First Year - First Semester

Hum/T/A HUMANITIES-A

English - 2 Pds/week - 50 Marks
Sociology - 2 Pds/week - 50 Marks

HUMANITIES

1.Basic writing skills
2.Report, Covering Letter & Curriculum-Vitae writing
3.Reading and Comprehension
4.Selected Short Stories

Text Book: ENGLISH FOR ALL

SOCIOLOGY

1.Sociology: Nature and scope of Sociology - Sociology and other Social Sciences - Sociological Perspectives and explanation of Social issues
2. Society and Technology: Impact of Technology on the Society - A case study
3. Social Stratification: Systems of Social Stratification - determinants of Social Stratification - Functionalist, Conflict and Elitist perspectives on Social Stratification
4.Work: Meaning and experience of work: Postindustrial society- Post-Fordism and the Flexible Firm
5.Development - Conceptions of and approaches to development - The Roles of State and the Market in the Development
6. Globalization: The concept of globalization - globalization and the nation state - Development and globalization in post colonial times.
7. Industrial Policy and Technological change in India - The nature and Role of the State in India
8. Technology Transfer: The Concept and Types of Technology Transfer-Dynamics of Technology Transfer
9. Technology Assessment: The Concept - Steps involved in Technology Assessment
10. Environment: Sociological Perspectives on Environment - Environmental Tradition and values in ancient India
11.The Development of Management: Scientific Management - Organic Organization - Net Work organization - Post modern Organization - Debureaucratization - Transformation of Management
12. Technological Problems and the Modern Society: Selected Case Studies - Electric Power Crisis, Industrial and/or Environmental Disaster, or Nuclear Accident.

EE/T/112 PRINCIPLES OF ELECTRICAL ENGINEERING-I

Units and Dimensions in electrical Engineering----History of the development of Electrical unit system. Unit conversions. Dimensional analysis. Related problems. A.C. fundamentals---- Periodic waves and Sinusoids. Average and RMS values. Phasor

concept of sinusoids. Impedance and Admittance. Power ,VA, VAR and Power Factor. Series, parallel and series-parallel RLC circuit analysis. Locus diagram. Resonance. Power factor correction. Network Theorems---- Kirchhoff's laws, Loop-current method, Superposition theorem, Thevenin's and Norton's theorems, Maximum Power Transfer theorem. Star-Delta conversion. Related problems on A.C. and D.C. circuits. Electromagnetism----Ampere's law, Magnetic field intensity, Magnetic flux and flux density, MMF, Magnetic circuit, Permeability, Reluctance and Permeance, Leakage and fringing, Concept of inductance, Stored energy, Lifting power. Ferromagnetic materials, Magnetisation curve, Hysteresis loop and hysteresis loss, Eddy-current loss, Derivation of expressions for hysteresis and eddy-current losses. Properties of permanent magnets. Ratings of resistors and inductors. Electrostatics----Coulomb's Law, Electric charge. Gauss Theorem, Electric flux and flux density. Electric field intensity, potential and potential gradient. Concept of capacitance, Different types of capacitors—parallel plate, cylindrical, spherical capacitors with homogeneous and composite dielectric. Stored energy in capacitors. Series-parallel combination of capacitors, Capacitor banks. Rating of capacitors.

Reference Books:

1. Advanced Electrical Technology-by H. Cotton.
2. Electrical Technology- by Hughes.
3. Alternating Current Circuits- by Kerchner & Corcoran.
4. Fundamentals of Electrical Engineering- by Ashfaq Husain.
5. Applied Electricity for Engineers- by Bessonov.
6. Electrical Engineering Fundamentals- by V. Del Toro.
7. Electrical Science- by Choudhuri, Chakraborty & Chatterjee.

EE/Math/T/113 MATHEMATICS-IF

Functions of a single variable: Rolle's Theorem, Mean value theorem, Taylor's Theorem. Maclaurin's series, indeterminate forms, maxima and minima. Functions of several variables, limit and continuity, Partial derivatives, differentials, partial derivatives of a composite function, implicit functions. Taylors Theorem, Maxima and minima. Lagranges method. Rienemam Integration. Definition and properties, Fundamental theory of integral calculus, improper integrals, gamma and beta functions. Multiple integrals, definition of double and triple integrals, properties and applications.

EE/Math/T/114 MATHEMATICS-IIF

Sequence, Infinite series, Comparison test, D'Alembert's test, Cauchy's root test.
Vector Algebra: Addition and subtraction of vectors, Different types of products of vectors.
Solid Geometry: Cartesian coordinates in three dimension, direction cosines, Equations of straight lines, planes and spheres.

Marices: Addition and multiplication of matrices, Determinant of a square matrix and its properties, Transpose and inverse, Solutions of system of linear equations. Symmetric, Skew-symmetric and Hermitian matrices. Ranks of a matrix, Eigenvalues and eigenvectors. Characteristic polynomial. Caley-Hamilton theorem and applications.
Ordinary Differential equation: 1^{st} order exact equations, first order linear equations. Second order linear equation with constant co-efficients. Euler Cauchy equation, method of variation of parameters.

AM/ME/T/1A ENGINEERING MECHANICS

Statics:
Introduction, Idealizations of Mechanics, Fundamentals of Vector Algebra, Application of Vectors in Mechanics, Equiv System, Equilibrium, FBD Concept, Fundamentals of Friction, Properties of surface, Centroid, Moment of Inertia
Dynamics:
Intro to vector calculus, Definition of vectors in Dynamics, Rectilinear Motion, Curvilinear motion of particle and description of different coordinate systems, Kinetics, Newton's Law and D' Alembert's principle and application to rectilinear and curvilinear motion, constrained motion, Energy and Momentum methods.

Ph/T/1A PHYSICS-IA

1. Use of vectors in particle mechanics, Unit vectors in spherical and cylindrical polar coordinates, Conservative vector fields and their potential functions - gravitational and electrostatic examples, Gradient of a scalar field, Equipotentials, States of equilibrium, Work and Energy, Conservation of energy, Motion in a central field and conservation of angular momentum.
2. Angular momentum of a system of particles, Torque, Moment of inertia , Parallel and Perpendicular axes theorem, Calculation of moment of inertia for (i) thin rod, (ii) disc, (iii) cylinder and (iv) sphere. Rotational dynamics of rigid body (simple cases).
3. Motion of fluids, Bernoulli's equation and its applications, motion of viscous fluids - Poiseuille's equation.
4. Simple harmonic motion, Composition of simple harmonic motion, Forced vibration and resonance, Wave equation in one dimension and travelling wave solution, Standing waves, Wave velocity and group velocity.
5. Assumption for the kinetic theory of gases, Expression for pressure, Significance of temperature, Deduction of gas laws, Qualitative idea of (i) Maxwell's velocity distribution. (ii) degrees of freedom and equipartition of energy, Specific heat of gases at constant volume and constant pressure.
6. Equation of state of a gas, Andrew's experiment, Qualitative discussion on van der Waal's equation of state, Critical constants, Law of corresponding states.
7. Macroscopic and microscopic description, Thermal equilibrium, Zeroth law of thermodynamics, Concept of international practical temperture scale, Heat and Work, First law of thermodymamics and some applications, Reversible and irreversible

processes, Carnot cycle, Second law of thermodymamics, Concept of entropy, Thermodynamic relations.

Ph/S/1 PHYSICS LABORATORY-I

(Selected Experiments from the following)

1. Determination of Galvanometer resistance by half - deflection method.
2. Determination of Galvanometer resistance by Thomson's method.
3. To find high resistance by Galvanometer deflection method.
4. To measure mechanical equivalent of heat, J by electrical method (Joule's) using copper calorimeter (radiation correction to be done).
5. To compare to low resistance by drop of potential method.
6. To determine resistance per unit length of wire by using Carey Foster bridge.
7. To estimate strength of a current by using copper voltmeter.
8. a) To compare the EMF's of two cells by using a potentiometer
b) To measure current by using a potentiometer
9. To measure the horizontal components of earth's magnetic field intensity using deflection and vibrating magnetometers.
10. Determination of co efficient of linear expansion by optical lever method.
11. Determination thermal conductivity of metal by Searle's method.
12. To determine co-efficient of viscosity by Capillary flow method.
13. Determination of Young's modulus by Flexure method.
14. To draw mutual and anode characteristics of triode and hence too fine Rp, μ, and gm
15. To draw the transistor characteristics (NPN/PNP) in the given configuration and hence to find hi, hf
16. Determination of refractive index of the material of the glass prism by prism spectrometer (for at least two ?s)
17. Study of collisions in one dimension using a linear air track
18. Use of an air track for obtaining potential energy curves for magnetic interactions.
19. Study of oscillations under potential wells of various shapes using an air track.
20. Experiments on diffraction in single slit, double slit and plane grating using He- Ne laser
a) To find the wavelength of a monochromatic light by single slit.
b) To find slit separation of a double slit.
c) To find number of rulings per cm of a plane grating
21. To find the wavelength of a monochromatic light by Newton rings.
22. Fabry-Perot interferometry: To find out separation of wavelength of sodium D1 & D2 lines.

BED/ME/S/1 BASIC ENGINEERING DRAWING

Drawing primitives: instruments, letters, lines, title block, geometric curves & shapes, scale and dimension.
Projection: orthographic and isometric, sectional views.

WS/ME/S/6A WORKSHOP PRACTICE-VI (Carpentry and Fitter Shop)

Introduction to types of Indian woods used for engineering purposes and carpenter's tools; use of wood working machines; making of selected joinery.
Introduction to fitter's tools, gauges, measuring instruments etc.; marking of jobs; fitter's job involving chipping, filing, sawing, drilling; use of taps and dies; pipe fittings and plumbing.

WS/ME/S/10 WORKSHOP PRACTICE-X (Forging and Welding)

Forging: Introduction to forging tools, furnaces and forging machines; to practice basic forging operations- drawing out, upsetting, necking etc.; introduction to forge welding. Introduction to and practice of different welding processes- gas, SMAW, TIG, MIG, SAW, resistance welding etc.; introduction to gas cutting and its application; soldering, brazing etc.; making welded joints using different welding processes.

First Year - Second Semester

EE/T/121 PRINCIPLES OF ELECTRICAL ENGINEERING-II

Circuit analysis----- Nodal analysis, Compensation theorem, Reciprocity theorem. Analysis of coupled circuit- mutual coupling and mutual inductance, dot convention, principle of transformer. Three-phase A.C.---- Three-phase A.C. balanced circuits, balanced supply with three-wire and four-wire. Unbalanced load. Three phase power measurement. Definitions of p.f. for unbalanced system. Analysis of unbalanced three-phase system by symmetrical components. Nonlinear circuit analysis---- Nonlinear resistances and inductances, series and parallel combination of linear and nonlinear resistances and inductances, application of graphical techniques. Ferro-resonance phenomenon. Non-sinusoidal periodic waves----- Harmonics, Generation of harmonics by nonlinear circuit elements, Harmonic decomposition of periodic waves, rms and average values. Harmonics in three-phase systems.

Reference Books:

1. Advanced Electrical Technology-by H. Cotton.
2. Electrical Technology- by Hughes.
3. Alternating Current Circuits- by Kerchner & Corcoran.
4. Fundamentals of Electrical Engineering- by Ashfaq Husain.
5. Applied Electricity for Engineers- by Bessonov.
6. Electrical Engineering Fundamentals- by V. Del Toro.
7. Electrical Science- by Choudhuri, Chakraborty & Chatterjee.

EE/ET/T/122 ELECTRONICS-I

Elementary physics of semiconductor materials and p-n junction. Basic characteristics of semiconductor devices like p-n diode, Schottky diode, zener diode, bipolar transistor,

JFET, MOSFET. Modelling of semiconductor devices, Hybrid parameters. Bipolar transistor biasing, characteristics of common emitter, common base and common collector configurations. Biasing of JFET and MOSFET. Transistor power amplifiers : class A, B, AB and complimentary symmetry amplifiers. Monostable, bistable and astable multivibrators using bipolar transistors. Special connections like Darlington connection, Bootstrap circuit, Schmitt trigger, constant current sources and constant current sinks. Transistorised Shunt and Series voltage regulators. Elementary physics of opto-electronic devices like LED, LCD devices, photo-diodes, photo-transistors, Light Dependant Resistors, etc., and their application to 7-segment displays, alphanumeric displays, opto-isolators, opto-interrupters, etc.

Suggested Text Books

1) A. Mottershead, “Electronic Devices and Circuits”, Prentice-Hall of India Pvt. Ltd.
2) A. P.Malvino, "Electronic Principles". Tata Mc-Graw Hill Publishing. Co.

EE/Math/T/123 MATHEMATICS-IIIF

Differential equation of second order with variable coefficients.
Ordinary point and regular singularity of second order linear differential equations, series solutions. Bessel functions, Legendre polynomials and their orthogonal properties.
Fourier series: Periodic functions, Trigonometric series of sine and cosines. Euler formulae, Derichlets’ conditions, even and odd functions, half range sine and cosine series, Fourier series in intervals, multiple Fourier series, Discrete time fourier series.
Partial differential equations: Solution of one dimensional wave and diffusion equations and Laplace’s equations of two dimension by method of separation of variables.
Integral transforms: Laplace’s and Fourier transforms, Properties and applications of differential equations. Discrete Fourier transform, Z-Transform, applications to differential equations.

AM/ME/T/3 STRENGTH OF MATERIALS

Uniaxial stress field, Thin pressure vessels, Torsion (inclusive of Helical spring), shear force and Bending moment, Bending and shear stress in beams, Deflection beams, Energy methods in Strength of Materials, Problem of Plane stress and strain, Theories of failure, Buckling of columns.

EE/ME/T/125 THERMODYNAMICS AND HEAT POWER ENGINEERING

Ideal or perfect gases: laws, properties, equation of state, gas constants, internal energy and enthalpy of perfect gas, P-V and T-S planes, P-V relations, work done, Heat transferred.
Laws of thermodynamics
Adiabatic, Isothermal and polytropic processes, carnot, Otto and diesel cycles.
Vapour formation at constant pressure: saturated and superheated steam, enthalpy of

steam throttling, steam table, P-V, T-S, diagrams, steam cycles, pump work, thermal efficiency.
Basic laws of heat conduction, general heat conduction equation, boundary conditions, one dimensional heat conduction equation solutions, electrical analogy.

Ph/T/2B PHYSICS-IIB

1. Biot-Savart law and Ampere's law in magnetostatics, Calculation of magnetic field in simple situations like (i) straight wire (ii) circular wire (at a point on the symmetry axis) and (iii) Solenoid.
2. Time-varying fields, Faraday's law of electromagnetic induction, Self and mutual inductance, Resonance and oscillation in electrical circuits.
3. Nature of light waves, Interference of light waves, Young's experiment, Spatial and temporal coherence, Fresnel bi-prism, Interference in thin film, Newton's rings, Measurement of film thickness and wavelength, Diffraction of light waves, Huygen's construction, Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction due to single slit and plane diffraction grating, Approximate rectilinear propagation of light, Zone plate, Polarisation of light waves, Polarisation by reflection, Brewster's law, Double refraction- ordinary extraordinary rays, Polaroid, Optical activity.
4. Energy levels of the hydrogen atom and the Bohr atom model, X-ray spectra, X-ray diffraction, Bragg's law, Compton effect. De-Broglie waves, Particle diffraction, Uncertainty principle and its application
5. Wave-particle duality and uncertainty principle, Two-slit experiment, Concept of wave function, physical interpretation of wave function, Probability density, current, equation of continuity, Time independent Schrodinger equation for a free particle and a particle in a potential, Stationary states, Postulates of quantum mechanics, expectation values of physical observables, energy eigenvalues for particle in a box, Square well potential, Reflection and transmission coefficient in potential barriers, Linear harmonic oscillator, Particle in a central potential, Orbital angular momentum, Hydrogen atom- energy levels, degenaracy.

Ph/S/2 PHYSICS LABORATORY-II

(Selected Experiments from the following)

1. Determination of Galvanometer resistance by half - deflection method.
2. Determination of Galvanometer resistance by Thomson's method.
3. To find high resistance by Galvanometer deflection method.
4. To measure mechanical equivalent of heat, J by electrical method (Joule's) using copper calorimeter (radiation correction to be done).
5. To compare to low resistance by drop of potential method.
6. To determine resistance per unit length of wire by using Carey Foster bridge.
7. To estimate strength of a current by using copper voltmeter.
8. a) To compare the EMF's of two cells by using a potentiometer
b) To measure current by using a potentiometer
9. To measure the horizontal components of earth's magnetic field intensity using

deflection and vibrating magnetometers.
10. Determination of co efficient of linear expansion by optical lever method.
11. Determination thermal conductivity of metal by Searle's method.
12. To determine co-efficient of viscosity by Capillary flow method.
13. Determination of Young's modulus by Flexure method.
14. To draw mutual and anode characteristics of triode and hence too fine Rp, μ, and gm
15. To draw the transistor characteristics (NPN/PNP) in the given configuration and hence to find hi, hf
16. Determination of refractive index of the material of the glass prism by prism spectrometer (for at least two ?s)
17. Study of collisions in one dimension using a linear air track
18. Use of an air track for obtaining potential energy curves for magnetic interactions.
19. Study of oscillations under potential wells of various shapes using an air track.
20. Experiments on diffraction in single slit, double slit and plane grating using He- Ne laser
a) To find the wavelength of a monochromatic light by single slit.
b) To find slit separation of a double slit.
c) To find number of rulings per cm of a plane grating
21. To find the wavelength of a monochromatic light by Newton rings.
22. Fabry-Perot interferometry: To find out separation of wavelength of sodium D1 & D2 lines.

AED/ME/S/1 ADVANCED ENGINEERING DRAWING

True length, development of surface of simple objects. Threaded joint & riveted joints, cotter/knuckle joint. Pulley, shaft coupling.

WS/ME/S/12B WORKSHOP PRACTICE-XII (Machine Shop)

Introduction to machine tools - lathes, drilling machines, shaping machines, planning machines, slotting machines, milling machines, grinding machines; machine shop work involving different operations by using the above mentioned machines through making of jobs.
Experiments on: Study of the speed structure of a lathe, study of apron mechanism and calibration of feeds in a lathe.
Study and grinding of various cutting tools.

Second Year First Semester

EE/T/211 CIRCUIT THEORY

Laplace Transform -- Concept of complex frequency, transform of standard periodic and non periodic waveforms. Independent and dependent sources and equivalence of sources. Circuit elements and their transformed equivalents, treatment of mutual couplings. Transient and steady state response of RL, RC, LC and RLC circuits in transient with or without stored energy – solutions in t & s domains. Concept of natural frequency and

damping. Sketching transient response, determination of peak values. Practical applications. Loop and node variable analysis of transformed circuits . Applications of network theorems in steady state & transient domains. Graph of network: Concept of tree branch, tree link, tie set and cut set. Various incidence matrices and their properties, loop currents and node-pair potentials, formulation of equilibrium equations on the loop and node basis. Network functions, driving point and transfer functions, two port networks, impedance and admittance parameters, transmission and inverse transmission parameters, hybrid and inverse hybrid paramers. Series, parallel and cascade connections of two port networks. Elements of realisability and synthesis of one port network.

Reference Books:

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

EE/T/212 ELECTRICAL ENGINEERING MATERIALS

Introduction :Atomic Structure of materials, energy levels, and Electronic states, bonded structures (Covalent, ionic, metallic), Complex Structures (fiber, plastic elastomers) Binding energy, force and inter-atomic distance. Crystal Geometry, space lattices, unit cells. Crystallographic Axes, solids, Energy Band formation in solid, electronic distinction between conductors, insulator and semiconductor. Insulating Materials: State of insulating materials and their applications. Electronic, ionic, orientation and space charge polarizations. Dielectric constant, frequency and temperature dependence of relative permittivity behavior of dielectric under alternating fields dielectric losses, temperature dependence of insulating resistance, classification of insulating material, high polymer, XLPE, ceramics. Conductors: Electrical conductivity of metals, Lorentz theory, free electron theory, electron scattering, Intrinsic materials and alloys. Resistivities of conductors including alloys. High resistivity conducting materials and their applications, contact materials. Semiconductor: Intrinsic and extrinsic semiconductor, Fermi-Dirac distribution, dependence of carrier concentration on temperature, Zener breakdown phenomena, photo electric effect in semiconductor, Hall effect & tunneling effect. Magnetic Materials: Atomic interpretation of ferromagnetic materials, Atomic exchange force, crystallographic forces, magnetic anisotropy, magnetostriction, Curie-Weiss law, Curie law, Curie temperature of ferromagnetic materials, soft magnetic material, CRGO, Ni-Fe alloy and applications, hard magnetic materials Alnico, Alcomax and application. Ferrite-ferromagnetic materials and their applications, Piezo-electric materials. Super Conductivity: Theory of super conductivities, critical field, critical current density, transition temperature normal and superconductivity steps, types of super conductor, high temperature superconductor and applications.

Ref. Books

1. Electrical Engineering Material by A.J. Dekker
2. Electrical Engineering Material by B.M. Tareev
3. Dielectric Materials and applications by A. Von Hipple
4. Transistors : D.L. Croissette

EE/T/213 INTRODUCTION TO COMPUTING

Part - I

A. Computer Hardware

• Number system and codes. Elements of logic gates.
• Introduction to basic structure and operational concepts of a computer, instruction formats, instruction execution process, addressing modes, stacks and subroutine handling, instruction sets and organisational features of some representative processors like Intel 8085 & 80 X 86.
• Main memory organisation - memory technology, specifications, hierarchy, virtual memory, cache memory.
• Memory types : RAM, ROM, PROM, EPROM, E2ROM, Static and Dynamic RAM.
• Input - Output Organisation : Addressing of I/O devices with memory - mapped, standard I/O Data transfer (Serial & Parallel Communication), Interrupt handling.
• PC Architecture :
Buses : Different types of buses in a Personal Computer. Standards.
• Peripheral devices like Hard Disk Drive, Floppy Disk Drive, CD ROM Drive, Monitor, Mouse, Printer (Dot Matrix, Ink-jet, Laser), Network Interface Card.

Part - II

B. Operating Systems
• Introduction : Functions & Features of Operating System, Different types : Single user, Batch, Multiprogramming, Time-sharing, Generic layers of Operating System.
• Single User Systems : Basic I/O, ROM resident and Disk based I/O System, Command Interpreter with reference to OS like MSDOS. Overview of Windows OS.
• Overview of Windows 2000 Operating System
• Overview of Linux Operating System
• File Systems : File concept, operation on file, Directory system, File protection, allocation methods and implementation issues.
• Memory Management : Preliminaries, Resident Monitors, Swapping, Fixed Partitions, Variable Partitions, Page Segmentation, Virtual Memory Concepts.

C. Introduction to Data Structure and Data Base Management System

Reference Books

1. P. N. Basu, An Introduction to Computing and C Language, New Light Publishers, 2002.
2. Harvey M. Deitel, An Introduction to Operating Systems, Addison-Wesley Publishers Co.

EE/ET/T/214 ELECTRONICS-II

Integrated Circuits : LSI, VLSI.

Study of an industry standard multifunction IC like 555 timer and 723 voltage regulator through some of its configurations. The Operational Amplifier : its characteristics. Applications as inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, integrator, differentiator. Further use as voltage comparator, oscillator, simple precision rectifier, simple active filters etc. Introduction to digital logic gates. Characteristics of TTL, LSTTL, CMOS and HCMOS logic families. Tri-state logic. Implementation of combinational logic functions using basic gates. Minimisation of gates. Sequential logic elements like RS, JK, T & D type flip flops. Uses of flip flops in binary, decimal and divide-by-12 counters. Cascading of counters. Shift registers, serial / parallel input and serial / parallel output. Cascading of shift registers. Special functions like latch, decoder, display drivers. Digital to Analog and Analog to Digital converters.

Suggested Text Books

1) D. Roy Choudhury, S. Jain, "Linear Integrated Circuits", New Age International (P) Ltd.
2) R. A. Gayakwad,"Op Amps and Linear Integrated Circuits", Prentice Hall of India (P) Ltd
3) A.P. Malvino, D.P. Leach, "Digital Principles and Applications", Tata McGraw-Hill Publishing Co.Ltd.
4) H. Taub, D. Schilling, "Digital Integrated Electronics", McGraw-Hill Kogakusha Ltd.

EE/Math/T/215 MATHEMATICS-IVF

Complex analysis: Functions of a complex variable, limits, continuity and differentiability. Cauchy-Riemann equations complex integration, Cauchy's fundamental theorem, Cauchy's; integral formulae, Taylor's Theorem, Laurent's theorem, Singularity, Residue Theorem, Contour Integral.
Vector calculus: Scalar and vector fields, Concepts of gradient, divergence and curl and their expression in Cartesian, cylindrical and spherical coordinates, Laplacian in these coordinates, Gauss, Stokes' and Green's theorem.
Probability Theory: Definition, Law of probability, conditional probability Baydes' theorem, random variables, Probability distribution, exponential binomial, Poisson and normal distributions, estimation of parameters. Testing of hypothesis (optional)

Complex analysis : Functions of a complex variable, limits, continuity and differentiability. Cauchy-Riemann equation, complex integration, Cauchys' fundamental theorem, cauchys; integral formulae, Taylors' Theorem, Laurents' theorem, Singularity, Residue Theorem, Contour integral.
Vector calculus : Scalar and vector fields, Concepts of gradient, divergence and curl and their expression in Cartesian, cylindrical and spherical co-ordinates, laplacian in these co-ordinates, Gauss' Stokes' and greens theorem,
Probability Theory: Definition, Laws of probability, conditional probability, Bayerr'system theorem, random variables, Probability Distribution, Expectation, Binomial, Poisson and normal distributions, estimation of parameters, Testing of hypothesis(optional)

EE/ME/T/216 PRIME MOVERS FOR ELECTRICAL SYSTEMS

Heat Power - 2 Pds/week - 50 Marks
Hydraulics - 3 Pds/week - 50 Marks

IC engines: Principles of operations of IC engines, Classifications, working cycles, supercharging, fuel injection and fuel ignition, performance.
Steam and gas Turbines: Principles of turbines, Classifications, steam and gas turbine cycles, efficiency, power and specific fuel consumption, impulse turbine, reaction turbine, multi stage turbine, governing of steam turbines.
Hydraulics and hydraulic turbines: Fluid properties and fluid statics, fluid kinematics, conversation equation, fluid dynamics, flow through closed conduits, Classification of hydraulic turbines, turbine size, Pelton wheel, Francise turbine, Kaplan turbine, Specific speed of a turbine, comparison of turbines, performance of turbines-constant head, constant speed and constant efficiency curves, governing of hydraulic turbines.
Wind Turbines: Different terms and definitions, types of wind turbines, P-V characteristics.

EE/S/211 E. E. LABORATORY – I

Selected Experiments in Electrical Mechanics, Control System, Power System and Measurements Laboratories.

EE/ME/S/212 M. E. LABORATORY – I

Selected Experiments in Applied Mechanics Laboratory.

MDD/ME/S/1 MACHINE DESIGN AND DRAWING

Basic idea of design, factor of safety, modes of failure, theories of failure, design under static and fatigue loading.
Design of Cotter/knuckle Joint, threaded and riveted joint, eccentric loading. Shaft coupling (rigid / flexible). Belt-pulley drive. Pressure vessel.

Second Year Second Semester

EE/T/221 ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Classification of electrical measuring instruments, general feature of indicating instruments: controlling, damping, balancing. Galvanometer: dynamics, sensitivity, D'Arsonval galvanometer, Ballistic galvanometer, Vibration Galvanometer, PMMC instrument, temperature compensation, rectifier type instrument, Moving iron instrument, errors and compensations, electrodynamometer type instrument, power measurement, low power factor wattmeter, wattmeter connections and errors, Induction type energy meter: characteristics, errors and their compensation, extension of instrument range: shunt, multiplier, current transformer, potential transformer; testing and calibration of measuring instruments. Kelvin double bridge, series and shunt type ohmmeter, megger, measurement of surface resistivity. Measurement of inductances and capacitances, measurement of incremental inductances, interbridge transformer, residuals, errors in bridges, detectors, dc potentiometer: Weston normal cell,Vernier type, Kelvin-Verley slide, dual range, applications, phantom loading, ac potentiometer: polar type and co-ordinate type, use of Ballistic Galvanometer in magnetic testing, ac magnetic testing: Lloyd-fisher square, transducers: RTD, thermistor, thermocouple, laws of thermocouple circuits, cold junction compensation, strain gauge.

Book:-

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

EE/T/222 ELECTRICAL MACHINES-I

PART-I

General Introduction on Electrical Machines : Faraday's laws of Electromagnetic induction, Fleming's rule and Lenz's law. Space distributions of flux density and time variation of voltage. Magnetic curves and their relevance. Core lose and copper lose. Materials used for rotating electrical machines. DC machines: Detail construction and operating Principle. Function of commutator and brush system. Dc machine as motor and generator.. Shunt ,series and compound excitation. Building up of DC shunt generator. DC motor general torque equation. No-load operation. AC Machines: Three phase balanced excitation system. Development of rotating magnetic field. Frequency of the induced emf and relationship to number of poles. Mechanical and electrical angles. Construction and basic principle of operation of 3-phase induction motor. Slip, slip speed and slip frequency. Basic principle of operation of three phase alternator, synchronous motor, single phase induction motor and alternator.

PART-II

1-Phase Transformer : Construction and basic principle of operation. Core type and shell type transformers. Materials used for core, winding and insulation. EMF equation. Core loss copper loss and leakage reactances. Harmonics in magnetizing current and magnetizing inrush current. Generalised derivation of electrical equivalent circuit from magnetic structure. Phasor diagram. Dry type and oil cooled type. Natural and forced type of cooling. Tank and radiator construction, operation. Transformer oil, transformer accessories e.g. conservator, breather, Buckholtz relay, bushings etc.
Testing of Transformers : Polarity of windings, OC and SC test. Separation of losses, derivation of equivalent circuit parameters. Regulation, efficiency, all-day efficiency. Parallel operation. Effects of changes of frequency and voltage on transformer performance.
Single phase auto transformers: Principle of operation, phasor diagram. Comparison of weight, copper loss, equivalent reactance with 2-winding transformer.
Special Transformer : Current Transformer, pulse transformer and high frequency ferrite core transformer with pulsed dc supply.

Text Book:

1. H. Cotton," Advanced Electrical Technology"
2. Clayton & Hancock," Performance and Design of DC machines"
3. Puschtein & Lloyd,"Alternating Current Machines"
4. M.G.Say,"The Performance and design of alternating Current Machines"

EE/T/223 FIELD THEORY

Electric vector field and scalar potential field, Relation between electric field intensity and potential, Gauss’s integral law for electric displacement field, electric dipole fields, Electric polarization, and its relation to the permittivity of dielectric media, Gauss’s law in differential form, Poisson’s and Laplace’s equations, These equations in cartesian, cylindrical and spherical coordinates, Matching boundary conditions at the interface of different dielectric media, Electric stress and mechanical force in charged conductors, Energy stored in electric field, Solution of Laplace’s equation by separation of variables method, Capacitance of coaxial cables and two wire transmission lines and related electric fields, Numerical analysis of electric fields by solving Laplace’s equation, Iterative methods, Finite elements. Uniqueness theorem, Method of Images for the solution of electric fields. Magnetic field intensity, Scalar and Vector magnetic potential, Lorentz force, Motoring and generating principles, Faraday’s Law of electromagnetic induction, Ampere’s law in both integral and differential forms, Biot-Savart’s law, Boundary conditions, Solution of field problem by image method, Self and mutual inductance, Inductance of coaxial cable and two wire transmission lines, Energy in magnetic field, Force due to magnetic field in magnetic medium. Maxwell’s field equations, Displacement current density and continuity equation, Electromagnetic wave equation in loss-free and lossy media, Plane and polarized waves and their propagation as

solutions of wave equation, Poynting's vector, Power flow through electromagnetic media, Elements of wave guide and radiating systems (antenna), Diffusion equation for eddy currents and skin effect.

References:

1. Engineering Electromagnetics W.H.Hayt
2. Electromagnetics Kraus & Carver
3. Electromagnetic Theory and application P.Mukhopadhyay
4. Electromagnetics A.Pramanik
5. Electromagnetics Edminister

EE/T/224 SIGNALS & SYSTEMS

PART - I

General concept of Systems: Classification. Differential equation of Systems. Definition of Linear Time invariant (LTI) Systems. Laplace Transform (LT) methods for solving linear differential equations with constant coefficients. Concept of transfer function. Poles and zeros. Time response of First and second order systems.
Modeling of Dynamic Systems: Mechanical systems (including rotary systems, gears, articulated systems, Electromechanical systems, DC motors, moving coil speakers, ballistic galvanometers, Thermal systems (first order and second order models), Electric circuit analogues. Modeling of LTI systems using operational amplifiers. Simulation of differential equations with operational amplifiers. Amplitude scaling and Time Scaling. State variable representation of systems: Normalization of linear equations. Concept of state variables. Representation in standard forms. Concept of state trajectories. Time response of second order systems.

PART-II

Signals and their mathematical descriptions: Singularity functions. Properties of Impulse Functions. Convolution integral. Decomposition of simple aperiodic waveforms in terms of singularity functions. Review of Fourier series. Laplace transform of periodic functions. Fourier transform of aperiodic functions. Frequency Response: Frequency response of LTI systems in Bode and polar planes. Bode asymptotic plots. Concepts of bandwidth, gain-and phase-crossover frequencies. Resonance in second order systems. Experimental determination of frequency response. Correlation of time and frequency response.

1. Main Reading:

i) Kuo. F.F; "Network Analysis & Synthesis", John Wiley & Sons
ii) Kuo, B. C; "Automatic Control System" Prentice Hall of India

2. Supplementary Reading:

i) Nagrath I J, Gopal M, "Control System Engineering", Wiley Eastern Limited.
ii) Lindner D. K; "Introduction to signals and systems", McGraw Hill.
iii) Dasgupta S, “Control System Theory”, Khanna Publishers

EE/T/225 POWER SUPPLY SYSTEMS

Structure of Power System – Generation, transmission and distribution. Power generating stations – different types. Steam power stations: Main parts and working, types of boilers and their characteristics. Characteristics of steam turbines and alternators. Main flow circuits of steam power station. Power station auxiliaries, cooling system of alternators. Starting up and shut down procedures of thermal units. Gas-turbine power stations- Main parts, plant layout and Bryton cycle operation. Combined cycle generation & Co-generation. Nuclear power stations- Layout of nuclear power station, types of power reactors, main parts and control of reactors, nuclear waste disposal, radioactivity and hazards. Hydroelectric stations: Arrangement and location of hydroelectric stations, principles of working, types of turbines and their characteristics, Pumped storage plants. Coordination of operation of different power stations . Substation - Classification of substations, Major equipments in Substation, Busbar layouts. Power distribution system: Primary and secondary distribution, types of conductors in distribution system, comparison of distribution systems. Distributor design, radial and ring main, current and voltage profiles along a distributor, economics of feeder design. Electrical wiring and installation - Domestic, commercial and industrial wiring, estimation of main, submain and subcircuit wiring. Earthing practice. Testing of installation. Special lighting connections. Conductors, Fuse and disconnecting devices.

Reference Books:

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

EE/T/226 PROGRAMMABLE LOGIC & SEQUENTIAL SYSTEMS

Part -I

• Sequential Circuits. State machines and State diagrams. Present State Table, Next State Table.
• Concepts of Synchronous, Asynchronous, Linear Sequential Machine.

• Time driven, Event driven and Time/Event driven sequential systems. Statement List, Process timing diagram, Function sequence, Chart, Mode Chart, Start Chart. Case Studies.
• Relay logic and switching algebra
• Ladder diagram representation of sequential systems.
• Design of elementary sequential systems.
• Petrinet representation and case studies
• Memory Interfacing : Memory Map, Address decoding, word-size expansion, capacity expansion.
• Algorithmic Sequential Machines
• Design of Direct Addressed and Indirect Addressed ROM based Sequential systems, Case Studies.
• Design of Input Forming Logic of the State Machine using Direct -Addressed and Indirect Addressed Multiplexers. Case Studies.
• State Assignment for Minimisation of Output Forming Logic. State assignment to eliminate output glitches.
• Microprocessor as an FSM/ASM.

Part -II

• Programmable Controllers (PC) : Architecture and functional components, I/O Processing Methodologies, Programming Languages. Sequence Function Chart, Ladder Diagram, PC input/output Diagram. Case Studies.
• Programmable Logic Devices : Concepts of PLA, PAL and FPGAs, Architecture, Basic Design Process.
• Introduction to VHDL language basics. Modelling combinational and sequential logic systems. Simulation and tasting.
• Types of FPGAs
• Xilinx solutions : Xilinx CPLDs and applications areas.
• JTAG Development and Debugging Support.

Reference Books

1. David J. Comer, Digital Logic and State Machine Design, Hold, Rinehart and Winston.
2. Robert N. Bateson, Introduction to Control System Technology, Fifth Edition, Prentice-Hall Inc., 1996.
3. Programmable Logic Design Quick Start Handbook, Karen Pernell & Nick Mehta, Xilinx Second Edition, 2002.
4. Contemporary logic design by Randy Katz.

EE/S/221 E. E. LABORATORY – II

Selected Experiments in Electrical Mechanics, Control Systems, Power System and Measurements Laboratories.

EE/S/222 COMPUTER FUNDAMENTALS

Study of basic computer system and interconnection diagram of computer peripherals.

Study of DOS system and programming in BASIC and FORTRAN. Study of WINDOWS operating system and programming with application software in WINDOWS. Learning INTERNET system.

EE/ET/S/223 ELECTRONICS LABORATORY

Selected Experiments on diodes, transistors, amplifiers etc.

EE/ME/S/224 M. E. LABORATORY – II

Selected Experiments in Heat power and Hydraulics Laboratory.

Third Year First Semester

EE/T/311 ELECTRICAL INSTRUMENTATION

Signal conditioning & isolation techniques: low level and high level signals, MUX,PGA; ADC: counter, ramp, dual-slope, successive-approximation, sample & hold circuits; DAC: binary-weighted register, R-2R ladder; ADC & DAC characteristics & specifications, waveform display devices & applications: CRT, LCD, plasma display, alphanumeric display; timing/counting, PLL and its applications, active filters: VCVS, state-variable; filter approximations: Butterworth, Chebyshev; switched capacitor circuits, digital R-L-C meters. Measurement of displacement: LVDT, capacitive; Measurement of pressure: diaphragm, bellows, bourdon tube; measurement of flow: electromagnetic, ultrasonic, hot-wire anemometer; measurement of level: resistive, capacitive, ultrasound; measurement of humidity: resistive, capacitive; semiconductor temperature sensors, optical and radiation pyrometers, acoustic sensors and measurement techniques, magnetostrictive transducer, piezoelectric transducers, force-balance transducers, pH sensors. Power quantity transducers. Signal conditioning of transducers.

Book:-

1. Measurement Systems: by Ernest Doebelin
2. Experimental Methods for Engineers: by J. P. Holman
3. Industrial Instrumentation : by D. Patranabis
4. Sensors & Transducers : by D. Patranabis
5. Instrument Measurement & Analysis : By Nakra & Chaudhry
6. Digital Principles & Applications : by Malvino & Leach
7. Modern Electronic Instrumentation & Measurement Techniques : by Helfrick & Cooper
8. Electronic Instrumentation : by Oliver & Cage
9. Operational Amplifier - Design & Applications : Tobey, Graeme & Huelsman
10. Operational Amplifier & Linear Integrated Circuits: by Coughlin & Driscoll
11. Principles of Measurement Systems : by John P. Bentley

EE/T/312 POWER SYSTEM PLANNING AND DESIGN

Administrative aspects of electricity supply- Development of power sector in India. Administrative set up and organisations in power sector. Stages involved in power planning- load analysis, load management & load forecasting. Legal aspects of electricity supply- Electricity acts, rules and codes. Standards followed in power supply, environmental and safety measures. Commercial aspects of electricity supply – Expenditure in power Utility. Factors influencing tariffs, types of consumers, different types of tariffs. Transmission line structure- Types of conductors, line supports – poles, towers, struts & Guy wires, sag and tension calculations, stringing chart, sag template. Insulators – Materials of insulators, types of insulators – Pin and Disc type – their applications. Underground Cables – Construction of cables, single and multicore cables, different types, capacitance of belted cables, dielectric loss in cables, heating of cables. Transmission line parameters – Resistance, Inductance, Capacitance and Conductance.Inductance of single phase line, inductance of three phase line with symmetrical and unsymmetrical spacing, concept of GMD and GMR . Inductance of composite conductor systems – stranded conductors, bundle conductor and Double circuit lines . Capacitance of single phase line, capacitance of three phase lines with symmetrical and unsymmetrical spacings, capacitance calculation for double circuit line and bundle conductor. Effect of earth on capacitance calculation. Skin effect and proximity effect. Line representation – Representation of short, medium and long lines , Pai and T models. A,B,C,D constants of transmission lines and their measurement. Travelling wave interpretation of long line equations, tuned lines.

Reference Books:

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

EE/T/313 ELECTRICAL MACHINES-II

PART-I

DC machines: Armature windings, equalizers. Armature reaction effects, mmf distribution, compensating windings, improvements. Commutation, sparking, brushes, interface film, interpoles. Various losses in the DC machine. Core loss , laminated yoke construction.
DC Generators : Characteristics with different excitation systems, voltage regulation, parallel operations.
DC Motors :Characteristics with different excitation, methods of starting, speed control, torque characteristics, equivalent circuits and transfer function. Series parallel operation of motors.

Permanent magnet DC machines. Testing of DC machines : Swinburne test, Hopkinson's test, Brake test. Tests specified as per standards.

PART-II

Polyphase Transformer : Construction and basic principle of operation. Core type 3-limb and 5-limb construction and shell type. Flux distribution. Star, delta, open delta and Zigzag connections. Tertiary windings. Vector groups. Graded insulation and shielding for HV. Harmonics in 3-phase transformers. Tap Changer principles, types and operation. Parallel operation, unbalanced loading, capacity calculations. Tests specified as per standards.
Special connections : Scott and le Blanc connection, 3-phase to 6-phase and 3-phase to 1-phase transformation. Three phase auto transformers, principle of operation, phasor diagram.
AC Commutator Motors: Transformer and rotation emf's in phase and commutator winding. Expiration for torque and power. Action of commutator as frequency convertor. Study of AC plain series motor, its phasor diagram, commutation, brush emf's design features. Use of compensation and compole winding to improve power factor and commutation.

Text Book:

1. Clayton & Hancock,"Performance and Design of DC machines"
2. P. S. Bimbhra,"Electrical Machinery", Khanna Publishers
3. M.G.Say,"The Performance and Design of Alternating Current Machines"
4. J & P Transformer Handbook
5. E. O. Taylor,"The Performance & Design of AC Commutator Motors"

EE/T/314 CONTROL SYSTEM ENGINEERING

Part I

Introduction to Control Systems: Classification of control systems, Examples of control systems, Feedback Control Systems Properties of Control Systems: Stability, steady-state & transient errors, disturbance rejection, insensitivity and robustness. Errors and Error constants, System types. Control system components: Potentiometer, tachogenerator, synchro & resolver, LVDT, dc & ac servomotor, Actuator Specefication. Time response of system: Transient & steady state response of second order system and ramp response of second order system, system response with additional poles and zeros, concept of dominant poles. Control actions: Proportional, integral, derivative, and their combinations. Case Studies: Performance analysis of remote position control system and voltage regulator. Design and compensation of control systems in frequency domain: Frequency Domain Specifications in open loop and close loop and their significance, Lag compensator, lead compensator and lag-lead compensator. Actuator design.

Part II

Stability of linear systems: Routh-Hurwitz criterion, Nyquist criterion. Stability margins. Root locus. Effects of system gain on stability. Nichols chart. Block diagram development of system, block diagram reduction and signal flow graph. State variable analysis: Concept of state, state variable, state model. State variable formulation of control system, diagonalization, Relating transfer function with state model. Time response of state model of linear time-invariant system. Elementary concept of controllability & observability. Selected topics in Matrix Algebra: Nonsingular transformation of matrix, Matrix polynomials and exponential.

Reference Books.

1. M. Gopal, Control Systems Principles and Design, Second Edition, Tata McGraw Hill 2002.
2. Benjamin C. Kuo, Automatic Control Systems, 7th Edition, Prentice Hall of India, 1995.
3. Naresh K. Sinha, Control Systems, CBS college Publishing, 1986.

EE/T/315 NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

Number representation, machine precision, round off and truncation error, accuracy of numerical calculation on digital computers. Solution of simultaneous linear equation and matrix inversion by direct approach eg., Gaussian elimination, Gauss Jordan, L-U factorisation, and Q-R factorisation method and iterative approach e.g., Jacobi, Gauss-Seidel and Relaxation methods. Ill-conditioned system, vector and matrix norm, condition number. Eigen values and Eigen vectors. Roots of non-linear algebraic equation using simple iteration, bisection, false position, secant and Newton-Raphson methods. Finding complex roots and roots of non linear simultaneous equations by Newton Raphson method. Interpolation and curve fitting, piecewise-linear interpolation, polynomial interpolation, Lagrange interpolation polynomials, Newton's forward, backward and divided difference interpolation formulas and errors. Least square curve fitting. Numerical integration, Newton-Cotes Integration formulas, Trapezoid rule, Simpson's rules, Mid point rule, Romberg integration and Gauss quadrature. Numerical differentiation, first and the second derivative, Richardson's Extrapolation. Ordinary differential equation, Euler's method, modified and extended Euler's method, Runge-Kutta's method, predictor-corrector method. Milne's method.

Books:

1. Applied Numerical Methods for Engineers using Matlab and C : Robert J. Schiling and Sandra L. Harris ; Thomsom Asea Pte. Ltd.
2. Sastry :Introductory Methods of Numarical Analysis.

C. Programming

C: Concept of flow chart and algorithm – C character set, constant and variables – operaters in C – input/ output statements – control statements – Arrays – Functions – Pointers & Structures – Preprocessors & Macros – Memory management – File handling – Linked lists.

C++ : - Introduction to OOP in C ++ : - Tokens – Functions in C++ - Classes and objects – Constructors & Deconstructors – inheritance – Polymorphism – File handling – Templates.

References:

1. Programming with C – Gottfried
2. ANSI C – Balaguruswamy
3. Working with C – Y. Kanetkar
4. Turbo C++ - R. Lafore
5. C++ - Balaguruswamy

EE/T/316 MICROPROCESSORS & MICROCONTROLLER

Part - I

• Microprocessor Architecture : Address / Data and Control lines, Timing diagrams, Internal registers, Interrupt mechanism (Hardware/Software), DMA mechanism - [NB. Study mainly based on Intel 8085 and other popular microprocessors].

• Detailed description of a typical Microprocessor (preferably 8085 & 80X86).

• Interfacing with support chips : Programmable Peripheral Interface (8255), Programmable time/counter (8253), Programmable UART (8251), Programmable Interrupt Controller (8259), DMA Controller (8257), Programmable Keyboard and Display Controller (8279) - signals and timing details along with hardware/software interfacing techniques.

• I/O interfaces with switch, multisegment display, ADC/DAC

• Assembly Language Programming of 8 bit and 16 bit Microprocessors : Instruction Cycle, Machine Cycle, T states. Instruction Set, addressing modes, stack subroutine, interrupt service routines. Example programs in assembly languages. Concept and operation of Assembler and Cross Assembler.

Part -II

• Microcontrollers and Embedded Processors ? Difference between a Microprocessor and Microcontroller ? Criteria for choosing a Microcontroller ? Architecture, Memory Interface and Programming concepts of some Microcontrollers. [NB. Study mainly based on Intel 8051 (and its variants) and 80196]. ? Development of application programs in

assembly language using 8051. • I/O interfacing standards. • Microprocessor based system design aids and trouble shooting techniques.

Reference Books

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085A/8080A, Wiley Eastern Limited.
2. Muhammed Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Inc., Fifth Edition, 2003.

EE/S/311 E. E. LABORATORY – III

Selected Experiments in Electrical Mechanics, Control Systems, Power System High Voltage and Measurements & Instrumentation Laboratories.

EE/S/312 ELECTRICAL MACHINE DESIGN – I

Load box and rheostat design. Design of single phase transformer, lifting magnets and reactors.

EE/S/313 COMPUTER PROGRAMMING LABORATORY

Programming and solving electrical Engg. Problems by ‘C’ & ‘C++’.

EE/S/314 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

Hand on experience with different microprocessor and microcontroller systems and their interfaces.

Third Year Second Semester

EE/T/321 POWER ELECTRONICS

PART - I

Major Power semiconductor devices like Diode, SCR, Triac, Bipolar Power Transistor, Power MOSFET, IGBT, GTO, MCT - their type variations, important parameters, Safe Operating Area, Drive techniques, turn-off methods, protection, snubbers, cooling and Heatsinks. Principles of Step-down and step-up Choppers. Half-bridge, push-pull and bridge inverters. Methods of voltage control : dc bus variation and PWM. SCR forced commutation techniques and their application to choppers and inverters. Principles of isolated dc/dc converters and SMPS.

Suggested Text Books

1) N. Mohan, T.M. Undeland & W.P. Robbins, "Power Electronics", John Wiley & Sons.
2) B.W. Williams, "Power Electronics", Macmillan.
3) P.S. Bimbhra,"Power Electronics", Khanna Publishers
4) P.C. Sen, "Modern Power Electronics", Wheeler Publishing.

PART – II

Input and output characteristics of common rectifier topologies : Single-phase half-wave and full-wave Diode rectifiers with R, RL and RC load. Study of same with highly inductive load. Effect of Free-wheel diode. Three-phase half-wave and full-wave Diode rectifiers with highly inductive load. Use of Inter-Phase Reactor and introduction to higher pulse rectifier systems. Single-phase half-wave and full-wave SCR rectifiers with R and RL load. Study of same with highly inductive load. Effect of Free-wheel diode. Three-phase half-wave and full-wave SCR rectifiers with highly inductive load. Effect of free-wheel diode. Half-controlled rectifiers with highly inductive load. Commutation effects, overlap angle and voltage loss. Input current harmonics and power factor, output harmonics. Principle of generation of control pulses for SCR converters : cosine, ramp and equidistant pulse methods. Principle of UJT control. Line Commutated SCR inverters, reverse power flow. Principle of the Cyclo-converter.

Suggested Text Books

1) N. Mohan, T.M. Undeland & W.P. Robbins, "Power Electronics", John Wiley & Sons.
2) V. Subrahmanyam, "Power Electronics", New Age International (P) Ltd.
3) P.S. Bimbhra,"Power Electronics", Khanna Publishers
4) P.C. Sen, "Power Electronics", Tata McGraw-Hill Publishing Co. Ltd.
5) G.K. Dubey, S.R. Doradla, A. Joshi & R.M.K. Sinha, "Thyristorised Power Controllers", Wiley Eastern Ltd.

EE/T/322 DIGITAL SIGNAL PROCESSING

Sampling, aliasing, Z-transform and its properties. Discrete LTI systems, Z-transfer function, discrete convolution. Standard transformation techniques: Mapping of differentials, impulse invariant transformation, Bilinear transformation, Matched z-transformation. Introduction to digital filters: Filter approximations. Filter transformations. IIR and FIR filters. Design of IIR and FIR filters. Filter structures. Finite word length effects in digital filters.1D and 2D Offline digital filters. Image Processing fundamentals: 2D Sampling, image filters, contrast enhancement. Discrete Fourier Transform: DFT and FFT algorithms. Applications of FFT (spectrum analysis, FFT based digital filtering). Hardware for digital signal processing. DSP chips.

Book :-

1. Digital Signal Processing : by Proakis & Manolakis
2. Digital Signal Processing : by Johnny R. Johnson
3. Digital Signal Processing : by Salivahanan, Vallavaraj & Gnanapriya

4. Discrete Signal Processing : by Oppenheim, Schafer & Buck
5. Digital Signal Processing : by Rabinar & Gold
6. Digital Image Processing : by Rafael C. Gonzalez, Richard E. Woods
7. Digital Signal Processing : by P. Ramesh Babu

EE/T/323 POWER SYSTEM PERFORMANCE

Per-Unit representation of Power system– Selection of base quantities, percent and per unit values, advantage of per unit system. AC Transmission – Power flow through a line, power circle diagram, line charts, active power flow and voltage control in transmission system. Line loadability and voltage dependence. Power flow in interconnected systems and load flow analysis – Gauss –Seidel method. Symmetrical fault analysis . Elements of HVDC Power transmission. Basic concept of active and reactive power control of Synchronous generator. Interdependence of active power with frequency and reactive power with voltage and concept of decoupling. Speed Governing System: Description of Speed Governor, Speed changer and main components of speed governing system, principle of operation . Load frequency control: Representation of speed governing system, effect of governor droop on load sharing among generators ,dependence of load on frequency, system inertia. Modeling and analysis of single area load-frequency control, supplementary control, concept of control area. Reactive power control: Role of excitation system, main & pilot exciters, description of different types of excitation systems. Economic operation of power plant – cost curves, heat rate, incremental rate, economic load sharing among generating units. Power system stability: Steady state and transient stability, Swing equation and its numerical solution, equal area criterion for transient stability, , improvement of transient stability.

Reference Books:

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

EE/T/324 ELECTRICAL MACHINES-III

PART-I

Three Phase Induction Motor : Per Phase equivalent Circuit. Phasor Diagram. Types of windings. Deep bar and double cage rotor. Pole changing motor. Equations of torque. Torque-speed characteristics. Effect of change I ritor resistance in slip-ring machine and slip power recovery. Circle diagram. Methods of starting and speed control. Tests as per standards. Separation of losses. Operation of induction machines as generator. Single Phase induction motor : Spli phase capacitor –start-induction-run with centrifugal switch. Operating principles. Operating characteristics. Double revolving field theory, cross field

theory. Equivalent circuit, phasor diagram. Shaded pole type motor: Construction and operating principle, operating characteristics.

PART-II

Synchronous Generator : Armature reaction, its effect on load power factor. Alternator regulation, synchronous reactance. Prediction of regulation by various methods. Cylindrical rotor and salient rotor construction. Two reaction theory. Damper windings. Short circuit transient and subtransient reactances. Determination of Xs, Xd, Xq, X1, X2 , X0, Xd', Xq', Xd'', Xq''. Methods of voltage control, static excitation system. Synchronisation of alternators, power flow, power angle characteristics, operating chart, synchronizing power, stability. Excitation characteristics, V-curves, parallel operation. Synchronous Motors : Power developed, circle diagrams for constant power developed and constant excitation. V-curves and O-curves. Starting methods. Operation as synchronous condenser.

Text Book:

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

EE/T/325 ELECTRICAL UTILISATION & ILLUMINATION ENGINEERING

PART – I

Harmonic current generation due to non-linear loads. Effect of Harmonic currents on power supply system and its components. Power factor degradation due to harmonics. Displacement Factor, Distortion Factor and Harmonic Factor. Power line filters. Concepts of static Var compensators. Introduction to near-unity power factor rectifiers and Active Power Filters. Electric heating : Basic advantages, classification of furnaces and ovens. Industrial application areas. Resistance Furnaces : basic principles of direct and indirect heating types. Control of heating : on-off control, graded resistance, tapped inductor. Solid state control - SCR on-off control, ac phase control, integral cycle control. Arc Furnaces : basic principles of direct and indirect heating types. 1-phase and 3-phase AC and DC arc types. Their power supply regulator system. Electrode position control system.
Induction Furnaces : basic principles of coreless and core types. Their power supply systems. SCR resonant inverters for induction heating.
Dielectric Heating : basic principle. Storage Batteries : common types and their characteristics. Principles of charging, modes of charging, eg., float, boost, constant current, constant voltage, etc. Temperature compensation of charging voltage.

Uninterruptible Power Supplies : Basic concepts, schemes, back-up, redundancy, transfer switch. AC Voltage Stabilisers : Basic principles like tap-changing, servo-controlled buck-boost transformer, Constant Voltage Transformer.

PART – II

Light and electromagnetic radiation; sources of light- thermal radiator-blackbody radiator, laws of thermal radiation; daylight and artificial light, spectral power distribution (SPD) of light sources. Radiometric and photometric quantities, visual response curve of standard observer, relation between lumen and watt, photometric standards. Laws of illumination, perfect diffuser, Lambert's law.
Photometry - visual & physical photometry, Bench photometer, Luxmeter, Integrating sphere, Distribution photometer. Computation of lumen output from luminaire from luminous intensity distribution- zone factor, zonal lumen. Lamps-general classification, incandescent, tungsten halogen, fluorescent, compact fluorescent – construction, principle of operation, features etc. Ballast- its function, electromagnetic and electronic type - principle of operation. Luminaire- its function and classification. Elementary lighting design- design parameters, BIS recommendation, general indoor lighting design by Lumen method. Concepts of energy efficient lighting design and payback calculation.

Suggested Text Books

1) H. Partab, "Art & Science of Utilisation of Electrical Energy", Dhanpat Rai & Sons.
2) G.W. Vinal, "Storage Batteries", John Wiley & Sons Inc.
3) N. Mohan, T.M. Undeland & W.P. Robbins, "Power Electronics", John Wiley & Sons.
4) P.C. Sen, "Power Electronics", Tata McGraw-Hill Publishing Co. Ltd.
5) P.C. Sen, "Modern Power Electronics", Wheeler Publishing.
6) G.K. Dubey, S.R. Doradla, A. Joshi & R.M.K. Sinha, "Thyristorised Power Controllers", Wiley Eastern Ltd.

EE/T/326 HIGH VOLTAGE ENGINEERING

Types of Insulators and their applications, Voltage distribution and string efficiency of disc insulators Evolution of high voltage cables, XLPE cables, Gas-filled cables, Inter-sheath grading, Thermal characteristics of cables Non-condenser and condenser bushings, Field distribution in and around bushings Gas Insulated Substation – Layout and Components, Gas mixtures and their properties, Technical and economic considerations Corona discharge, Corona Loss and radio interference, Suppression of corona and its ill effects Travelling wave equations, Reflection and refraction of travelling waves, Line terminations, Ladder diagram, Travelling waves in multi-conductor systems Causes of lightning overvoltages, Interaction between lightning and power system, Causes of switching surges and power-frequency over voltages, Estimation of switching surges in power system Basic idea about protection against overvoltages, Lightning arresters and surge suppressors, Ground wires, Grounding practices, Insulation coordination scheme of

open-air substation, Basic Impulse Level, Statistical Methods Generation of High AC Voltage – Testing transformer and its cascade connection, single-phase series resonance circuit, Generation of High DC Voltage – Single-stage and multi-stage symmetric as well as asymmetric voltage multiplier circuits, Generation of Impulse Voltage – Single-stage and multi-stage impulse generators circuits, Triggering and synchronization with CRO Measurement of Peak value of high AC Voltage – Frequency dependent method: Chubb & Fortescue Method, Frequency independent methods: Davis-Bowdler Method, Rabus Method, Sphere-Gap Method Measurement of RMS value of high AC Voltage – Capacitive Voltage Transformer, Potential Dividers, Electrostatic Voltmeter Measurement of High DC Voltage – Ammeter in series with high resistance Measurement of Dielectric Loss-factor – High Voltage Schering Bridge High Voltage type tests of insulators, Impulse test of transformers as per relevant Indian standards

References:

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

EE/S/321 E. E. LABORATORY – IV

Selected Experiments in Electrical Mechanics, Control Systems, Power System, High Voltage and Measurements & Instrumentation Laboratories.

EE/S/322 ELECTRICAL MACHINE DESIGN – II

Design of integral h.p. DC machine and Three Phase Transformer. (Text Books)

EE/S/323 POWER SYSTEM DESIGN

Problems on power transmission and distribution system design.

EE/S/324 MODELING AND DIGITAL SIMULATION LABORATORY

Introduction to Matlab/Simulink: Basic matrix operation, file operations, plotting, Matlab program development in command window. Simulation of problems on Matlab/Simulink related to:

– Modeling of 1st and 2nd order systems. Study on time domain and frequency domain behavior.
– D.C. circuit transients in time domain.
– A.C. circuit response in time and frequency domain.
– Simulation of D.C. shunt motor and open loop response.
– Closed-loop speed control of D.C. shunt motor: Stability analysis by root-locus method.
– Simulation of ?-circuit long transmission line and study of wave propagation.

– Simulation of series and shunt faults in transmission lines.
– Simulation of load frequency control for single-area and two-area power system.
– Simulation of sampling and aliasing phenomenon. Study on quantization error of ADC.
– FFT and Inverse FFT of harmonic rich signals.
– Design of IIR and FIR filters and study on effect of finite wordlength.
– Modeling of illumination level at working plane.

Fourth Year – First Semester

EE/T/411 PRINCIPLES OF COMMUNICATION ENGINEERING AND COMPUTER NETWORKS

Part I: Communication Engineering 1. Signals and Spectra: Properties of Signals and Noise, Fourier Transform, Power Spectral Density and Autocorrelation, Random signals, Random Process 2. Analog modulation techniques: AM, FM, PM. 3. Pulse amplitude modulation and Digital communication: PAM, Delta, ASK, FSK, PSK, MSK 4. Performance of Communication Systems corrupted by noise, Signal-to-Noise Ratio, C/I Ratio. 5. Access methods: TDMA, FDMA, Spread spectrum analysis, FH, DS, CDMA, CSMA, WDMA 6. Wire and Wireless Communication Systems: Telephone systems, Cellular System (Concepts, AMPS, GSM, 3G, 4G), Satellite Communication system, Link Budget Analysis, Optical communication

Part II: Computer Networks

1. Introduction to Computer Networks: Analog vs. Digital Transmission, Nyquist and Shannon Limits, ISOOSI layer architecture OSI Reference Model: A Layered Approach, Introduction to TCP/IP 2. Basics of Digital Data Transmission and Media: UTP, STP, Coax, fiber, Wireless, Analog or Digital Data to Analog Signals, Modems, RS-232C, Error Detection and CRC Polynomial Codes, encoding schemes: NZ, NRZ, Manchester encoding. 3. Local Area Networks (LAN), Topologies, Media, Medium Access Control, MAC Layer, LLC, IEEE 802.3, 802.5 Standards, Token Ring, Token bus, CSMA/CD, Ethernet, Hub Switches & Bridges. 4. Wireless LAN, IEEE802. 11X standard. 5. Circuit Switching and Packet Switching, Digital Switching Concepts, Virtual Circuits, X.25 6. Network & Transport layer, Routing and Traffic Control, Flow and Congestion Control, Internetworking, Routers and Gateways, Internet IP, Transport Protocols, TCP/IP, Frame and Cell Relay, ATM and ISDN. 7. Network Security

Books:

1. Digital and Analog Communication Systems - Leon W. Couch, II, Addison Wesley Longman
2. Modern Digital and Analog Communication Systems - B. P. Lathi, Oxford University Press
3. Digital Communications- Fundamentals and Applications - Bernard Sklar, Addison Wesley Longman

4. Wireless Digital Communications - Modulation & Spread Spectrum Applications - Kamilo Feher, Prentice-Hall India
5. Wireless Communications - Signal Processing Perspectives - H. Vincent Poor, Gregory W. Wornell (ed.), Prentice Hall India
6. Computer Networks-Andrew S. Tanenbaum, Prentice Hall India.

EE/T/412 POWER SYSTEM PROTECTION AND SWITCHGEAR

Analysis of asymmetrical faults in power system. General requirements of circuit breakers. Auto- reclosing feature – three pole & single pole autoreclosing. Formation of electric arc. Arc build-up and quenching theory, recovery voltage and RRRV, Arc restriking phenormena. Problems of capacitive and low inductive current interruptions. Rating of circuit breakers and effect of transient current on it. Different types of arc quenching media and special devices for arc quenching. Different types of circuit breakers - their relative merits and demerits. Specific field of usage. Testing of circuit breakers. D.C circuit breaking. Fundamental principles of protective relays, their properties and block diagrams. Single input relays, overcurrent, earth fault and over voltage relays. Principle and application of directional overcurrent and earth fault relays. Principle of 2-input comparison, two and rnuiti input comparators. Distance relays their settings, errors and remedies to errors. Differential relays current and voltage comparison. Motor protection, Different types of pilot protection wire, carrier and wireless pilot. Carrier aided distance protection. Carrier phase comparison schemes.

Reference Books:

1. The Art And Science Of Protective Relaying, by C.R.Mason, John Wiley
2. Protective Relays – Their theory And Practice Vol-I & II, by A.R.Van. C. Warrington, john Willey
3. Power System Protection, by S.P.Patra, S.K.Basu & S.Choudhuri, Oxfort & IBH
4. Power System Protection & Switchgear, by B.Ravindranath & M.Chander, Willey Eastern
5. Switchgear & Protection, by S. S. Rao, Khanna Publishers.
6. Power System Protection, Vols.I, II & III, by Electricity Council, Macdonald & Co.
7. The J & P Switchgear Book, Johnson & Philips Ltd. Newness Butterworths.
8. Power System Protection, Vols.I, II, III & IV, by The Electricity Training Association, IEE.

EE/T/413 PROCESS INSTRUMENTATION AND CONTROL

Part I

Concepts of Modulating and Sequential Control. Structure of Modulating Control loops. Process Control terminology. Process Instrumentation diagrams. Controller Implementation: Electronic analog, Digital, Pneumatic Controllers. Self-tuning and Multifunction Controllers, Control Valves. Process Actuators: Electrical, Pneumatic,

Hydraulic, Valve positioners. Industrial Instrumentation Systems: Components, structure, specification. Self tuning and Adaptive controllers.

Supervisory control : Objectives and Implementation.

Part II

Concept of Processes and Units: Process statics, mass and enthalpy balance. Modelling of process dynamics. Modelling of Chemical processes. Single loop control of standard first order process plants. P-I-D control, Controller tuning, Ziegler-Nichlol's method, Frequency domain design. Feedforward control, Multiloop and Cascade control, Interaction and decoupling Non-linear effects in plants and controllers. Simulation of process control systems. Boiler Drum Level Control. Discrete Controllers: Selection of sampling intervals, stability analysis.

Books:

1. Principles and Practice of Automatic Process Control - Smith and Corripio
2. Principles of Process Control - Patranabis
3. Automatic Process Control - Eckmann
4. Process Control Systems - Shinskey
5. Process Systems Analysis and Control - Coughanowr & Koppel
6. Chemical Process Control - Stephanopoulos

EE/T/414 ELECTRIC DRIVES

PART-I

Motor Control components like DOL starters, contactors, limit switches, relays etc. and example of motor control circuit like start -stop control star-delta starter, forward-reverse change –over. Drive specifications. Four quadrant representations, dynamics of loading of motors with different types of load. Heating and cooling of motors, operating duty cycles. Choice of coupling and bearings. Power electronic control of starting of DC and AC motors. Accelerating time, energy loss in starting. Effect of flywheels. Realisation of the total converter system of AC and DC drives using choppers. Phase controlled rectifiers. Dual converters, Voltage Source inverters (VSI), Current Source Inverter (CSI). Current controlled VSI and cycloconverters. Basic operating principle and characteristics of the schemes. Regeneration in Drives, Dynamic braking, regeneratine braking, DC injection, plugging. Protection schemes for overall drive systems. Electric Traction : General introduction and requirements, speed-time curve mechanics in train movement. DC and AC traction supplies. Current collectors. Traction motors. Linear motors and magnetic levitation. Boosters in traction supplies.

Suggested Books :
1) G. K. Dubey.'Fundamentals of Electrical Drives", Narosa Publishing House

2) N. K. De & P. K. Sen,"Electric Drives", Prentice Hall of India Ltd.
3) H. Partab,"Modern Electric Traction", Dhanpat Rai & Sons

PART-II

Basic terminology: Base speed, speed ratio, constant torque drive, constant hp drive etc. Solid state control of DC motors : Basic principles. Drive schemes with armature voltage feedback and IR-compensations together with tacho feedback for both constant flux and field weakening. Modeling of the DC power converter system. Solid state control of AC motors : Basic principles. Drive schemes with stator voltage control. V/f control with constant flux and field weakening with and without tacho feed-back, slip compensation. Modelling of different AC converter system. Solid state control of synchronous motors.

Suggested Books :
1) G. K. Dubey.'Fundamentals of Electrical Drives", Narosa Publishing House
2) N. K. De & P. K. Sen,"Electric Drives", Prentice Hall of India Ltd.
3) W. Shepherd, L. N. Hulley & D. T. W. Liang,"Power Electronics & Motor Control", Cambridge University Press.

EE/T/415 ELECTIVE PAPER– I

EE/T/415A COMPUTER AND CONTROL ENGINEERING

Part - I

Introduction, Pulse transfer function. Transfer function from difference equation. Transient response characteristics of z-plane pole-locations. Damping ratio and natural frequency. Discretization and Bilinear transformation. Stability on z-plane, Jury's stability criterion, Routh-Hurwitz stability criterion. Choice of sampling rate. Frequency response of discrete functions. Sampling Spectra and Aliasing. Sampling theorem Systems with time-delay. Specifications and Design of Discrete data of Control System. Digital compensator design in frequency domain. Lead, lag and lag-lead compensation, Single loop digital controllers. Two term (PI, PD) and three term (PID) Control algorithm design. Implementation of digital controllers.

Part - II

Introduction to computer Control. Computers of Distributed and direct Digital Control. Hardware elements in a computer control System Data acquisition system., Computer command, Distributed Control SV Approach. State model of discrete processes, Transfer functions, simulation diagram and Flow graphs. Solution of state difference equations. Similarity transformation. Concept of Controllability and Observability. Discrete-time state-space design - state variable feedback control by pole-placement method. Some Applications and case of Computer based direct Digital Control and distributed control.

EE/T/415B HIGH VOLTAGE TECHNIQUE – I

Breakdown in gases, Townsend Mechanism, Paschen's Law, Streamer breakdown, Breakdown under Surge Voltages, Different types of breakdown in solid dielectrics, Different types of breakdown in liquids, Partial discharge and its measurement techniques. Basic Equations of Electric field analysis. Electric Field Analysis by Finite Difference Method – in 2D and Axi-Symmetric Systems with equal and unequal nodal distances, Formulations for homogeneous and multi-dielectric media, Basic 3D formulations. Electric Field Analysis by Finite Element Method – in 2D and Axi-Symmetric systems, Formulations for homogeneous and multi-dielectric media. Electric Field Analysis by Charge Simulation Method – Basic formulations for homogeneous and multi-dielectric media, Types of charges and Accuracy Criteria. Analytical Method of Electric Field Analysis – Cylinder and Sphere in uniform field. Field Utilisation factors for fields around cylinders and spheres. Graphical Field plotting for 2D and Axi-Symmetric systems. Techniques of electric stress control.

References:

1. High Voltage Engineering Edited by Alston.
2. High Voltage Engineering Fundamentals Kuffel & Zaengl.
3. High Voltage Engineering Razevig & Chourasia.

EE/T/415C SPECIAL ELECTRICAL MACHINES & DRIVES

PART-I

Special Machines :Reluctance Motor, Switched Reluctance Motor, Brushless DC motor, Hysteresis Motor, servo motor, stepper motor. Electronic excitation schemes for these. PM synchronous motor and generator. 1-phase alternator, linear induction motors, doubly-fed slip-ring machine. Energy efficient motor.
Induction Regulators: Basic Principles.

PART-II

Microcontroller DSP & PLC application to motor drives.
Introduction to AI application to Machine drives.
Feedback system components like tachogenerators, optical encoders, hall-effect sensors

etc.
Application of simulation tools to machine and drive analysis.

Text Book:
1) C.G. Veinott, "Fractional and Sub-fractional Horsepower Motors"
2) J.Gieras, "Permanent Magnet Motor Technology", CRC Press
3) B. K. Bose, "Modern Power El;ectronics and AC Drives", Pearson Education.

EE/T/415D ADVANCED INSTRUMENTATION-I

Waveform-synthesizer. vector voltmeter. lock-in amplifier. Instrumentation networking techniques: GPIB, fieldbus etc. Smart sensor systems. Data Acquisition Systems. Distributed instrumentation and SCADA. Error of measurements and statistical analysis of data. Special ADCs: flash, subranging, pipelined, delta-sigma modulator. Errors in ADC, ADC codes. Correlation methods of measurement, time-averaging techniques, signal averaging, median filtering. System identification techniques: deconvolution, least square and recursive least square, regression models, AR, MA and ARMA models, applications.

Book:-

1. Electronic Circuits: by Tietze & Schenk
2. Data Converters : by Anvekar & Sonde
3. Random Processes & Kalman filtering: by Brown & Hwang
4. Electronic Instrumentation : by Oliver & Cage
5. Modern Electronic Instrumentation & Measurement : by Helfrick & Cooper 6. Electrical Measurement Analysis: by E. Frank.

EE/T/415E ADVANCED POWER SYSTEMS ANALYSIS

Load flow analysis : Formulation of the load flow problem. Solution of load flow problem by Newton Raphson methods. Incorporating tapchanging transformers and phase shifters in load flow problem, area interchange control. Short circuit study: Formulation of bus impedance matrix, digital computer solution of symmetrical and unsymmetrical faults. Economic operation: Characteristics of generating units, generation scheduling neglecting transmission loss, scheduling problems considering transmission loss and its solution by B-coefficient method, derivation of B-coefficients, unit commitment problem and its solution by dynamic programming, hydro-therrnal scheduling and its solution for short range problem. Load frequency control : Multi area load frequency control problem and concept of tie line control. Transient stability: Multimachine transient stability, its mathematical formulation and solution, representation of excitation system and its inclusion in stability studies, methods of improving transient stability. Introduction to dynamic stability: Small perturbation model of single machine connected to infinite bus, analysis of voltage regulator action, cause of negative damping, preliminary concept of dynamic stability and power system stabilizer.

Reference Books:

1. Computer Methods inPower System Analysis by Stagg & El-Abiad, Tata McGraw Hill
2. Computer Aided Power System Operation & Analysis, by R.N.Dhar, Tata McGraw Hill
3. Electric Energy Systems Theory, O.I.Elgard, Tata McGraw Hill
4. Power Generation Operation And Control, by A.J.Wood & B.F.Wollenberg, John Willey
5. Power System Engineering, by I.J.Nagrath & D.P.Kothari, Tata McGraw Hill
6. Power System Analysis, by A.R.Bergen & V.Vittal, Pearson education
7. Computer Aided Power System Analysis, by G.L.Kusic, Prentice Hall India

EE/T/415F ADVANCED ILLUMINATION ENGINEERING

Part-1: Lamp materials- filament, glass, ceramics, gases, phosphors and other metals & nonmetals; theory of gas discharge phenomena; lamp design considerations; characteristics of low & high pressure mercury-vapour & sodium-vapour lamps; modern energy saving lamps - comparative study; LED – characteristics, features and applications; LASER – characteristics, features and applications, non-lighting lamps. Optical fiber – its construction as light guide, features and application. Ballasts & ignitors for different HID lamps; design consideration of electromagnetic and electronic ballast for TL and HID lamps; ballast materials. Optical system of human eye; performance characteristics of human visual system; external factors of vision-visual acuity, contrast sensitivity, time, luminance, colour; visual perception; optical radiation hazards. Illuminance calculation-illuminance as vector quantity, direct illuminance from point, linear, area sources, advanced methods of illuminance calculation, luminance, luminous exitance, non-planer illuminance – spherical, cylindrical etc., interreflected illuminance. Retroreflection - basic concept and application.

Part –2: Luminaire – design considerations, optical control schemes, design procedure of reflecting and refracting type of luminaire, testing of luminaire, Ingress Protection (IP) code, Luminaire standard – Indian Standard recommendation. Photometry- detector fundamentals; types of detectors–terminology, characteristics, figures of merit etc.; detection elements- filters, cosine diffuser, imaging optics, detector system fundamentals. Photometric measurements – luminous flux, luminous intensity, luminance, illuminance, colour temperature, sources of errors and correction, uncertainty analysis; calibration and calibration report; understanding of luminaire photometric test report; photometry for LED. Colorimetry – visual basis of colorimetry, source colour & object colour, additive and subtractive colour mixture; CIE chromaticity – colour equation, XYZ and UCS colour space, source and object colour specification, chromaticity coordinates Yxy, Luv, dominant wavelength, purity, Grassmann’s law of colour mixing, CIE standard source and illuminant, colour space and colour difference, Munsell colour system; colorimetric instrument – light source colorimetry and colorimetry of materials; colour rendering index-its measurement; metamerism. Lighting controls:– different control equipment-on/off switch, simple automatic switches, photocell, occupancy sensor, timer, lighting

contactors, dimmer, low voltage relays; communication links-line and low voltage hardware; different control strategies.

EE/T/416 GENERAL VIVA VOCE

Based on the theory and sessional subjects covered under B. E. E. Programme.

EE/S/411 E.E. LABORATORY – V

Selected Experiments in Electrical Mechanics, Control Systems, Power System, High Voltage and Measurements & Instrumentation Laboratories.

EE/S/412 ELECTIVE PROJECT AND COMPUTATION - I

Project and computation works based on elective paper chosen.

EE/S/413 SEMINAR – I

In this course the student would have to present the dissertation on a topic in consultation with the teacher concerned and give a talk on that.

EE/S/414 ELECTRICAL MACHINE DESIGN – III

Design of three phase induction motor and single phase induction motor. (Computerised performance calculation)

Fourth Year – Second Semester

EE/Gen/T/421 ENGINEERING ECONOMICS AND COSTING

Introduction – Engineering economy and its important, Want activity satisfaction of wants. Resources planning and distribution in economic system – Laissez Faire and socialism. Factors of production and concept of optimum. Laws of return. Demand - Elasticity of demand, demand – estimation, market research, supply and industrial costs. Money – Value of money, quantity theory; inflation and deflection. Neural network and its applications. Banking - role in commercial banks credit and its importance in industrial financing, sources of finance Reserve bank of India and its functions. Business management and organization, Proprietorship, Partnership and joint stock company – their formation, finance and management. Elements of taxation, insurance, Business combinations. Basic Principals of management. Industrial record keeping : Double entry system – Journal, lager, trail balance, cash book, preparation of final accounts, trading and profit and lose account and balance sheet. Industrial costs and their classifications – Material cost control, labor cost control and overhead cost control. Depreciation and replacement studies; Financial control ratio analysis and their interpretation for industrial control. Budgetary control.

Books: 1. Neural Networks by Simon Hay kin.

MNG/ME/T/1 INDUSTRIAL MANAGEMENT

Growth of Industries, Management thoughts and scientific management, Taylorism; Factory system of production, Introduction to management problems, Types of manufacture, Planning analysis and control aspects in industries.
Types of business ownership, means of finance and business combinations, organization structures, committee organization, authority and responsibility, duty and span of control. Plant location, factory buildings and physical facilities, plant layout, tools and techniques of plant layout, materials - handling arrangements. Product development, standardization, simplification and diversification.
Functions of production, planning and control, production forecasting, production scheduling and network techniques, Gantt chart, CPM, PERT etc.
Work study, job evaluation and merit rating; purchase system and inventory control. Inspection and quality control of systems, statistical quality control, maintenance and replacement policies for machine and equipments; decision making theories, breakeven analysis cost benefit analysis, evaluation of financial and managerial efficiencies. Introduction to operational research techniques. Application of fuzzy logic in modern management concepts. Human relations in industry and labour compensation. Personnel management, provision of industrial legislations in India. Wage and salary administrations. Welfare and safety provisions, trade union acts. Study of environmental impacts and environmental laws.

Text Book:
Production and operations management: S.N.Chari

Reference books:
1. " Industrial Management" by: Basu & Majmundar (Birla Pub., Newdelhi)
2. " Quantitative techniques in management" by: N.D.Vohra (Tata Mcgraw Hill)
3. "Production systems analysis and control" by : Riggs
4. "Works organization and management by: Basu, Sahoo & Dutta.
5. Fuzzy logic with Engineering applications: Timothy J. Ross (Mcgraw Hill)

EE/T/423 ELECTIVE PAPER– II

1. ADVANCED CONTROL THEORY
2. HIGH VOLTAGE TECHNIQUE – II
3. ELECTRICAL MACHINE MODELLING & ANALYSIS
4. ADVANCED INSTRUMENTATION-II
5. ADVANCED TOPICS IN POWER SYSTEMS
6. ADVANCED LIGHTING DESIGN

EE/T/423A ADVANCED CONTROL THEORY

Part - I

Concepts of Controllability and Observability. Control Law design for full state feedback. Pole placement by state feedback. Observer Systems and Design of State Observers. Optimal Control Systems and Performance Indices. Optimal Control of linear systems with Quadratic Performance Index. Optimal State Regulator Design through Matrix Ricatti equation. Robust Control Systems and System sensitivity. Stability of systems with uncertain parameters. Kharitnov's methodology. Structured and Unstructured uncertainty. Stability robustness of Control Systems. Integral Control and Robust Tracking H2 and H-infinity control.

Part – II

Non-linear systems. Describing functions of common Non-linearity. Stability Analysis by Describing Function method. Phase plane method. Construction of phase Trajectories. System Analysis on phase plane. Optimal switching in Bang-Bang Control Systems. Lyapunov method of Stability Analysis. Popov's Circle Criterion. Case study in nonlinear Control Performance Analysis of Systems with Dead-time elements. Modelling and Specifications. Actuators: Electric, Hydraulic and Pneumatic inertial sensors. Gyroscopes and Accelerometers- Modelling and Specifications. Case study of an aerospace control system with actuator & inertial sensor.

EE/T/423B HIGH VOLTAGE TECHNIQUE – II

Layout of high voltage laboratory with major testing and measuring equipments, Determination of their ranges and ratings, earthing system, electromagnetic shielding and protective fencing. Multistage impulse generator circuits, determination of output from circuit solution, Selection of circuit parameters for controlling output wave shape, DC charging circuit, DC voltage ripples and voltage regulation, Triggering techniques, Synchronization with CRO. Measurement of High Voltages, Electrostatic Voltmeters, Compensated ac and impulse peak voltmeters, Different types of voltage dividers and their characteristics, Surge current and voltage recorders, Surge crest ammeter and Klydanograph. High Voltage Schering Bridge. Microprocessor based measurement techniques. Over-Voltage Phenomena: Lightning and switching surges, Temporary over voltages, Ground wires and protector tubes. Insulation Coordination – BIL and SIL of equipments, Surge diverters and their characteristics, Classical and statistical concepts of insulation coordination. Transient Analysis: Electromagnetic transients by EMTP, Ferro-resonance, Impulse Voltage distribution in transformer windings.

References:

1. High Voltage Engineering Edited by Alston
2. Insulation Coordination in high voltage electric power systems by W. Diesendorf
3. An introduction to high voltage experimental technique by Dieter Kind
4. Extra high voltage ac transmission engineering by R.D. Begamudre

EE/T/423C ELECTRICAL MACHINE MODELLING & ANALYSIS

PART-I

Generalised theory of machines. Transient analysis of DC and AC machines. Space vectors and its application to the analysis of electric machines, specially of induction motors. Principle of vector decoupled control.

PART-II

Motor behaviour under asymmetrical supply voltages.
Analysis of 3-phase induction motor with AC phase controlled supply.
Motor problems associated with non-ideal power supplies from converter. Commutation problem in dc motor. Harmonic effects on induction motor - harmonic equivalent circuit and harmonic torques.
Application of simulation tools for machine modeling, analysis and design.

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

EE/T/423D ADVANCED INSTRUMENTATION-II

Advanced sensors: corriollis massflow meter, optoelectronic sensors. Sensor fusion. Tomographic measurement techniques. Sensor linearisation techniques. Inductive voltage divider – construction, testing and uses. Current comparators – A.C. and D.C., their uses in trasnformer. Calibrations and resistance comparisons. Absolute measurement of voltage by oscillating electrode voltmeter. Josephson junction voltage standard. Quantum Hall resistance standard. Non-destructive testing: ultrasonic, eddy current, electromagnetic etc. Introduction to digital control. Dahlin controller. Kalman controller. Introduction to adaptive control. Deterministic self-tuning regulators. Model reference adaptive systems: the MIT rule. Gain scheduling controllers. Variable structure control with sliding mode for linear systems. Characteristics of reaching and sliding modes. Chattering. State estimation techniques, observer. Introduction to Kalman filter, applications.

Book:-

1. Industrial Digital Control: by K. Warwick & D. Rees
2. Chemical Process Control: by Stephanopoulos
3. Adaptive Control : by Ästrom & Wittenmark

4. Random Processes & Kalman Filtering: by Brown & Hwang
5. Electronic Instrumentation: by Oliver & Cage
6. Advanced Engineering Mathematics: by Kreszyg.
7. Information Theory: by Reza.
8. Practical Non-Destructive Testing: by Baldev Raj, T. Jaykumar and M. Thavasimuthu.
9. Alternating Current Bridge Methods: by Hague and Foord.
10. NPL review.
11. Bradshaw, E., Hussain, S.A., Kesavamurthy, N., and Menon, K.B., "Absolute Measurement of High Voltages by Oscillating Electrode Voltmeters". Journal I.E.E., 1956, 103, Part. A., pp. 55.

EE/T/423E ADVANCED TOPICS IN POWER SYSTEMS

Static & Digital Relaying: Generalised approach for two input and multi input comparators, derivation of inputs for different types of static distance protection, hard-ware for static relays, concept of digital relaying, derivation of fundamental component of voltage and current for digital protection. HVDC Operation and control : CIA. CC and CEA control. Determination of stable operating point. Introduction to FACTS – Brief description of various FACTS devices and their principle of operation, role of FACTS in active and reactive power control. Harmonics in Power Systems – Different sources of harmonics, effects of harmonics on Power System performance and power quality. Computer aided operation and control of Power Systems--- Concept of Energy Control Center, introduction to SCADA and Security monitoring.

Reference Books:

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

EE/T/423F ADVANCED LIGHTING DESIGN

Part 1:

Daylighting – characteristics and features of daylight; sky models – Indian clear sky, CIE standard overcast and standard clear sky; daylighting concepts-sidelighting, toplighting; window design formula; Daylight Factor method; physical scale modeling of daylighting system, daylight linked artificial lighting. Quality and quantity assessment of lighting systems – BIS recommendation of lux level; factors affecting the required quantity;

evaluating the quantity of illuminance; procedures of field measurements; quality of illuminance – discomfort & disability glare – evaluation method, veiling reflection, Visual Comfort Probability (VCP).

Indoor lighting– zonal cavity method for general lighting design - CU determination for zonal cavities and different shaped ceilings, Residential, office, industrial, hospitals etc. – Indian Standard recommendation for indoor lighting, selection criteria of lamps and luminaire, design considerations, design procedure. Emergency lighting:– escape lighting, standby lighting; maintained & non-maintained lighting systems – transport lighting.

Part 2:

Outdoor lighting– roadlighting – road classifications according to BIS, pole arrangements, terminology, lamp & luminaire selection, different design procedures – beam lumen method, point-by-point method, isolux diagram method; tunnel lighting; floodlighting- selection of floodlights-NEMA classifications, design procedure; sportslighting- special lighting requirements for football, cricket, badminton ground – BIS recommendation, selection criteria of lamp and luminaire, design considerations, design procedure. Marine & aviation lighting – basic ideas, lamp & luminaire selection, special requirements etc. Lighting energy management and economics – lighting power budget; lighting power limit; evaluation of existing system; different options for consideration; simple payback analysis; life cycle cost analysis; components of cost and savings. Computer application in lighting design – computation of lumen package, luminous efficacy, correlated colour temperature, chromaticity coordinate, dominant wavelength, purity of a lamp from lamp SPD data; plotting of isolux diagram, indoor general lighting design, roadlighting design etc.

EE/T/424 SPECIAL PAPER - I

EE/T/424A ADVANCED COMPUTING TECHNIQUES

Numerical solutions of Boundary Value problems: Finite Difference Method – derivation of FDM equations from Tailor series in two dimensional composite media systems. Finite Element Method – derivation of nodal equations from minimum energy constraint in two dimensional and composite media systems. Formation of coefficient matrix, solution of sparse coefficient matrix. Generalised function estimation techniques: Artificial Neural Networks – Perceptron, supervised and unsupervised learning , multilayer feedforward network, error back propagation. Fuzzy Systems – Properties of fuzzy sets, fuzzy membership function, knowledge base, inference engine, defuzzyfication. Fuzzy inferencing systems, introduction to neuro-fuzzy systems. Classical optimization techniques: Non linear programming: Unconstrained minimization, necessary and

sufficient conditions for optimality, convexity, direction vector, Steepest descent method, Newton's method, Quasi Newton's methods. Introduction to constrained minimization problem, KKT optimality condition, Penalty function method. Linear Programming: LP problem, Simplex Algorithm, two phase method, Duality in LP. Integer Programming: Branch and bound algorithm. Combinatorial optimization techniques: Genetic Algorithms – Concept of chromosome, reproduction, Crossover & mutation, fitness function. Real coded Genetic Algorithms. Simulated Annealing technique – Annealing in metal crystalization, Boltzman distribution, Initial temparature, cooling rate, metropolis algorithm.

References:

1. Neural Networks – A Comprehensive Foundation, by Simon Haykin, Pearson education
2. Fuzzy Logic With Engineering Applications, by T.J.Ross, McGraw Hill
3. Optimization Theory And Application by S.S.Rao, Wiley Eastern
4. Optimization Concepts And Applications In Engineering, by A.D.Belegundu & T.R. Chandrupatla, Pearson education
5. Genetic Algorithm In Search Optimization And Machine Learning, by D.E.Goldberg, Pearson Education
6. Simulated Annealing: Theory and Applications, by P.J.M. Van Laarhoven & E.H.L.Aarts, Kluwer Academic Publishers
7. Finite Elements for Electrical Engineers, by P. P. Silvester & R. L. Ferrari, Cambridge University Press.

EE/T/424B RELIABILITY ENGINEERING

Reliability Mathematics : – Probability concepts – Riles of probability – Probability distributions – Discrete distributions – Continuous distributions – Statistical confidence – Statistical hypothesis testing Analysis of Reliability Data : - Probability plotting – Ranking of data – Probability plotting techniques – Hazard plotting. Reliability Prediction & Modeling : - Prediction Accuracy – System Reliability models – Availability – Standard approaches to Reliability prediction.

Component Reliability : - Reliability of components like resistors, capacitors, diodes etc. – Reliability prediction worksheet.

Software Reliability : - Software failure modes – Structured programs – Program checking & testing – Software reliability Statistics. Basic Reliability Concepts : - Reliability Function – Repairable and Non-repairable Systems – Markov modeling – Two state models – Series , parallel and composite systems – MTTF, MTTR, MTBF etc. Static Generating Capacity Reliability Evaluation : - Construction of Capacity Outage Probability Tables – Rounding off capacity outage probability tables – Deterministic risk criteria – Percentage reserve – Loss of largest unit – Recursion algorithm – Calculation of loss of load indices – Frequency and duration technique – State space diagram – Load model. Reliability of Substation : - Substation failure events – Stuck condition of breaker

Order of load point failures. Reliability of Distribution systems : - Load and energy oriented indices – Residual systems – Effect of lateral distribution protection – Effects of isolators – Disconnectors etc. - Method of network reduction. Temporary and Transient outages– nclusion of weather effects– Stotacastic approach etc.

References :

1. Practical Reliability Engineering – Patrick D.T. & O'Connor
2. Power System Reliability – Roy Billinton 3. Power System Reliability – Billinton & Allan.

EE/T/425 SPECIAL PAPER – II

EE/T/425A ENERGY SYSTEMS

1. Energy Resources: Terminology, Major Energy Resources in use: Resource, Reserve and Availability of Oil, Gas and Coal in global and national context. Hydro-electricity and Nuclear-electricity: Availability and developmental Constraints. 2. Energy Consumption Demand: Consumption Sectors; Growth rate in Industrial, Commercial & Residential, Agriculture and Transportation Sector of total energy and electricity National and International trends. 3. Renewable Energy: Need for accelerated growth: availability and environmental constraints of traditional non-renewable sources. Demerits of Solar sources. Technologies for electricity generation (I) wind, (ii) PV, and (iii) Biomass; Tidal and Geothermal power plants. Ocean Thermal and Wave electricity generation. Fuel cells. 4. Energy Storage: Role of Storage in electricity supply: Types and operation of Storage systems: (I) Chemical, (ii) Mechanical, (iii) Thermal, (iv) Magnetic Storage. Hydrogen energy. 5. Energy Management and Audit:

Demand Side and Supply Side of Management (DSM & SSM): Conservation of electrical energy, Technology & Potential Energy. Conservation Act, 2001. Energy Audit: Preliminary Detailed Audit.

EE/T/425B REAL TIME SYSTEMS

Part-I

Introduction to Real-Time Systems: Definition and Example of Real-Time Systems. Hardware, Operating System and application software. Functionalities of Real-Time Systems. Classification of Real-Time Systems. Real-Time Systems Hardware Architecture: Features of computer for Real-Time Systems. Generic Hardware structure of Embedded System. Redundant Architecture. Industrial digital Interface. Serial Interfaces. D to A to D interfaces. Watch dog Timer. Real Time Operating System:

Introductory concepts. Real time application as a collection of Tasks. Kernel and Executive. Polled loop system. Interrupt driven system. Handlers. Task Management. Mailboxes. Semaphores. Queues. Management of shared resources. Job management. Exchange management. Memory Management. Example of Real Time operating System (iRMX, POSIX). Issues in Real time System Design: Real Time response. Recovering from failures. Software safety, reliability and fault tolerance. Co-Design. Race condition and timing.

Part-II

Real Time Software Life cycle: Waterfall & CENELEC/ISO Life Cycle. Ward & Mellor Life Cycle. Phases of software life cycle. Non-temporal transition of software life cycle. Spiral Model. Analysis and Application: Data flow diagram. State diagram. State ChaReal-Time Systems. Feature design. Limitation of non-temporal description. Real Time Software Architecture and Design: Software architecture definition. Defining sub systems. Task Design. Task scheduling, Task dispatching policy. Entry queuing policy. Protected data types. Error detection. Programming languages and tools: Desired Language characteristics. Multitasking, Low-level programming. Programming Language features. Timing specification. Use of C Language. Features of Ada Language. Cross compilers. Performance analysis : Response time calculation. Interrupt latency, Time loading and measurement. Memory requirement analysis. I/O performance. System Testing and Integration : Unit test. Software integrated test. Hardware development system. In circuit emulator

Main Reading

1. Goldsmith Sylvia, “A Practical Guide to Real-Time Systems Development”, Prentice Hall.
2. Philip A.Laplante, “Real Time System Design and Analysis”, IEEE CS Press
3. C.M Krishna and Kang G.Shin, "Real-Time System", McGraw-Hill International Editions, Computer Science Series, 1997.
4. David Simon, “An Embedded Software Primer,” Addison Wesley, 1999

Supplementary Reading

1. J.E.Cooling, " Software design for Real-Time Systems", Chamopan & Hall Pub.
2. Yann Hang Lee and C.N. Krishnan, "Readings in Real-Time Systems", IEEE CS Press.
3. John B. Peatman, "Design with Micro Controllers", McGraw-Hill International, Computer Engineering series.

EE/S/421 E.E. LABORATORY – VI

Selected Experiments in Electrical Mechanics, Control Systems, Power System, High Voltage and Measurements & Instrumentation Laboratories.

EE/S/422 ELECTIVE PROJECT AND COMPUTATION - II

Computation works based on elective paper chosen. Student would complete the projects(for which the proposal was submitted in the 1st semester to the satisfaction of the supervisor)

EE/S/423 SEMINAR – II

In this course the student would have to present the dissertation in the form of a seminars and would have to take part in group discussion on seminars by other fellow students.

EE/S/424 POWER ELECTRONICS DESIGN

Design of 1- phase and 3-phase rectifiers and inverters. Design of choppers, dc/dc converters and ac phase controllers. Design of related magnetic and filter circuits. Design of relay and servo stabilizers. Design of the control hardware and software for power electronic circuits. Design of interface between control and power section. Application of SPICE or other simulation software to power electronic simulation.