1998
4.	Ludeman L.C.	-	Fundamentals of Digital Signal Processing, Wiley India, 1st Ed. 2009
5.	H. Saunders**,** V. Valkenburg	-	Analog Filter Design, Oxford University Press, 1st Ed. 1995

2EE388: FINITE ELEMENT ANALYSIS OF ELECTRICAL MACHINES **L T P C**
3 - 2 4

Basic Design Methodology and Engineering Considerations: Design methodology and engineering consideration, selection of input data and design variables, flow charts for design of transformers, rotating machines, electromagnets, design optimization of transformers, rotating machines, electromagnets etc.

Concepts of Computer Aided Design (CAD): Development of computer program and performance prediction, optimization techniques and their application to design problems, use of graphic tools in computer, development of PC based software, exercises on design using standard soft wares.

Finite Element (FE) Analysis based Design: Fundamentals of Finite Element method, FE techniques and their applications for designing transformers, rotating machines, electromagnets etc, 2D and 3D parametric analysis, methods of FE analysis, FEM in one dimension, 2D, 3D, governing equations, CAD programming of transformers, rotating machines, electromagnets.

Laboratory Work:
This shall consist of at least 10 simulations / assignments based on the above syllabus.

Text Books:

1.	S. K. Sen	-	Principles of Electrical Machine Design with Computer programmes, Oxford & IBH, 1st Ed. 2006
2.	Nicola Bianchi	-	Electrical Machines Analysis using Finite Element methods, 1st Ed., 2005

Reference Books:

1.	M. Ramamoorthy	-	Computer Aided Design of Electrical Equipments, 1st Ed. 1988
2.	Silvester and Ferrari	-	Finite Elements Methods for Electrical Engineers, Press Syndicate of the University of Cambridge, 3rd Ed. 1996
3.	C. S. Ratnajeewan	-	Finite Elements Electromagnetics Design, Elsevier, 1st Ed. 1995

INSTITUTE ELECTIVE–I **[3 - - 3]**

2EE401: POWER SYSTEM PROTECTION AND SWITCHGEAR [3 0 2 4]

Electromagnetic Relays: Constructional features, various types, principle of operation, application and their limitations, over current, directional (current and power), differential, distance, frequency and other types of relays.
Numerical Protection: Introduction, block diagram of numerical relay, numerical over-current protection, numerical transformer differential protection, numerical distance protection of transmission line.
Protective Systems: Generator and transformer protection systems, protection of busbars, protection of transmission lines including principles of pilot wire and carrier protection, CTs, CVTs & PTs and their application in protective schemes.
Switchgear: Fault clearing and interruption of current, theory of initiation of arc, methods of quenching arc, theory, control of restriking and recovery voltage, calculation of the rating of the circuit breakers, principle of operation of various types of circuit breakers - indoor and outdoor types, air - break, oil - filled, air blast, SF6 and vacuum circuit breakers, selection of circuit breakers, elementary ideas of testing methods, fuses - types, MCB, ELCB, applications and limitations.

Practical / termwork shall be based on above syllabus

Text/Reference Books:
1. B Ravindranath & M. Chander - Power System Protection and Switchgear, New Age International Publishers
2. B. Ram.- Power System Protection and Switchgear, Tata McGraw Hill
3. Mason - Art of science of protection relaying , Wiley Eastern Limited
4. Paithankar Y. O. - Fundamentals of Power System Protection, PHI Publication
5. S.S.Rao -Switchgear and Protection, Khanna Publishers

2EE402: INDUSTRIAL INSTRUMENTATION AND AUTOMATION [3 0 2 4]

Transducers: Main three block of instrumentation system – transducer / sensor, signal conditioner & display, definition and nature, functional characteristics, principles, classification, general characteristics, electrical, design characteristics, static and dynamic performance characteristics of instrumentation system, displacement/motion transducer, temperature transducers, pressure transducers, liquid level transducers, optical sensors, intelligent sensors, bio sensors, ultrasonic transducers, general characteristics of an instrumentation system
Force, weight & torque measurement transducers: force, torque, strain gauge transducers and load cells, force, weight and torque measurements, piezo-electric transducers, piezo-electric elements, piezo-electric accelerometers and other applications.
Displacement Measurement: capacitive, inductive and resistive type transducers and other methods for linear and angular displacement measurement, transducers and measurement systems for pressure, flow and level of liquid solid gaseous material.
Thermometry: resistance temperature detectors, thermocouples, thermistors and their circuits, use of linear expansion of solid, liquid and gas for measuring temperature and pressure, use of bimetallic strips (thermostat) for temperature measurement, hydro-metry (density measurement).
Humidity and moisture sensing elements and their measurement techniques: Nuclear radiation detection and measurement, voltage and current transducers, non-destructive testing using eddy current and ultrasonic transducers, spectrophotometers, gas - chromatography, thermal conductivity meters, viscosity and specific gravity measurement, pH measurement.

Recorders: X - Y, strip chart and circular type graphic recorders, indicating, recording and controlling instruments, multi-channel recorders, signal conditioners i.e. buffer, comparator, instrumentation amplifier, wave shaper and filters, spectrum analyzer.
Automation: Introduction to automation system with block diagram, analog/digital, I/O Modules, elementary idea of LAN and SCADA, PLC and DCS used in automation system, scope of P.C. based automation system. Overall idea of automation used in some plants such as thermal power plant, cement plant, steel plant, production plant of any electrical equipments.
Practical / term work shall be based on above syllabus

Text/Reference Books:

1. Patranabis - Industrial Instrumentation, TMH
2. E.O. Doeblin- Measurement systems : Application & Design, McGraw-Hill, Inc.
3. C.S. Rangan, G.R. Sharma, V.S. Mani -Instrumentation: Devices and systems, TMH
4. R. K. Jain - Mechanical and Industrial measurements, Khanna Publishers
5. Krishnakant – Computer based Industrial control, PHI

2EE403: ELECTRICAL MACHINE DESIGN [3 0 2 4]

General aspects: Insulating materials and classification, heating of electrical machines, cooling of transformers and rotating machines, electrical and magnetic loading, output co-efficients, factors affecting size of machines
Design Of Inductors, Design Of Small Single-Phase Transformers: Design Of Core And Windings, Window Dimensions, Selection Of Stampings
Transformer Design (3-phase): Introduction, design equations, choice of design parameters, main dimensions of magnetic circuit, transformer windings, mechanical forces in transformers, tap changing, design of windings, performance characteristics of designed transformer, cooling system design.
Design of Armature Windings: Types of dc winding, simplex lap and wave d.c. armature windings, dummy coils, equalizer connections.
A.C. Windings: Single layer, concentric, hemitropic, whole coil and mush winding, double layer, integral and fractional pitch winding.
3-Phase Induction Motor Design: Introduction, output equation, design of stator winding, flux density in stator tooth, depth of stator core, length of air gap, design of squirrel cage rotor, design of wound rotor, flux density in rotor tooth, depth of rotor core, performance relating to design, design performance from circle diagram, dispersion coefficient.
Design of D.C. Machines: Introduction to design, output equation, main diamensions of armature, design of armature winding, design of armature core, performance of designed armature, design of the field system, length of air gap, design of the field winding, performance of the field system, design of commutator and brushes, performance of commutator, design of interpoles, design of inter pole winding, overall performance.
Design of Synchronous Machines : Output equation, main dimensions, short circuit ratio and its consideration, air gap length, shape of pole face, armature design, armature winding, slots, length of mean turn and stator core, calculation of armature resistance and reactance, design of rotor, design of pole and pole winding, short circuit characteristic and performance evaluation.

Term work:
Design Sheets: Student is required to submit at least four design sheets in full size as term work.
Sketch Book: Sketches of components and parts of designed machines are to be drawn in sketchbook.

Text/Reference Books:

1. A.K. Sawhney - A course in electrical machine design, Dhanpat rai and Sons
2. M.G. Say - Performance and design of a.c. machines, CBS
3. Clayton - Performance and design of d.c. machines, CBS
4. Indrajit Das Gupta- Design of transformers , Tata Mc Graw Hill
5. BHEL – Transformers, Tata Mc Graw Hill

2EE404: ELECTRIC DRIVE SYSTEMS [3 0 2 4]

Fundamental of Electric Drives: Basic concepts, characteristics and operating modes of drive motors, starting, braking and speed control of motors, four quadrant drives, types of loads, torque and associated controls used in process industries, selection of motors and rating.

DC Motor Drives: Analysis of separately excited dc motor with continuous armature current and discontinuous armature current, analysis of series dc motor drives, power factor improvement, comparative evaluation of phase angle control, semi-converter operation of full converter, asymmetrical firing, forced commutation, sequence control, three phase semi-converter, full converter, dual converter with circulating current, dual converter without circulating current controlled drives, closed loop control system of dc motor drives, reversible drives, analysis and performance characteristics of chopper fed dc motors, braking, multiphase chopper, phase locked loop control of dc drive.

Induction Motor Drive: AC motor operation with non–sinusoidal supply waveform, variable frequency operation, principles of variable frequency operation, steady state performance at constant v/f, constant flux operation, constant current operation, transient performance of the frequency controlled induction motor, closed loop control of ac drives, closed loop circuits for stator voltage control, v/f control, slip power recovery control, rotor resistance control by chopper, introduction of field oriented control of ac motors, open loop vector control of induction motor, comparison of ac & dc drive, their selection for particular application, effect of non-sinusoidal wave form on AC machine performance.

Synchronous Motor Drives: Three phase synchronous motors, variable speed drives, variable frequency control, self-controlled synchronous motor drive employing load commutated thyristor inverter, self controlled synchronous motor drive employing a cyclo converter.

Stepper motor drives: different types of stepper motors and their speed control circuits.

Commutatorless D.C. Motors: Solid-state commutation, unconventional commutatorless motors.

Switched Reluctance Motor Drives: Introduction, concepts of SRM drives, Speed sensor and sensorless drives.

Practical / term work shall be based on above syllabus

TEXT/REFERENCE BOOKS:

1. J.M.D.Murphy -Thyristor control of A.C motors, Pergamon Press
2. B.K.Bose- Power Electronics & Variable Frequency drive, IEEE press
3. Mohammad Rashid - Power Electronics: Circuits, Devices &Applications, Prentice Hall
4. Ned Mohan, W. P. Robbins & T. M. Undeland - Power Electronics: Converter Applications & Design, John Willey & Sons
5. G. K. dubey – Fundamental of Electrical Drives, Narosa Publication
6. S. K. Pillai- First Course on Electrical Drives,Wiley Eastern Limited, New Delhi
7. Vedam Subramanyam - Electric Drives– concepts and publications, Tata Mc -Graw Hill
8. W. Leonhard – control of electric drives, springee verly
9. R. Krishanan, Electric motor drives, Prentice Hall India.

2EE405 MINOR PROJECT **[0 0 12 6]**

A student is required to carry out project work. The project should be on design and fabrication work based on the choice of the subjects they have studied so far. Students can take study project on advance topic with submission of comprehensive report containing all special features.
At the end of the semester, student will be required to submit a report of work done and will defend his/her work carried out before examiners at the time of final evaluation.

(2EE4E6): ELECTIVE – II **[3 0 2 4]**

2EE416: ADVANCED MICROPROCESSOR **[3 0 2 4]**

Introduction: Overview of microcomputer structure & operation, microprocessor evolution & types, features of advanced microprocessors (16 bit & higher), multi-user/multi-tasking operating system concepts.
8086/8088 Family: The 8086 microprocessor family, overview, Bus standards: PC buses, industrial buses, interface standards: Centronics parallel, RS –232, USB, 8086 internal architecture, introduction to programming of 8086, constructing the machine codes for 8086 instructions, use of assembler, assembly language program development tools, Minimum mode/Maximum mode operation of 8086, 8086 system connection and timing diagrams.
Assembly Language Programming of 8086: Jumps, flags & conditional jumps, If–then, If – then – Else & multiple If – Then – Else programs, while-do programs, repeat until programs, instruction timing & delay loops, 8086 string instructions writing & using procedures, assembler macros, instruction descriptions & assembler directives, 8086 interrupt applications.
Peripheral interfacing devices: Programmable timers–8253/8254, Universal asynchronous and synchronous receiver and transmitter (USART)–8251, RS 232 port, display interfacing using 8279, DMA controller-8257.
Other Processors: Study of 80186, 80286, 80486, Pentium up to recent processor architecture and its comparison.
8096/80196 Micro Controller: 8096 micro controller hardware, overview of 8096 micro controller.
Applications: Applications of microprocessor based systems for measurement of electrical quantities, protective relays; firing control of SCR, process control systems as temperature, flow and other applications.
Practical / termwork shall be based on above syllabus
Text/ Reference Books:

1. D.V.Hall - Microprocessors & interfacing, programming & hardware, Tata Mc Graw Hill
2. John Uffenbeck - The 8086/8088 family, design, programming and interfacing, PHI.
3. 8096/80196 user's guide
4. Barry b. Brey - The intel microprocessors: 8086/8088, 80186/ 80188, 80286, 80386, and 80486, pentium, and pentium pro processor_architecture, programming, and interfacing, PHI

2EE426: ADVANCED APPLICATIONS IN POWER ELECTRONICS **[3 0 2 4]**

Review of Solid State Devices: SCR, Triac, GTO, BJT, IGBT, MOSFET, SIT, MCT; their characteristics, gating requirements, protection, triggering circuits and applications.
Multilevel Inverters: Multilevel concepts, types of multilevel inverters; such as diode clamped, flying-capacitors, cascaded, applications and comparison.
Resonant Converter: Series and parallel resonant, class E, ZCS and ZVS resonant converters.
Advanced Converters: Unity power-factor rectifiers for bucking and boosting dc voltage, ac voltage regulators using IGBTs with input unity power-factor, current controlled voltage source

inverters and PWM current source inverters, resonant converters, DC to DC converter-forward, flyback, bridge converter.

Power Supplies: SMPS, converters, design and analysis, UPS; on line, off line, line interactive, chargers, inverters, transfer switch, transformer, control, design etc., power supplies for telecommunication systems and automobiles.

Electrical Utility Applications: High voltage DC transmission, static var compensator, Active filters, wind generator connected to utility grid, FACTs, induction heating, electric welding, ballast and other applications.

Practical / Termwork shall be based on above syllabus

Text/References Books:

1. M. H. Rashid, " Power Electronics: Circuit -Devices and Applications", Prentice Hall, New Delhi.
2. Ned Mohan, T. M. Undeland, W. P. Robbins. "Power Electronics: Converters. Applications and Design", John Wiley and Sons, Singaapore.
3. M. D. Murphy, F. G. Tumbull. "Power Electronic Control of AC Motors". Pergamon , Oxford.
4. B. K. Bose. "Power Electronics and AC Drives", Prentice Hall. . New Jersey.
5. G. K. Dubey. S. R. Doradla, A. Joshi, R. M. K. Sinha. " Thyristorised Power Contorllers", Wiley Eastern, New Delhi.
6. D. A. Paice, " Power Electronic Converter Harmonies: Multipulse Methods for Clean Power" IEEE Press, New York.

2EE436: COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES [3 0 2 4]

Basic design methodology and engineering considerations: Choice of electric, magnetic and insulating materials, standards used in design, frame sizes, name plate details, electric & magnetic loading, output equations relating to dc and ac machines, performance equations from design data, computerisation of design procedures.

Concepts of CAD: Development of computer program and performance prediction, optimization techniques and their application to design problems, use of graphic tools in computer, development of PC based software, exercises on design using standard soft wares.

Finite element method of design: Fundamentals of finite element (FE) design, FE techniques and their applications for designing transformers, rotating machines, electromagnets etc, methods of FE analysis, finite element methods in one dimension, 2D, governing equations, CAD programming using MATLAB.

Practical / termwork shall be based on above syllabus

Text/Reference Books:

1. Albert. E. Clayton- Performance and design of direct current machines, CBS Publishers & Distributors
2. M. G. Say - Performance and design of electrical machines, CBS Publishers & Distributors
3. Veinott - CAD of electrical machines
4. S. K. Sen - Principles of Electrical Machine Design with Computer programmes, Oxford & IBH
5. Ramamoorthy - Computer aided design of electrical equipments
6. Silvester and Ferrari - Finite elements methods for electrical engineers, Press Syndicate of the University of Cambridge
7. C. S. Ratnajeewan - Finite elements, electromagnetics design, Hoole Els evier,

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2EE446: ADVANCED ELECTRICAL MACHINES [3 0 2 4]

Permanent Magnet Material and Magnetic Circuits: Characteristics, B-H loop and demagnetization characteristics, temperature effects, mechanical properties, applications
Permanent Magnet Machines: Features, construction and excitation pattern for square wave PMBL motors, sine wave PMBL motors and PM synchronous motors, characteristics and control, different types of converters.
Switched Reluctance Motor: Poles, phases and windings, inductance profile, static torque production, partition of energy and the effects of saturation, dynamic torque production, converter circuits, control, bearing less SRM.
Linear Induction Motors: Introduction, construction, classification and basic topologies, operational aspects, transient and control of linear induction motor.
Induction Generator: Construction, operating principle and equivalent circuit, phasor diagram, advantages, disadvantages and application.
High Performance Energy Efficient Machines: Technology of energy efficient motors, selection and application of energy efficient motors.

Practical / termwork shall be based on above syllabus

Text/References Books:

1. T.J.E. Miller – Brushless PM and Reluctance Motor Drives, Clarendon Press Oxford.
2. Jacek Gierasewing - P. M. motor technology, M. Dekker
3. R. Krishnan – Electric Motor Drives, PHI
4. O Kelly, Denis - Performance and Control of Electrical Machines, McGraw-Hill Book Company
5. P.C. Sen – Principles of Electrical Machines and Power Electronics
6. Latest IEEE transactions on Industry applications

2EE456: DYNAMICS AND MODELLING OF ELECTRICAL MACHINES [3 0 2 4]

Energy State Functions: Basic principles of electromechanical energy conversion, general expressions of generated -voltage and force/torque, basic modelling of electrical machines from coupled circuit point of view, techniques of transformations, general volt-ampere and torque equations under stationary and rotating reference frames, instantaneous symmetrical components, and generalized operational equivalent circuits, space vector concepts.
Modelling of D.C Machines: Analysis under motoring and generating - simulation for transient and dynamic conditions, voltage build up in generators, effects of load change, run-up and dynamic operation of motors under different excitations, response under load change, speed control and braking.
Modelling of Synchronous Machines: d-q transformations fixed to field structure, steady state and dynamic equations, phasor diagram for cylindrical rotor and salient pole machines - electromagnetic and reluctance torques, response under short circuit conditions, sub transient, transient and steady state conditions, simulation of vector controlled synchronous motors, computer simulation using mathematical softwares.
Modelling of Induction Machines: Equations under stationary and rotating reference frames, derivation of equivalent circuits, correlation of inductances, run up transients, dynamics under load change, speed reversal and braking, computer simulation to predict dynamic response, simulation of induction motors under soft start, VVVF and vector controlled drives, unbalanced and asymmetrical operation, symmetrical component and rotating field theory, modelling and simulation of single phase motors.
Modelling of PMBLDC Machines: Introduction, voltage and torque equations, steady state analysis.

Practical / term work shall be based on above syllabus

Text/Reference Books:

1. Bernard Adkins - The General theory of Electrical Machines , Chapman & Hall Ltd. London
2. Paul C. Krause, "Analysis of Electric Machinery ", Me-Graw Hill. New York
3. C.V. Jones - "Unified Theory of Electrical Machines", Butterworth Publishers
4. D. C. white and H. H. Woodson, " Electromechanical Energy, Conversion", McGraw Hills.
5. I. P. Kopylov, "Mathematical Models of Electric Machines", Mir Publisher Moscow

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2EE466: DIGITAL SIGNAL PROCESSING [3 0 2 4]

Signals and Their Representation: Periodic, non-periodic, continuous, discrete-time, digital signals, special functions (delta function etc.), periodic signals and Fourier series analysis, non-periodic signals and the Fourier transform, relationship to the Laplace transforms.

Linear Continuous-time Systems: Discrete time signals and systems, discrete signal sequences, linear shift invariant systems, discrete signals, stability and causality, difference equations, impulse response, the convolution integral, response of linear time-varying systems to signals, frequency domain representations, Fourier transform and its properties, introduction to z –transforms and its applications.

Discrete Fourier Transform: Discrete Fourier transform, representation of discrete Fourier series, properties of discrete Fourier series, periodic convolution, DFT-properties of DFT, computation of DFT, circular convolution, linear convolution using DFT – FFTs.

Filter Design: Design of digital filters, IIR and FIR filters, low pass analog filter design, Butterworth and Chebyshev filters, design examples, bilinear transformation and impulse invariant techniques, FIR filter design, linear phase characteristics, window method.

Practical /termwork shall be based on above syllabus.

Text/Reference Books:

1. Proakis & Manolokis, Digital Signal Processing, Principles, Algorithm & Applications, Prentice Hall
2. Oppenheim & Schafer, Discrete Time Signal Processing, Prentice Hall
3. Ludeman L.C., Fundamentals of Digital Signal Processing, Harper & Row Publishers
4. Van Valkenburg M.E., Analog Filter Design, Holt Saunders
5. Terrel T.J. & Shark L.K., Digital Signal Processing, Macmillan

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INSTITUTE ELECTIVE – II

ENERGY MANAGEMENT AND AUDIT [3 0 0 3]

Energy Scenario : Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, re-structuring of the energy supply sector, energy strategy for the furture, air pollution, climate change. Energy Conservation Act-2001 and its features.

Basics of Energy and its various forms:

Electricity basics – DC & AC currents, electricity tariff, Thermal basics- fuels, thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity and heat transfer, units and conversion.

Energy Management and Audit : Definition, energy audit, need, types of energy audit. Energy management approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments.

Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Energy Monitoring and Targeting: Defining monitoring and targeting, elements of monitoring and targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM).

Energy efficiency in thermal utilities: Energy efficiency in boilers, steam system, furnaces, insulation and refractories, co-generation, saving potentials in each case.

Energy efficiency in electrical utilities:

Energy efficiency in electrical system, electric motors, compressed air system, fans and blowers, pumps and pumping system, lighting system, energy saving potentials in each case.

Energy efficient technologies in electrical system: Energy efficients motors, electronic ballast, automatic power factor controllers.

Environmental Aspects of Energy and Pollution Control: Definitions, pollution from use of energy, electrostatic precipitator (ESP), greenhouse effect and global warming.

Energy performance assessment for equipment and utility systems: like boilers, furnaces, co-generation, turbines, heat exchangers, electric motors, variable speed drives, fans and blowers, water pumps, compressors, lightning systems.

Text/ References:

1. Hand book of Energy Audit and Management: Tata Energy Research Institute
2. National Accrediation for Energy Audit and Management Volume I to IV, National productivity Council.
3. S.Rao - Energy Technology, Khanna Publishers
4. B. R. Gupta -Generation of Electrical Energy, Eurasia Publishing House (P) Ltd

A. Farooq Khan - Energy Management: Issues and Challenges in the Twenty-first Century, Anmol Publications Pvt. Ltd

5. Pradeep Chaturvedi - Energy Management: Policy, Planning and Utilization, Concept Publishing Company
6. Paul W. O'Callaghan- Energy Management, McGraw-Hill Book Company

Syllabus for B.Tech Semester VIII (Electrical)

2EE407: MAJOR PROJECT (Full Semester) **[- - - 17]**

A student is required to carry out elaborated project work. The project may be either design and fabrication work or a simulation of a problem on a computer. At the end of the semester student will be required to submit a detailed report of literature survey, design problem formulation, work plan and work done and will defend his/her work carried out before the examiners at the time of final evaluation.