EE 2201 PRINCIPLES OF ELECTRICAL ENGINEERING

MODULE – I

Introduction: Importance of Electrical Engineering in day-to-day life, Electrical elements and their classification, Ideal and Real Sources, Source Conversion, KCL and KVL, Loop current and Nodal voltage method-for D.C. Circuits: Steady state analysis with independent and dependent sources; Series and Parallel circuits, Star-Delta conversion

(5)

MODULE – II

A.C. Single-Phase Series Circuits: Common signals and their waveforms, RMS and Average value. Form factor & Peak factor of sinusoidal waveform. Impedance of Series circuits. Phasor diagram. Active Power. Power factor. Power triangle.

(5)

MODULE – III

A.C. Single-Phase Parallel Circuits: Admittance method, Phasor diagram. Power. Power factor. Power triangle, Series- parallel Circuit, Power factor improvement, Series and Parallel Resonance, Resonance curve , Q –factor, Dynamic Impedance, and Bandwidth.

(5)

MODULE – IV

Circuit Theorems: Superposition theorem, Thevenin's & Norton's theorem, Maximum Power Transfer theorem for Independent and Dependent Sources in DC as well as AC circuit.

(5)

MODULE – V

Three Phase Circuits: Line and Phase relation for Star and Delta connection, Power relations, Analysis of balanced and unbalanced 3 phase circuits.

(5)

MODULE – VI

Magnetic Circuits: Introduction, Series-parallel magnetic circuits, Analysis of Linear and Non-linear magnetic circuits, Energy storage, A.C. excitation, Eddy currents and Hysteresis losses.

(5)

MODULE – VII

Coupled Circuits (Dot rule), Self and mutual inductances, Coefficient of coupling.

Basic Indicating Instruments: Moving coil and moving iron type instruments.

(5)

Text Books:

1. Huges Electrical Technology, Revised by McKenzie Smith, Addison Wesley.
2. Fitzgerald and Higginbotham, Basic Electrical Engineering, McGraw Hill Inc, 1981.

Reference Books:

1. D.P. Kothari and I.J. Nagrath, Basic Electrical Engineering, 3rd Edition, TMH, New Delhi, 2009.
2. W. H. Hayt, Jr J. E. Kemmerly and S. M.Durbin, Engineering Circuit Analysis, 7th Edn TMH, 2010.
3. Electrical Engineering Fundamental, Vincent Del Toro, Prentice Hall, New Delhi.

EE 3201 INTRODUCTION TO SYSTEM THEORY

MODULE – I

Introduction to Signals and Systems: Definition, Basis of classification, Representation of common signals and their properties, System modeling.

(4)

MODULE – II

Analogous System: Introduction, D Alembert's Principle, Force-voltage and force-current analogies, Electrical analogue of mechanical, Hydraulic and thermal systems.

(5)

MODULE – III

Fourier Transform Method: Introduction, Fourier transform pair, Amplitude spectrum and phase spectrum of signals, Sinusoidal transfer function.

(3)

MODULE – IV

Laplace Transform Method: Introduction, Laplace transform pair, Laplace transformation of common functions, Gate function, Step function and impulse function, Laplace theorems shifting, initial value, final value and convolution theorems.
Inverse Laplace transform by partial fraction expansion and convolution integral method.

(12)

MODULE – V

System Analysis: System Analysis by Laplace Transform method, System response. Natural, forced, transient and steady state responses. Transfer function and characteristic equation, Superposition integral, Concept of poles and zeros, Nature of system response from poles and zeros.

(6)

MODULE – VI

System Stability: Concept of stability, Types, Necessary and sufficient conditions, Routh Hurwitz stability criterion, Limitations and its applications to closed loop systems.

(4)

MODULE – VII

State-Space Concept: Introduction, Definition: State, State variable, State vector and state space, State space representation, Derivation of State model from transfer function, Bush form and diagonal canonical form of state model, Non-uniqueness of state model, Derivation of transfer function from state model, Transition matrix and its properties, Solution of time invariant state equation.

(6)

Text Books:

1. Analysis of Linear Systems – D.K.Cheng.
2. Control System Engineering – Nagrath & Gopal
3. Control System – A. Anand Kumar

Reference Books:

1. Networks and Systems – D. Roy Choudhury
2. Signals and Systems - Basu & Natarajan

EE 3205 NETWORK THEORY

MODULE – I
Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem
(3)

MODULE – II
Network Topology: Definition and properties, Matrices of Graph, Network Equations & Solutions: Node and Mesh transformation, Generalized element, Source transformation, Formulation of network equations, Network with controlled sources, Transform networks, Properties of network matrices, Solution of equations. Linear time-invariant networks, Evaluation of initial conditions, Frequency and impedance scaling.
(10)

MODULE – III
Multi-terminal Networks: Natural frequency, Network functions, Two-port parameters, Equivalent networks.
(6)

MODULE – IV
Elements of Network Synthesis: Positive real function, Reactance functions, RC functions, RL Network, Two-port functions, Minimum phase networks.
(7)

MODULE – V
Approximation: Filter specifications, Butterworth approximation, Chebyshev approximation, Comparison between Butterworth and chebyshev transfer functions.
(6)

MODULE – VI
Bandpass filter approximation, Frequency transformation, Insertion Loss Synthesis: Co-efficient matching technique, Darlington's method.
(6)

MODULE – VII
Active Networks and Filters: Active elements, Single amplifier filters, State variable realization, All pass and notch filter, Higher order filter.
(7)

Text Book:

1. V.K. Aatre, Network Theory & Filter Design

Reference Book:

1. M.E. Van Valkenberg, Introduction to Modern Network Synthesis
2. Balabanian, N. and T.A. Bickart, "Electric Network Theory", John Wiley & Sons, New York, 1969.
3. C. L. Wadhwa, Network Analysis and Synthesis, New Age Publication.

EE 3207 ELECTRIC ENERGY GENERATION AND CONTROL

MODULE – I

Introduction: Overview of power generation scenario from thermal, hydro and nuclear and non-conventional sources.

(2)

MODULE – II

Thermal Stations: Selection of site for a thermal station, layout, main components, boiler, economizer, air preheater, super heater, reheater, condenser, feed heater, cooling powers, FD and ID fans, Coal handling plant, water treatment plant, Ash handling plant, Types of boilers and theirs characteristics, Steam turbines, and their characteristics, governing system for thermal stations.

(15)

MODULE – III

Hydro Electric Stations: Selection of site, layout, classification of hydro plants, general arrangement and operation of a hydro-plant, governing system for hydel plant, types of turbines.

(5)

MODULE – IV

Nuclear Power Station: Nuclear reaction for nuclear power, nuclear fuels, feasibility of a nuclear power station, layout, main part of a nuclear station, nuclear reactor classification, control system for nuclear power station, Safety of nuclear power reactor.

(5)

MODULE – V

Diesel Electric Station: Site selection, layout, main components, choice and characteristics of diesel engines, diesel engines, diesel plant efficiency and heatbalance, maintenance.

(5)

MODULE – VI

Gas Turbine Plant: Plant layout, a simple gas turbine plant, methods to improve thermal efficiency of a gas turbine plant, fuel for gas turbine plant, combined gas turbine cycle, advantages of gas turbine plants over steam plants.

(5)

MODULE – VII

Non-conventional Sources of Energy and Economics of Power Generation: Wind, Tidal, Solar, and Load curve, Load factor, diversity factor, Plant capacity factor, Plant utilization factor, different types of tariffs, Inter connection of power system.

(8)

Text Books:

1. Power Plant Engineering- PK Nag TMH publications
2. A Textbook on Power System Engg. – A Chakravarti, ML Soni, PV Gupta and U.S. Bhatnagar, Dhanpat Rai & Co., New Delhi

Reference Books:

1. Elements of Electrical Power Station Design – MV Deshpande, Pitman and Sons Ltd.
2. Electric Power Generation, Transmission and Distribution - S.M. Singh, Prentice Hall of India, Delhi.
3. Generation, Distribution and Utilization of Electrical Power – C.L. Wadhwa, New Age Publication.

EE 4201 ELECTRICAL MEASUREMENT AND INSTRUMENTATION

MODULE – I

Introduction: Definition of measurement, Generalized input-output configuration of measuring instruments and instrumentation systems. Performance characteristics (static and dynamic), Accuracy, Precision, Types of error, Statistical analysis, Standards of measurement. Systems of units. Fundamental and derived units. Dimensions.

(5)

MODULE – II

Analog Instruments: Basic requirement of a measuring instrument. Introduction to D' Arsonval galvanometer, Construction and principle of Moving coil, Moving iron, Induction types of instruments, Measurement of voltage, current and power, phase, frequency, Range extension including current and potential transformers.

(10)

MODULE – III

Bridge: DC bridges for measurement of resistance Wheatstone bridges, Kelvin's double bridges and AC bridges for measurement of L, R, C & M, Maxwell's bridges, Anderson's bridges, Wien's bridges. Measurement of frequency, localization of cable fault.

Potentiometers: DC and AC potentiometers, Principles, Standardization and application.

(9)

MODULE – IV

Electronic Instruments: Electronic voltmeter, Digital voltmeter, vector voltmeter, Vector Impedance meter and Q-meter.

(5)

MODULE-V

Display Devices & Recorders: Digital display, LED, LCD, Strip chart recorder, X-Y recorder

(5)

MODULE – VI

Transducers: Classification, Inductive, Resistive and Capacitive transducers, Analog and Digital Transducers with applications. Hall effect, Piezo Electric, Photovoltaic transducer. Measurement of temperature and pressure

(8)

MODULE – VII

Oscilloscopes: CRT, Construction, Basic CRO circuits, Block diagram of a modern oscilloscope, Y-amplifiers, X-amplifiers, Triggering, Oscilloscopic measurement.

Special CRO's: Dual trace, Dual beam, Sampling oscilloscope, Storage CROs.

(5)

Text Books:

1. Helfrick and Copper - Modern Electronics Instrumentation and Measurement, Pearson Education, New Delhi.
2. Sawhney A.K. - Electrical & Electronic Measurement and Instrumentation, Dhanpat Rai & Son's.

Reference Book:

1. Patranabis D – Sensors and Transducers, Wheeler, 1996.
2. Kalsi - Electronics Instrumentation, TMH Publication, New Delhi.
3. Deoblin - Electrical Measurement.
4. Patranabis D – Principles of Industrial Instrumentation, TMH Publication, New Delhi, 1976.

EE 4203 ELECTRICAL MACHINE - I

MODULE – I

Basic Concepts of Electrical Machines: Introduction, Electromagnetic induction, flux linkage, statistically and dynamically induced emf, Classification and description of electrical machines, Heating and cooling of electrical machines.

(5)

MODULE – II

Elements of Rotating Machines: Introduction, Basic Components, Rotor, Stator and field excitation. Generator and motor action, EMF and torque equations, Leakage flux, Losses and efficiency, Rating and loss dissipation, Electrical and mechanical degrees.

(4)

MODULE – III

Introduction to D.C. Machines: Constructional parts of d. c. machines and their function, Principle of operation, Armature winding- Lap and wave, Simplex and duplex, Method of excitation, Classification, Derivation of emf and torque equations, Process of commutation, Armature reaction, Interpoles, Compensating winding and equalizer rings.

(8)

MODULE – IV

DC Generators: Operating Characteristics- Magnetization, Internal and external characteristics, Critical resistance and critical speed, Process of building up of voltage, Causes of failure of voltage build-up and remedies, Parallel operation of d.c. generators, Applications.

(7)

MODULE – V

D.C. Motors: Basic equation for voltage, Power, Torque and speed, Condition for maximum power, Operating characteristics- Torque-current, Speed-current and Torque-speed characteristics. Comparison, Starters, Speed control methods, Testing of d.c. machines- Swinburn's, Hopkinson's and Series field tests. Calculation of efficiency, Applications.

(7)

MODULE – VI

Transformers: Principle of operation, Construction and practical considerations, Ideal and physical transformer, emf equation, transformation ratio, Phasor diagram. Performance analysis, Equivalent circuit, Losses and efficiency, Condition for maximum efficiency, Determination of equivalent circuit parameters by O.C. and S.C. tests, Per unit calculation, Polarity test, Voltage regulation, all day efficiency.

(8)

MODULE – VII

Transformer Connections and Operation: Back-to-back test, Parallel operation, Autotransformer, 3-phase transformer, Three-phase transformer connections- Star-star, Delta-delta, Star-delta, Delta-star, Zig-zag connections. Scott connection, Open delta connection, Transformer cooling.

(6)

Text books:

1. Electric Machinery - Fitzgerald
2. Performance and Design of DC Machines - A.E. Clayton

Reference books:

1. Electrical Machines – Bimbhra, Khanna Publishers, Delhi
2. Parker Smith's - Series in Electrical Engineering.
3. Electrical Machines - Nagrath & Kothari, TMH Delhi

EE 4207 DIGITAL SIGNAL PROCESSING

MODULE – I

Introduction: Discrete-Time Signals, Shanon's sampling theorem, Difference equation description, characteristics of digital filters and time domain analysis, properties of discrete time system (linearity, time-variance, convolution), BIBO stability, Z-transformation and their application in solving difference equations, Relationship between Laplace and Z-transforms.

(7)

MODULE – II

Frequency Domain Analysis: Discrete Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT), Periodic convolution, Direct evaluation of DFT, FFT algorithms- decimation in time and frequency, Relationship between Fourier and Z-transforms

(8)

MODULE – III

Digital Filter Structures: Direct form I&II, cascade, parallel and ladder realizations.

(5)

MODULE – IV

Filter Function Approximations and Transformations.

Review of approximations of ideal analog filter response, Butterworth filter, Chebyshev Type I & II.

(6)

MODULE – V

Frequency Transformations: Frequency transformation in analog domain, frequency transformation in digital domain.

(4)

MODULE – VI

Design of IIR Filter: Design based on analog filter approximations, Impulse invariance method, Matched Z-transformation, Bilinear transformation.

(7)

MODULE – VII

Design of FIR Filters: Symmetric and antisymmetric FIR filters, design of linear phase FIR filters using windows and frequency – sampling methods, design of optimum equiripple linear phase FIR filters, comparison of FIR and IIR filters.

(8)

Text Books:

1. John G. Proakis, Dimitris G. Mamalakis, Digital Signal Processing, Principles, Algorithms and Applications
2. Alan V. Oppenheim Ronald W. Schafer, Digital Signal Processing, PHI, India.

Reference Book:

1. Antonious, Digital Filter Design, Mc-Graw-Hill International Editions.

EE 4209 ENGINEERING ELECTROMAGNETICS

MODULE – I

Electrostatic and Magnetostatic Energy, Forces and Torques: Electrostatic energy. Electrostatic forces and torques in terms of stored electrostatic energy. (Chapter 3, pp. 133-143)

Magnetic energy. Magnetic forces and torques in terms of stored magnetic energy. (Chapter 6, pp. 277-281, pp. 289-294).

(6)

MODULE – II

Electrostatic Boundary-Value Problems: Introduction. Poisson's and Laplace's equations. Boundary conditions. Uniqueness theorem. Solution of one-dimensional Laplace's and Poisson's equations. Solution of two-dimensional Laplace's equation by method of separation of variables in cartesian, cylindrical and spherical coordinates. (Chapter 4, pp. 152-159, pp. 174-192)

(8)

MODULE – III

Plane Electromagnetic Waves: Wave equations. Helmholtz equations. Plane waves. Propagation of uniform plane waves in dielectric and conducting media. Polarization of plane waves. (Chapter 8, pp. 354-379)

(8)

MODULE – IV

Reflection and Refraction of Plane Waves: Electromagnetic boundary conditions. Reflection of normally and obliquely incident plane waves from perfect conductor and dielectric. Total reflection. Total transmission. (Chapter 8, pp. 386-401, pp. 406-417)

(6)

MODULE – V

Rectangular Waveguides and Cavity Resonators: Introduction. General wave behaviors along uniform guiding structures. TEM, TM and TE waves. Rectangular waveguides. Rectangular cavity resonators. (Chapter 10, pp. 520-533, pp. 547-558, pp. 582-588).

(8)

MODULE – VI

Radiation and Antennas: Introduction. Scalar and vector potentials. Retarded potentials. Radiation from elemental electric dipole. Antenna pattern and antenna parameters. Thin linear antennas. Half-wave dipole. Effective antenna length. Antenna arrays. Two-element arrays. (Chapter 11, pp. 600-605, pp. 607-625)

(6)

MODULE – VII

Solution of Two-Dimensional Problems: Method of images (Chapter 4, pp. 159-174). Conformal transformations (Ref. Class notes)

(5)

Text Book:

1. Cheng, D.K., "Field and Wave Electromagnatics", Pearson Education (Singapore) Pte. Ltd., 2nd Edn., 1989.
2. Hayt, W.H., J.A. Buck, "Engineering Electromagnetics", Tata Mc Graw Hill.

Reference Book:

1. Edward C. Jordan & Keith G. Balmain, "Electro-magnetic waves & Radiating System", PHI.
2. Deepak Sood, "Field & Wave, A Fundamental Approach", University Science Press.
3. S. C. Matapatra, Sudipta Mahapatra, "Principles of Electromagnetics", Tata McGraw Hill.
4. Matthew Sadiku, "Principles of Electromagnetics", Oxford University Press.
5. A. R. Harish, M. Sachidananda, "Antennas & Wave Propagation", Oxford University Press.

EE 5201 MICROPROCESSOR & MICROCONTROLLER

MODULE – I
Digital computer, Computer languages, Main frame, Mini computers, Microcomputers, Architecture of 8085 microprocessor, Functions of different pins, Bus Concept.
(5)

MODULE – II
Memory organization, Memory map, Interfacing devices, Memory interfacing, Different machine cycles
(5)

MODULE – III
Instruction set, Instruction classification, Instruction format, Addressing modes of 8085, Simple illustrative programs and flow chart, System timing diagram.
(7)

MODULE – IV
Programming techniques, Looping, Counting, Logic operations, Sorting, Counter and time delays, Stack and subroutine, Code conversion BCD to binary, Binary to BCD, Binary to ASCII and ASCII to Binary, BCD Arithmetic.
(6)

MODULE – V
Data transfer schemes, Memory mapped I/O and I/O mapping, I/O port Intel 8212 interfacing with multiplexed 7-segment LED and matrix keyboard, Intel 8255 all modes, Timer 8253/8254 Keyboard/Display Interface 8279, Control words and interfacing.
(8)

MODULE – VI
Interrupt structure of 8085, Hardware and software interrupts, EI, DI, RIM and SIM instructions, Interfacing DAC 1408 and staircase ramp and triangular wave form generation, Interfacing ADC 0801, Applications.
(6)

MODULE – VII
Introduction to microcontroller, Popular microcontroller, Applications, Architecture of 8051 microcomputer, Internal and external memories, Interrupts.
(8)

Text Books:

1. Ramesh S. Gaonkar, Microprocessor Architecture - Programming, Applications
2. Raj Kamal, Microcontrollers - Architecture, Programming, Interfacing and System Design, Pearson Education.

Reference Books:

1. Renu Singh and B. P. Singh, Microprocessors, Interfacing and Applications, New Age International Publication.
2. A.P. Malvino, Digital Computer Electronics
3. S. K. Venkatram, Advanced Microprocessor & Microcontroller
4. A. P. Mathur, Introduction to Microprocessors

EE 5203 ELECTRICAL MACHINES - II

MODULE – I

Basic Concept of A.C. Rotating Machines: Introduction to Armature winding, Integral slot and fractional slot winding, Distribution factor (Kd), Pitch factor (Kp) and winding factor (Kw). Production of rotating magnetic field, EMF and torque equations, Effect of tooth harmonics and methods of reduction.

(4)

MODULE – II

Synchronous Generator: Construction, Cylindrical rotor and salient pole rotor, Principle of operation, Excitation system, Effect of winding factor on EMF, Armature reaction, Circuit model, Phasor diagram, O.C. and S.C. tests, Short-circuit ratio, Determination of voltage regulation by synchronous impedance, MMF and zero power factor methods.

(8)

MODULE – III

Performance Characteristics of Synchronous Generator: Two reaction theory, Phasor diagram, Power-angle characteristic of synchronous generators, Synchronizing power and torque, Synchronizing methods, Parallel operation of synchronous generator, Effect of change in excitation and mechanical power input on load sharing, Operation of alternator on infinite bus bars, Slip test.

(7)

MODULE – IV

Synchronous Motor: Construction, Principle of operation, Equivalent circuit, Phasor diagram, Circuit model, Effect of change in excitation on armature current and power factor, Starting of synchronous motor, Synchronous condenser, Hunting, Applications.

(7)

MODULE – V

3-ϕ Induction Motor : Introduction, Construction, Principle of operation, Slip and rotor frequency, Comparison with transformer, Equivalent circuit model, Representation of mechanical load, No load and blocked rotor tests. Torque and power output, Losses and efficiency, Separation of losses.

(7)

MODULE – VI

Performance Characteristics of 3-phase Induction Motor: Circle Diagram, Torque-slip characteristics, Effect of rotor resistance, Starting torque and maximum torque, Starting and speed control methods, Cogging and crawling, Introduction to induction generator, Applications.

(7)

MODULE –VII

Single-phase Induction Motor: Introduction, Double revolving field theory, Crossfield theory, Torque-speed characteristic, Equivalent circuit model, Starting methods, Applications.

(5)

Text Book:

1. A.S. Langsdorf, Alternating Current Machines
2. A.E. Fitzgerald, Electric Machinery

Reference Books:

1. P. S. Bimbhra, Electrical Machines, Khanna Publishers
2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 2002.
3. P. K. Mukherjee, S. Chakravarti, Electrical Machines, Dhanpat Rai & Sons.

EE 5205 POWER ELECTRONICS

MODULE – I
Scope of power electronics, Overview of high power semiconductor switches, Two transistor analogy of SCR terminal characteristics, Rating and protection of SCR, UJT and Industrial firing circuit.

(6)

MODULE – II
Dynamic characteristics of SCR, Gate characteristics, series and parallel operation of SCR, power diodes.

(6)

MODULE – III
Single phase controlled, Half wave, Full wave rectifier with R, RL and RLE loads, Single phase semiconverter, Effect of Source impedance performance, Evaluation of converter using Fourier series analysis.

(7)

MODULE – IV
Three phase uncontrolled rectifier with resistive load, Three phase half wave, Full wave rectifiers with R-load, 3-phase semiconverter, RMS, Average value, Fourier analysis,THD, HF and PF of converter.

(6)

MODULE – V
Chopper, Introduction, Principle of operation control, Strategies, Step-up and step-down chopper, Chopper configuration, Type A,B,C,D & E chopper uses.

(6)

MODULE – VI
Single phase inverter, VSI and CSI, Analysis with R, RL, and RLC loads, 180° and 120° mode of operation of 3-phase VSI, SPM, MPM and Sinusoidal PWM techniques, Series inverters use.

(7)

MODULE – VII
AC voltage regulators, 1-phase ac voltage controller with R and RL loads, Integral cycle control. **Cycloconverters:** Introduction, The basic principle of operation, Steps up and step-down cycloconverter, Single phase to single phase cycloconverters.

(7)

Text Book:

1. M.H. Rashid, Power Electronics: Circuits, Device and Applications, 2nd Ed.n, PHI, New Jersey, 1993.
2. M.D. Singh, K.B. Khanchandani, Power Electronics, TMH, Delhi 2001.

Reference Books:

1. S.N.Singh, A Text Book of Power Electronics, Dhanpat Rai & Co., New Delhi 1st Edn., 2000.
2. Mohan, Underland, Robbins; Power Electronics Converters, Applications and Design, 3rd Edn., 2003, John Wiley & Sons Pte. Ltd.
3. R.S. Ramshaw, Power Electronics Semiconductor Switches, 2nd Edition, 1993, Chapman & Hall, Chennai.
4. V.R. Murhty, Power Electronics, Oxford Publishers.

EE 5207 POWER SYSTEM - I

MODULE – I

Introduction: Structure of a power system, Effect of transmission voltage, Different curves: load curves, Load duration curve, Different factors for Power plant operation: Demand factor, Load factor, diversity factor, plant capacity factor, plant utilisation factor, cost of electrical energy, different types of tariff: simple type, flat rate types, bulk rate, two part, three-part tariff, availability based tariff.

(9)

MODULE – II

Constants of O/H lines: Types of conductors, bundle conductor, resistance calculation, skin effect, inductance and capacitance of overhead lines: Inductance and capacitance of single phase and three phase line, Transposition, Double ckt. three phase lines.

(7)

MODULE – III

Over head line insulators: Types of insulators, potential distribution over a string of suspension insulators, methods of enhancing string efficiency, Underground cable: types, extra high voltage cables: electrostatic stresses, grading of cables.

(7)

MODULE – IV

Mechanical design of transmission line: Sag tension, length calculation, effect of wind and ice loading. corona effect.

(5)

MODULE – V

Distribution Systems: Feeders, distributors, and service mains, redial and ring main system, different types of DC and AC distribution systems, calculation.

(7)

MODULE – VI

Transmission System: Performance of transmission line, representation of short, medium and long transmission lines, Ferranti effect, SIL, Tuned Power Line, Power flow through transmission lines.

(7)

MODULE – VII

Voltage control: Dependency on reactive power, method of reactive power injection at load end.

(3)

Text Books:

1. Power System Analysis – Hadi Saadat, Tata McGraw-Hill Edition.
2. Electric Power System – C. L. Wadhwa, New Age International Publishing.

Reference Books:

1. Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, Tata-McGraw Hill.
2. Electric Energy Systems Theory - An Introduction – O. I. Elgerd, TMH Edition.
3. Power System Engineering – A. Chakrabarti, M. L. Soni, P. V. Gupta, U. S. Bhatnagar, Dhalpat Rai & Co.

EE 6201 CONTROL THEORY

MODULE – I

Introduction: Examples of control systems and applications, Basic components of control systems, Open loop and closed loop control systems, Effect of feedback on overall gain, Stability and external disturbances, Classification of control system : Linear and nonlinear continuous and digital, Time invariant and time varying, Minimum phase and non-minimum phase systems etc. Linearization of nonlinear systems using Taylors series.

MODULE – II

Block Diagrams and Signal Flow Graph: Block diagrams of control systems, Block diagram reduction, Signal Flow Graph (SFG)- Basic properties of SFG, SFG algebra, Gain formula to SGP, Application of gain formula to block diagrams.

MODULE – III

Time Response of Control Systems: Transient and steady state response, Time response specifications, Typical test signals, Steady state error, and error constant, Stability- Absolute, relative and conditional stability, Dominant poles of transfer function.

Root Locus Methods: Root locus concept, Properties and construction of root locus, Determination of relative stability from root locus, Root sensitivity to parameter variation, Root contours, Systems with transportation lag and effect of adding poles or zeros.

MODULE – IV

Bode Analysis and Introduction to Design: Frequency response specifications, Correlation between time and frequency domain Bode plot, Determination of stability using Bode plot, Introduction to design, lead, lag & lead-lag compensation.

MODULE – V

Other Frequency Domain Tools: Nyquist stability criterion, Theory of Magnitude phase plot, Constant M, constant N circle and Nichols chart.

MODULE – VI

Control System Components and Basic Control Actions: Sensors and encoders in control system, Potentiometer, Tachometers, incremental encoders, Synchros, Operational Amplifiers, Basic control actions: on-off control, P, PI, PD and PID.

MODULE – VIII

Concepts of State, State Variables: Development of state-space models. State and state equations, State equations from transfer function Transfer function from state equations, State transition matrix.

Text Books:

1. I. J. Nagrath & Gopal, "Control Systems Engineering", 4th Edition New Age International Publication.
2. K. Ogata, "Modern Control Engineering", 3rd Edition, Pearon Education.

Reference Books:

1. Norman Nise, "Control System Engineering, 4th Edition, Wiley.
2. Graham C. Goodwin, "Control System Design", PHI.
3. B. C. Kuo, "Automatic Control System", 7th Edition, PHI.

EE 6203 POWER SYSTEMS - II

MODULE – I

Per unit system representation, Reactance diagram, impedance diagram.

(5)

MODULE – II

Load flow Analysis: Load flow problem, Y_{bus}, Formulation of problem, Solution technique using Gauss- Siedal method.

(7)

MODULE – III

Symmetrical Short Circuits Analysis: Short circuit of a Synchronous machine on no load, Short circuit of loaded synchronous machine, Thevenin's equivalent circuit approach for short circuit analysis.

(7)

MODULE – IV

Symmetrical Components: Transformation, Phase shift in star-delta transformer, Sequence impedance and sequence networks of transmission line, Synchronous machine, Transformer and power system.

(8)

MODULE – V

Unsymmetrical Short Circuits: Symmetrical component analysis of unsymmetrical short circuits, Single line to ground fault, Double line to ground fault and line to line fault.

(7)

MODULE – VI

Power system stability problem, Swing equation, System response to small disturbances, Power angle equation and diagram

(6)

MODULE – VII

Transient stability, Equal area criterion, Measures for improving transient stability.

(5)

Text Books:

1. Stevenson and Grainger, Power system Analysis
2. Olle I. Elgerd, Electric Energy Systems Theory an Introduction

Reference Books:

1. Nagrath – Kothari, Modern Power System Analysis
2. C. L. Wadhwa, Electrical Power systems
3. B. R. Gupta, Power System Analysis

EE 6205 INDUSTRIAL DRIVES & CONTROL

MODULE – I

Electrical Drives: An Introduction, Parts of Electrical Drives; ac and dc Drives, fundamental torque equations, Speed torque conventions and multi-quadrant operation; calculation of equivalent drive parameters, Different load torques and their nature; steady state stability; load equalization.

(6)

MODULE – II

Selection of Motor rating and its control: Introduction, thermal model of a motor, Classes of Motor Duty cycle, selection of motor and its rating, Closed-loop and open loop control of drives, Modes of Operation; speed control & Drive classifications; closed - loop control of Drives; speed and current sensing; manual, semi-automatic & automatic control.

(6)

MODULE – III

D.C. Motor Drives: Introduction, Performance characteristics of DC Motors & their Modifications; Starting of DC motors & their Design, Electric Braking; Speed Control of DC motor; Converter controlled DC Drives; Single phase converter drives, three phase converter drives, Dual converter drives, Chopper controlled dc drives, Closed loop control of dc motor, selection of components and their specifications for Dc drives.

(6)

MODULE – IV

Phase Controlled Induction Motor Drives: Introduction, Speed-torque characteristics, Starting & Braking of IM; effects of unbalancing and harmonics on IM, Speed Control techniques, Stator voltage control, Closed Loop schemes for phase controlled IM drives, Rotor resistance control, Slip speed control, Slip power recovery schemes.

(6)

MODULE – V

Frequency Controlled Induction Motor Drives: Scalar control, Variable frequency control, constant volts/Hz control, Voltage source inverter (VSI) control using PWM techniques, Closed Loop speed control of VSI drives, Control from a current source Inverter(CSI), Closed Loop speed control of CSI drives, Comparison of CSI and VSI drives. Selection of components and their specification for AC drives.

(6)

MODULE – VI

Synchronous Motor Drives: Starting, Pull-in and Braking with Fixed Frequency Supply; Variable Speed Drives, Cyclo-converter based Synchronous motor control, control of Trapezoidal PMAC motor, Close loop speed control of Synchronous Machines.

(5)

MODULE – VII

Traction System: Introduction, Requirements of ideal Traction system, supply system for electric traction, Mechanism of train movement, Tractive efforts, energy consumption. Co-efficient of adhesion, traction motors starting, braking of Traction motors. Converter controlled drives for Traction Motor, Chopper controlled DC traction drives. Voltage source inverter (VSI) controlled AC traction drives, Load commutated inverter fed synchronous motor drivers for traction, Diesel electric traction drives.

(8)

Text Book:

1. G.K. Dubey, Fundamentals of Electrical Drives, Narosa publication, New Delhi
2. R. Krishnan, Electric Motor Drives-modeling, analysis and control.

Reference Books:

1. S.K.Bhattacharya & Brijinder Singh, Control of Electrical Machines
2. Mukhtar Ahmad, Industrial Drives and Control
3. S.K.Pillai, A first course on Electrical Drives
4. M. Chilikin, Electric Drives.
5. C. L. Wadhwa, Genaration Distribution and Utilization of Electrical energy

EE 7203 SWITCH GEAR AND PROTECTION

MODULE – I

Circuit Breakers: Arc voltage, Mechanism of arc interruption, Restriking voltage and recovery voltage, Classification of CBs, Oil CBs, Air CBs, Vacuum CBs, Sf6 CBs, HVDC CBs, Rating and Testing of CBs.

(15)

MODULE – II

Protective Relaying: Introduction to protective relaying, Thermal relay, Over current relay, Directional relay, Differential relay.

(4)

MODULE – III

Transmission Line and Feeder Protection: Over current and directional relay applications, Distance protection using impedance relay, Reactance relay, MHO relay.

(5)

MODULE – IV

Generator Protection: Protection against stator and rotor faults and abnormal operating conditions such as unbalanced loading, loss of excitation, Over speeding.

(6)

MODULE – V

Transformer Protection: Types of faults, Over current protection, Differential protection, Differential relay with harmonic restraint, Protection against high resistance ground faults, Interturn faults, Bucholz relay.

(5)

MODULE – VI

Introduction Motor Protection: Protection against phase fault, ground fault and abnormal operating conditions such as single phasing, Phase reversal and overloading.

(5)

MODULE – VII

Introduction to Carrier: Aided Protection and Numerical Protection

(5)

Text Books:

1. Power System Protection & Switch Gear : Badriram and Vishwa Karma, TMH Publications.
2. Switch Gear and Protection Sunil S. Rao, Khanna Publications

Reference Books:

1. Power System Protection & Switch Gear: Ravindranath & Chander, New Age Publications.
2. The Art and Science of Protective Relaying: C. Russel Mason, Wiley Bastern Ltd.

ELECTIVE – I

EE 7211 COMPUTER AIDED POWER SYSTEM ANALYSIS

MODULE – I

Introduction: The new computer environment, Basic single-phase modeling- Generator, Transmission lines, Transformer- Off nominal transfer tap representation, Phase shifting representation.

(4)

MODULE – II

Load Flow Analysis: Introduction, Nature of load flow equations, Computational steps and flow chart of Gauss Seidal Techniques, Newton Raphson method: Formulation for load buses and voltage controlled buses in rectangular and polar co-ordinates, Computational steps and flow chart.

(7)

MODULE – III

Computational Aspects of Large-Scale System: Sparsity of Y_{bus} and Jacobian matrix, Sparsity oriented computer programming, Reducing storage requirement, Decoupled power flow algorithm.

(4)

MODULE – IV

Optimal System Operation: Introduction, Characteristic of steam and hydro units, Economic dispatch of thermal units, Equal incremental cost operation, Computational steps, Transmission loss and incremental transmission loss (ITL), Computational aspects.

(7)

MODULE – V

Unit Commitment: Introduction, Objective function, Constraints, Dynamic programming method.

(4)

MODULE – VI

Short Circuit Analysis: Introduction, Bus impedance matrix and its building algorithm through modifications, Symmetrical and unsymmetrical fault calculation using Z_{bus} and its computational steps.

(8)

MODULE – VII

Power System Stability: Stability problem, swing equation and its numerical solution, Determination of initial state in a multimachine system, Base case Y BUS and modified Y BUS, Computational algorithm, Improvement of stability.

(6)

Text Books:

1. Power System Analysis - John J. Grainger, William D. Stevenson, Jr.
2. Power System Analysis - L. P. Singh

Reference Books:

1. Electric Energy Systems Theory - An Introduction, O.L. Elgerd.
2. Computer Modelling of Electrical Power Systems - J. Arrillaga, N.R. Watson
3. Power Generation Operation and Control - A.J. Wood, B.F. Wollenberg

EE 7213 MICROPROCESSOR APPLICATIONS

MODULE – I & II

Architecture and Application oriented assembly language programming on Intel 8086/8088 family of microprocessors on a P.C. Assembly language programming using DOS and BIOS function calls, using keyboard, display, I/O, Printer, and RS232C port functions.

(12)

MODULE – III

Assembly programming using MASM with code view facility with all assembler directives, source level debugging and use of watch windows to identify programme errors. Programming the Numeric processor (Intel 8087 NDP)

(8)

MODULE – IV & V

Architecture and Application oriented programming, using MC 68000 family of processors. Use of development systems, Assembling, linking and debugging.

(12)

MODULE – VI & VII

Architecture and Assembly language programming using Z-80 family of microprocessors, Real time Emulation, and simulation for application programmes, Programme development, hardware configuration and software design examples using:

A/D - D/A interface with processors.
I/O - interfacing using Intel 8255, MC 6820 - 6822, Z-80 PIO.
Video I/O using MC 6845 or Intel 8275.
Serial I/O using Intel 8251/Z-80-CTC.
Floppy disk controller Intel 8272.
Dynamic RAM Controller Intel 8202 family.
DMA Controller Intel 8237 Chip

(13)

Text Books:

1. Liu, Yu-Chang and Gibson, Glenn, A., "Microcomputer Systems, The 8086/8088 Family", PHI, New Delhi.
2. Leventhal, L.A., et al., "68000 Assembly Language Programming", Second Edition, Osborne Mc-Graw-Hill International Editions, Berkley, California, USA.
3. Osborne, Adan and Kane, Jerry, "An Introduction to Microprocessors," Volume-2, Parts A and B, Galgotia Book Source, Publishers, P.O. Box 688, New Delhi - 110001.
4. Douglas V. Hall, "Microprocessors and Interfacing: Programming Hardware", First/Second Edition, TMH Publishing Company Ltd., New Delhi.

EE 7215 BIO-ELECTRONICS INSTRUMENTATION

MODULE – I

Introduction, Medical instrumentation system Man instrumentation system, Brief idea of cardiovascular, Nurvous & respiratory system.

(6)

Text Books:

1. Biomedical Instrumentation & Measurements by Cromwell.
2. Biomedical instrumentation by Dr. M. Arumugham.
3. Medical electronics & Biomedical instrumentation by Rajaraw & Guha.

MODULE – II

Resting & action potential, Polarization & depolarisation, Propagation & action potential, Bioelectronic potential.

(6)

Text Books:

1. Biomedical Instrumentation & Measurements by Cromwell.
2. Biomedical instrumentation by Dr. M. Arumugham.
3. Medical electronics & Biomedical instrumentation by Rajaraw & Guha.

MODULE – III

Biopotential electrode, Active & passive transduces, biochemical transduces.

(7)

Text Books:

1. Biomedical Instrumentation & Measurements by Cromwell.
2. Biomedical instrumentation by Dr. M. Arumughan.
3. Medical electronics & Biomedical instrumentation by Rajaraw & Guha.

MODULE – IV

ECG electrodes & leads, Measurement of blood pressure, blood flow & heart sounds.

(5)

Text Books:

1. Biomedical Instrumentation & Measurements by Cromwell.
2. Biomedical instrumentation by Dr. M. Arumughan.
3. Medical electronics & Biomedical instrumentation by Rajaraw & Guha.

MODULE – V

Noninvasive instrumentation, Patient monitoring system, Electrical safety of patients in hospital, defi pace maker

(6)

Text Books:

1. Biomedical Instrumentation & Measurements by Cromwell.
2. Biomedical instrumentation by Dr. M. Arumughan

MODULE – VI

Amplifiers & recorders, Diathermy (Microwave) structure & ultrasonic), imaging system (X-ray, MRI & ultrasonic), lasers in medicine.

(8)

Text Books:

1. Handbook for Biomedical instrumentation by Khandpur.
2. Medical instrumentation by Rajarao.
3. Medical instrumentation (application & design) by Webstar.
4. Medical instrumentation by Carr & Brown

MODULE – VII

Biomedical DSP

Text Books:

1. Antenna Theory & practice by R. Chatterjee
2. Biomedical digital signal processing by Wills J. Tompkin.

EE 7217 NEURAL NETWORKS

MODULE – I

Introduction: Brain & Machine, Biological Neurons & its mathematical model, Artificial Neural Networks, Benefits and Applications, Architectures, Learning Process (paradigms & algorithms), Correlation Matrix Memory, Adaptation.

(6)

MODULE – II

Supervised Learning I: Pattern space and Weight space, Linearly & non Linearly separable classes, Decision Boundary, Hebbian learning & limitation, Perceptron, Perceptron convergence theorem, Logic Functions implementations.

(6)

MODULE – III

LMS Algorithm: Wiener-Hopf equations, Steepest Descent Search method, LMS algorithm, Convergence consideration in mean & mean square, Adaline, Learning curve, Learning rate annealing schedules.

(7)

MODULE – IV

Supervised Learning II: Multilayer Perceptrons, Backpropagation algorithm, XOR Problem, Training modes, Optimum learning, Local minima, Network Pruning techniques.

(7)

MODULE – V

Unsupervised Learning: Clustering, Hamming Networks, Maxnet, Simple competitive learning,Winner-Take-All Networks, Learning Vector Quantizers, Counterpropagation Networks, Self Organising Maps (Kohonen Networks), Adaptive Resonance Theory.

(6)

MODULE –VI

Associative Models: Hopfield Networks (Discrete and continuous), Storage capacity, Energy Function & minimization, Brain-State-in-a-Box Neural Network.

(6)

MODULE – VII

Applications of ANN & Matlab Simulation: Character Recognition, Control Applications, Data compression, Self organizing semantic Maps.

(7)

Text Books:

1. Neural Networks: A Comprehensive Foundation – Siman Haykin. (Pearson Education).
2. Elements of Artificial Neural Networks – Kishan Mehrotra, Chilukuri K. Mohan, Sanjay Ranka. (Penram International Publishing, India)

Reference Book

1. Neural Networks: A Classroom Approach – Satish Kumar, Tata McGraw Hill

MEE 1119 CONTROL SYSTEM DESIGN

Module 1:
Performance characteristics of feedback control system & design specification of control loop. Different types of control system applications and their functional requirement. Derivation of load-locus (toque/ speed characteristics of load). Selection of motors, sensors, drives. Choice of design domain & general guidelines for choice of domain. Controller configuration and choice of controller configuration for specific design requirement. Fundamental principles of control system design. Experimental evaluation of system dynamics in time domain and frequency domain.

Module 2:
Design with PD Controller: Time domain interpretation of PD controller, frequency domain interpretation of PD controller, summary of the effects of PD controller. Design with PI controller: Time domain interpretation of PI controller frequency domain interpretation of PI controller, summary of the effects of PI controller, design with PID controller, Ziegler Nichols tuning & other methods.

Module 3:
Design with lag/lead/lag-lead compensator, time domain interpretation of lag/lead/lag-lead compensator, frequency domain interpretation of lag/lead/lag-lead compensator, summary of the effects of lag/lead/lag-lead compensator.

Module 4:
Forward & feed-forward controller, minor loop feedback control, concept of robust design for control system, pole-zero cancellation design.

Module 5:
Sate feedback control, pole placement design through state feedback, state feedback with integral control, design state observer.

Module 6:
Design of Discrete Data Control System: Digital implementation of analog controller (PID) and lag-lead controllers, Design of discrete data control systems in frequency domain and Z plane.

Module 7:
Hardware and Software Implementation of Common Compensator: Physical realization of common compensator with active and passive elements, tunable PID algorithms- position and velocity algorithms.

Text Books:

1. B.C. Kuo, "Automatic Control System", 7th Edition PHI.
2. M. Gopal, "Control Systems Principles & Design", 2nd Edition, TMH.
3. J.G. Truxal, "Automatic Feedback Control System", McGraw Hill, New York.
4. K. Ogata, "Discrete Time Control Systems", 2nd Edition, Pearson Education.

Reference Books:

1. Norman Nise, "Control System Engineering", 4th Edition.
2. M. Gopal, "Digital Control & State Variable Method", TMH.
3. B.C. Kuo, "Digital Control System", 2nd Edition, Oxford

MEE 1151 ADVANCED POWER ELECTRONICS

Introduction:

Power Electronic Devices: (Diodes, Thyristors), Transistors, MOSFET, IGBT, IGCT, etc.- operating principle, Static & dynamic characteristics, Data sheet ratings; Thermal characteristics of power devices; Sample Gate drive circuits;

(5)

Switched Mode Power Supply:

Forward and flyback converter circuits: operation, waveforms analysis, small signal analysis of DC-DC converters and closed loop control.

(5)

Resonant Converters: Operating principle, waveforms analysis, switching trajectory, losses and control.

(4)

PWM inverter modulation strategies & dual bridge:

Sine wave with third harmonic, space vector modulation and predictive current control techniques; PWM rectifier; Input side bidirectional power flow requirement for regeneration & Dual thyristor bridge.

(5)

AC-AC Converter :

Cycloconverters: Circuit, operating principle, control, harmonics, power factor and applications; Non-drive application of power electronic converters: Matrix Converter- circuit and its operation.

(5)

Multi- level inverter :

Basic topology and waveform, improvement in harmonics and high voltage application;

(5)

Introduction to application oriented chips:

Industrial PWM driver chips for power supplies such as UC 3843, 3825 or equivalent; Industrial gate driver chips for PWM voltage source inverters with isolation and protection circuits. Intelligent power modules.

(4)

Reference Books:

1. Power Electronics, circuits, devices & applications- M.H. Rashid
2. Power Electronics: converter, application & design- N. Mohan, T.N. Undeland & Robins
3. Electric Motor Drives- R. Krishnan
4. Modern Power Electronics & Drives-B.K. Bose

ELECTIVE II

EE 8211 INFORMATION TECHNOLOGY

INTRODUCTION
MODULE – I
Definition and Components of Information Technology: It's Need and Role in Technological/ Commercial/ Rural/ Industrial/ Socio-economic Developments, Entertainment Industies, and in sectors like: Education, Defence, Communication, Stock Exchange, Banking, Biomedical, Nuclear, Judiciary, Police & Intelligence Network, Central & State Governments, etc.

(2)

INTERNET (COMPUTER NETWORKS)
MODULE – I & II
Network Structures: Network Architectures - The QSI Reference Model - Connection - Oriented and connectionless Services - Transmission Media - Wireless, Analog and Digital Transmission - Transmission and Switching - Basic ISDN Concept - LAN, MAN & WAN - IEEE Standard 802 for LANs - Fibre Optic Networks - Satellite Networks - Data Link Layer Design Issues, Error Detection and Correction - HDLC Protocol - Network Layer Design Issues - Internetworking and OSI (Bridges, Gateways, etc.) - The Global Internet - TCP/IP Protocol.

(9)

(Contents Ref.: [1] - Ch. 1, 2, 3, 4, 5, 6.4)

MODULE – III & IV
Client/Server Models: Names for Computers in Internet - Services Available on the Internet (E-mail, E-com, Network News, FTP, TELNET, Browsing the Worldwide Web, World Wide Web Documents (HTML), Advanced Web Technologies, Automated Web Search, Audio and Video Communication, Global Digital Library etc.) - Main Features of some Example Internet Services - Security of Internet Services (Public Key Cryptography, Authentication and Digital Signatures).

(8)

Ref.: [1] - Ch. 7.1; [2] Ch. 9, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27)

MULTIMEDIA
MODULE – V
Elements of Interactive Computer Graphics for Multimedia: Primary and Secondary Colours - Beam Penetration Type Color CRT - Refresh Display Processors - Random Scan Line Displays - A Simple Graphics Package - Display Files - Graphical Input Devices and Techniques - Event Handling - Input Functions - Raster Display Hardware and Scan Conversion.

(6)

(Contents Ref.: [3] - Ch. 2, 3, 6, 7, 11, 12, 13, 14, 15, 19)

MODULE – VI
Multimedia Hardware & Software: Multimedia & Windows - Multimedia Hardware (Equipment, CD-ROM Drive, Sound Card, Sampling, Screen Display, Image Capture Card, etc.) - Sound Characteristics, Digital Audio, MIDI, & Media Player - Recording, Editing and Playing Back Sounds - Recording and Playing Back Images, Graphics, Video and Animation - Video Compression Methods - Using CD-ROMs - Hypermedia and Hypertext - Creating a Multimedia Presentation - Authoring Software- Internet and Multimedia.

(9)

(Contents Ref.: [4] - Ch. 1, 2, 4, 5, 6, 7, 8, 9)

EXPERT SYSTEMS, KNOWLEDGE-BASED INDUSTRIES & INTERNET
MODULE – VII
Definition and Artificial Intelligence: Representation in AI - Properties of Internal Representation - First Order Predicated Calculus - Inferences - Abduction - Induction - Indexing - Semantic Networks - Isa Hierarchy - Slot Assertion Notation - Frame Notation - Context Free Grammars - Top-Down & Bottom-up Syntactic Parsing -Knowledge-base/Databases - Rule-based Programming - Expert Systems Design and On Line Information Retrieval.

(9)

(Contents Ref.: [5] - Ch. 1, 4, 7. 6; [6] - Ch. 1, 6)

A PARADIGM
MODULE – VIII
Information Technology as a Tool and Backbone for Modern Education System

(2)

Text Books:

1. Tanenbaum, Andrew. S, "Computer Networks", Third Edition, Prentice-Hall of India, Pvt. Ltd., New Delhi, India.
2. Comer, Douglas E., "The Internet Book", Second Edition Prentice-Hall of India Pvt. Ltd., New Delhi, India.
3. Newman, William M. and Sproull, Robert F., "Principles of Interactive Computer Graphics", Second Edition, McGraw-Hill International Book Company, New Delhi, India.
4. Collin, Simon, "Multimedia Made Simple", Asian Books Pvt. Ltd., New Delhi, India.
5. Charniak Eugene and McDermott, Drew, "Introduction to Artificial Intelligence", Addison-Wesley Publishing Company, California, U.S.A.
6. Morris, Anne, Editor, "The Application of Expert Systems in Libraries and Information Centres", Bowker-Saur, New York, U.S.A.

EE 8213 ROBOTICS

MODULE – I

Introduction of Robotics: Evolution of Robots and Robotics. What is and what is not a robot. Robot classification. Robot specifications. Robot applications. Direct Kinematics: Coordinate frames; Rotations; Homogeneous coordinates; D-H representation; The Arm Equation.

(10)

MODULE – II

Inverse Kinematics: Inverse kinematics problem. General properties of solutions. Tool configuration. Robotic work cell.

(4)

MODULE – III

Workspace Trajectory and Trajectory Planning: Workspace analysis. Workspace envelope. Workspace fixtures. Pick and place operation. Continuous-path motion. Interpolated motion. Straight line motion.

(5)

MODULE – IV

Control of Robot Manipulators: Computed torque control; Near Minimum time control; Variable structure control; Non-Linear decoupled feedback control; Resolved motion and Adaptive control.

(4)

MODULE – V

Robotic Sensors: Different sensors in robotics: Range; Proximity; Touch; Torque; Force and others.

(3)

MODULE – VI

Robotic Vision: Image acquisition. Imaging geometry, Image processing: Preprocessing; Segmentation and Description of 3-D structures; Recognition and interpretation.

(8)

MODULE – VII

Robot Programming Languages: Characteristics of Robot level languages. Task level languages: Task planning; Problem reduction; Use of predicate logic; Robot learning; Expert systems.

(4)

Text books:

1. Fundamental of Robotics: Analysis and Control- Robert J. Schilling.
2. Robotics: Control, Sensing, Vision and Intelligence- K. S. Fu, R.C. Gonzalez and Lee.

Reference Books:

1. Robotics and Control – R. K. Mittal and I. J. Nagrath.

EE 8215 HIGH VOLTAGE ENGINEERING

MODULE – I

Introduction: Electric Field Stresses, Gas/Vacuum as Insulator, Liquid Breakdown, Solid Breakdown, Estimation and Control of Electric Stress

(3)

MODULE – II

Conduction and Breakdown in Gases: Gases as Insulating Media, Ionization Processes, Townsend's Current Growth Equation, Townsend's Criterion for Breakdown, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges, Post-Breakdown Phenomena and Applications, Vacuum Insulation.

(6)

MODULE – III

Conduction and Breakdown in Liquid: Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure and Commercial Liquids.

MODULE – IV

Conduction and Breakdown Solid Dielectrics: Introduction, Intrinsic Breakdown, Electromechanical and Thermal Breakdown, Breakdown of Solid Dielectrics in Practice, Breakdown in Composite Dielectrics.

(10)

MODULE – V

Generation and Measurement of High Voltage and Currents: Generation of High dc voltages, Generation of High alternating voltages, Generation of impulse voltages, Generation of impulse currents, Tripping and control of impulse generators.

(10)

MODULE – VI

Generation and Measurement of High Voltage and Currents: Measurement of High direct current voltages, Measurement of High ac and impulse voltages, Measurement of High impulse currents.

MODULE – VII

Design, Planning and Layout of High Voltage Laboratories: Introduction, Test Facilities provided in high voltage laboratories, Activities and studies in high voltage laboratories, Classification of high voltage laboratories, Size and Rating of large size high voltage laboratories, Grounding of impulse testing laboratories

(3)

Text Book:

1. High Voltage Engineering, MS Naidu and V. Kamaraju, TMH New Delhi.
2. High Voltage Engineering Fundamentals, E. Kuffel and WS Zaengl, Pergamon Press, Oxford.

Reference Book:

1. High Voltage Engineering, CL Wadhwa, New Age International (P) Limited, Publishers, New Delhi**.**
2. Electrical Breakdown of Gases, JM, Meek and JD, Crages, John Wiley, New York.

EE 8217 EHV POWER TRANSMISSION

MODULE – I
Mexwell's coefficients, Sequence inductance and capacitance, Charge Matrix, Effect of Ground wire.

(6)

MODULE – II
Surface Voltage-gradient on bundled conductors, Mangoldt's formula, Gradient factors & their use, Ground level electrostatic field of EHV lines.

(6)

MODULE – III
Power frequency over-voltage control, Series and shunt compensation, Generalised Constants of Compensated line, Static Var Compensators (SVC/SVS).

(7)

MODULE – IV
Switching over-voltages in EHV Systems

(6)

MODULE – V
Six-pulse Bridge Circuit: waveforms and relevant equations, Twelve-pulse converter, Advantages of higher pulse number, Bipolar to monopolar operation, Converter performance with phase control, Commutation and effect of reactance.

(8)

MODULE – VI
Introduction to HVDC Transmission system, Economical advantages, Technical advantages, Critical distance, Submarine transmission.

(5)

MODULE – VII
Inverter, Equivalent circuit of HVDC system, Schematic diagram, Reactive power consideration in HVDC system, Harmonics, Filters in HVDC system.

(7)

Text Books:

1. Extra High Voltage AC Transmission Engineering (2nd Ed.) by R.D. Begamudre, Wiley Eastern Ltd.
2. HVDC Power Transmission Systems by K. Padiyar, Wiley Eastern Ltd.

Reference Books:

1. EHV AC and HVDC Transmission Engineering and Practices by S.S. Rao, Khanna Publications.

EE 8219 FUNDAMENTALS OF COMMUNICATION SYSTEM

MODULE – I

Representation of Signals and Systems: Fourier series, Fourier Transform, Properties of Fourier Transform, Signal power and power spectral density, Signal energy and energy spectral density, Dirac delta function and its applications, Elements of a Communication system, Block diagram of digital communication system

MODULE – II

Amplitude Modulation Systems: Basics of Amplitude modulation, Square law modulator, Switching modulator Square law demodulator, Envelop Detector, Double side band suppressed carrier modulation. Balanced and Ring Modulators, Coherent modulator, Quadrature Amplitude Modulation.

MODULE – III

Amplitude Modulation Systems (Continued) : Single side band modulation, Frequency Discrimination and phase discrimination modulators, Coherent detection of SSB, Introduction to Frequency Division Multiplexing and Time Division Multiplexing, Superheterodyne AM receiver and its characteristics.

MODULE – IV

Angle Modulation Systems: Basic of Frequency and phase modulation, Single tone frequency modulation, NBFM, WBFM, Transmission bandwidth of FM wave, Indirect and Direct methods of FM generation, Frequency Discriminator, phase locked Loop demodulator, Super heterodyne F.M. receiver.

MODULE – V

Digital Modulation Techniques: Sampling Quantization, PCM, DPCM, DM, ADM

MODULE – VI

NOISE: Short Noise, Thermal noise, White Noise, Noise figure, Noise figure of an amplifier, Noise figure of amplifiers in cascade, Noise temperature, Noise Equivalent Bandwidth, Noise due to several amplifiers in cascade.

MODULE – VII

Digital Modulation Techniques: Binary modulation, generation and detection of binary modulated wave, DPSK, QPSK, Matched filter, satellite Communication System, Transponder.

Text Books:

1. Communication Systems", 2/e, S.Haykin.
2. Communication Systems", 2/e, B. P. Lathi, 1968.

Reference Book:

1. Communication Systems Engineering by John G. Proakis and Masoud Salehi, Pearson Education.
2. Principals of Communication Systems 2/e, by H. Taub and D L Schilling, Tata McGraw Hills New Delhi.
3. Communication Systems", 3/e, S. Haykin.

EE 8221 UTILISATION OF ELECTRICAL POWER

MODULE – I

Electric Traction: Introduction, Requirements of Ideal Traction System Supply system for electric traction, Train movement Energy consumption. Co-efficient of adhesion, The traction motors starting, Breaking of Traction motors.

(6)

MODULE – II

Speed Control of Traction Motor: Semiconductor converter controlled drives of Traction Motor, Chopper controlled DC traction motor drives. PWM Voltage source inverter (VSI) Induction motor drives, Load commutated inverter fed synchronous motor drivers, CSI squirrel Cage IM drive, PWM VSI Squirrel cage IM drive. Drives of Diesel Electric Traction Motors: Diesel Engine driven D.C Generator Feeding dc series motors. Diesel Engine driven three-phase alternator supplying dc motors.

(8)

MODULE – III

Heating & Welding: Introduction, Different methods of heating, Temperature control of resistance furnace, Induction heating, Dielectric heating, Electric welding, Different welding methods, current control of welding transformer, Ultrasonic and laser welding.

(7)

MODULE – IV

Illumination: Introduction, Nature of radiations, Definitions. Polar curve, Laws of Illumination, Luminous Efficacy, Source of light, Incandescent, Vapour, Flourescent Lighting calculations, Flood lighting, Street lighting.

(7)

MODULE – V

PLC: Introduction, Ladder diagram fundamentals of PLC: Introduction, Basic components and their symbol, Fundamentals of ladder diagram. PLC configurations. System Block Diagram, Update-solve the ladder Network.

(6)

MODULE – VI

Fundamental PLC Programming: Physical components Vs. Programme components, Internal Relays, Disagreement circuit. Ladder programme, Execution sequence, Flip-Flop circuits, Mnemonic programming code: AND ladder rung, Entering normally closed contracts, OR ladder rung, Simple branches, Complex branches.

(6)

MODULE – VII

Motor Control Circuit Components, Interlocking methods for reversing control, Sequence control, Schematic and wiring diagram for motor control circuits, Remote control operation of an IM, Motor driven pump for a water tank, automatic water level control, Sequence operation of motors with interlocking arrangements.

(6)

Text Books:

1. Generation, Distribution and Utilisation of Electric Power C.L. Wadhwa, Wiley - 1993.
2. Electrical Design and Estimating and costing - K.B.Raina and S.K.Bhattacyarya, Wiley Delhi - 1993.
3. Fundamentals of Electrical Drives , G.K.Dubey , Narosa publication,New Delhi

Reference Books:

1. Utilization of Electric Power, N.V. Suryanarayana, Wiley - 1994.
2. Utilization of Electric Power - Taylor.

EE 8223 ARTIFICIAL INTELLIGENCE

MODULE – I

Introduction: Basic definitions and concept of Artificial Intelligence (AI) – Representations in AI – Properties of Internal representation – The predicate calculus – Indexing, pointers, Alternative notations etc.

(5)

MODULE – II

Lisp Language: LISP style – Atoms and Lists-Building up Lisp structure – Basic LISP Primitives – Definitions, Predicates, Conditionals and Binding – The FOR function – Recursion and Iteration – Association lists, Properties and Data Abstraction – Definition Using Lambda – Scope of Variables – Printing and Reading – Input/ Output Optional. Parameters, Macros and Backquote – List storage, survey and reclamation, etc.

(10)

MODULE – III

Parsing Language: Rules of syntax – Syntactic parsing (Top – Down and Bottom – up parsing, Transition Network Parsers) – The Interpretation of Definite Noun phrases – Case grammer and meaning of verbs syntactic use of semantic knowledge- organization of operating, etc.

(6)

MODULE – IV

Search: Search problems – search tree with state evaluation numbers – A general purpose search algorithm – Depth first and breadth first search algorithms – Function as data in LISP.

(5)

MODULE – V

Logic and Deduction: Using predicate calculus – forward chaining and unification – Skolenization – Backward chairing – Nonmonotonic reasoning.

(6)

MODULE – VI

Memory Organization And Deduction: The importance of memory organization and approaches – Data Dependencies – Reasoning Involving Time – Spatial Reasoning – Rule Based Programming.

(6)

MODULE – VII

Learning: Learning as Induction – Failure Driven Learning – Learning by being told.

(3)

Special Topics: Abduction and causation and evidence– Expert systems– AI and Robotics

(4)

Text Books:

1. Charnaik, Eugene and McDermott, Drew, "Introduction to Artificial Intelligence", Addison-Wesley Publishing Co., Mento Park, California, U.S.A.
2. Winston, Patric Henry and Horn, Berthold K.P., "LISP", Second Edition.
3. Artificial Intelligent System - Padhy, Oxford Publishers

MEE 2115 EMBEDDED SYSTEM AND APPLICATION

MODULE – I

Microcontrollers and their architecture: Introduction, general architecture of microcontrollers and microprocessors, types of microcontrollers, embedded processors. Overview of the 8051 family. 8051 architecture- memory organization, registers and I/O ports. Addressing modes , instruction sets, and assembly language programming. Introduction to C programming in 8051, Watchdog timer, Power down mode: idle/sleep mode.

MODULE – II

Interfacing: Programming timer/counter Interrupts- handling and programming. Serial communication using 8051-Interfacing with RS232. 8051 interfacing with keyboard, ADC, DAC, and LCD module interface. Application of microntroller for square wave and rectangular wave generation, frequency counter etc.

MODULE – III

Microcontroller RISC family-ARM processor fundamentals: Register Organisation, pipeline, core. ARM instruction sets: data processing, branch ,load-store, interrupts & program status register instructions. Exceptions & interrupts: handling & priorities. Development & Debugging tools for microcontroller based system design: software and hardware tools like {cross assembler, compiler, debugger, simulator, in-circuit emulator.

MODULE – IV

Embedded System Peripherals: Timers, Counters, example of reaction timer, UART, PWM generation, Controlling a dc motor using a PWM. General purpose processor, application specific instruction-set processor's (ASIP) and ASIC's, semiconductor IC's programmable logic device, Processor selection for embedded systems, special purpose processor.

MODULE – V

PIC microcontrollers: introduction, architecture (block diagram explanation only), and pin details of PIC 16F877 . Memory organization, ports and timers in PIC 16F877.

MODULE – VI

DSP based control of stepper motor: Basic operation of stepper motors, excitation tables of stepper motor, drive system of stepper motor, implementation of control logic using LF 2407 DSP, programming techniques for speed control of stepper motor.

MODULE – VII

DSP Based Control of BLDC Motor: Principle of BLDC motor, torque generation, BLDC motor control system, Implementation of BLDC motor control system using LF2407, subroutine for PWM generation and speed control of BLDC motor.

Text Books:

1. Muhammad Ali Mazidi, The 8051 microcontroller and Embedded System, 2006, Pearson Education.
2. PIC 16F877 data book
3. Hamid A. Toliyat, Steven Campbell-DSP-Based Electro-mechanical Motion Control, CRC Press
4. Andrew N Sloss,Dominic Symes,Chris Wright, ARM Developer's Guide, Elsevier

Reference Books:

1. ARM processor Data book
2. Kenneth Ayala, The 8051 Microcontroller, 3/ e, Thomson Publishing, New Delhi
3. David Seal,ARM Architecture Reference Manual
4. Wayne Wolf, Computers as Components: Principles of Embedded Computing system design, Else Vier, 2005

Resource Department/Center

1. Electrical and Electronics Engineering

MEE 2101 SOFT COMPUTING TECHNIQUES

Module - 1

Introduction: Background, uncertainty and imprecision, statistics and random processes, uncertainty in Information. Fuzzy sets and membership, chance versus ambiguity, fuzzy control from an industrial perspective, Knowledge based systems for process control, knowledge based controllers, knowledge representation in knowledge based controllers.

Mathematics of Fuzzy Control: Classical sets, Fuzzy sets, Properties of fuzzy sets, operations on fuzzy sets. Classical relations and fuzzy relations - cartesian product, crisp relation, Fuzzy relations, Tolerance and Equivalence Relations, Fuzzy tolerance and equivalence relations, operation on fuzzy relations, The extension principle.

Module - 2

Membership Function: Features of membership functions, standard forms and boundaries, Fuzzyification, Membership value assignment.

Fuzzy-to-Crisp Conversions: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations. Defuzzification Methods.

Module – 3

Introduction : Structure and foundation of Single Neuron, Neural Net Architectures, Neural Learning Application, Evaluation of Networks, Implementation.

Supervised Learning - Single Layer Networks, Perceptions, Linear saparability, Perception, Training algorithms, Guarantee of success, Modifications.

Module - 4

Multilayer Networks: Multilevel discrimination, preliminaries, backpropagation algorithm, setting the parameter values, Accelerating the learning process, Applications, RBF Network.

Module - 5

Unsupervised Learnings: Winner take all networks, learning vector quantizers, ART, Topologically ortanised networks.

Associative Models: Non-iterative procedures for Association, Hopfield networks.

Module - 6

Discussion of Neural Networks and Fuzzy Logic Application in areas of Power Electronics and motor control.

Text Books:

1. Fuzzylogic with Engineering Applications - Timothy J. Ross, McGraw-Hill International Editions.
2. Fuzzy Sets and Fuzzy logic: Theory and Applications - George J. Klir and Bo. Yuan, Prentice-Hall of India Private Limited.
3. Neural Networks: A Comprehensive Foundation - Siman Haykin, IEEE, Press, MacMillan, N.Y. 1994.

References Books:

1. Elements of Artificial Neural Networks - Kishan Mehrotra, Chilakuri K. Mohan, Sanjay Ranka (Penvam International Publishing (India)

MEE 2157 RENEWABLE SOURCES OF ELECTRICAL ENERGY

Module – I

Energy Scenario: Classification of Energy Sources, Energy resources (Conventional and nonconventional), Energy needs of India, and energy consumption patterns. Worldwide Potentials of these sources. Energy efficiency and energy security. Energy and its environmental impacts. Global environmental concern, Kyoto Protocol, Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds (PCF). Factors favoring and against renewable energy sources,IRP

(6)

Module – II

Solar Energy: Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, - solar cells , cell technologies, characteristics of PV systems, equivalent circuit, array design , building integrated PV system, its components , sizing and economics. Peak power operation, Solar tracking system, Standalone and grid interactive systems.

(8)

Module – III

Wind Energy: Wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems: system components, Types of Turbine, Turbine rating Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power operation, control systems, system design features, stand alone and grid connected operation.

(6)

Module – IV

Biomass Energy System: Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Cofiring, Generation from municipal solid waste, Issues in harnessing these sources.

(3)

Module – V

Hydro energy: Feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion (OTEC) systems – schemes, feasibility and viability.

(3)

Module – VI

Energy storage and hybrid system configurations: Energy storage: Battery – types, equivalent circuit, performance characteristics, battery design, charging and charge regulators. Battery management. Fly wheel- energy relations, components, benefits over battery. Fuel Cell energy storage systems. Ultra Capacitors.

(4)

Module – VII

Grid Integration: Grid integration with the system: Interface requirements, Stable operation, Transient-safety, Operating limits of voltage, frequency, stability margin, energy storage, and load scheduling.

(5)

Text Books:

1. Renewable energy technologies - R. Ramesh, Narosa Publication.
2. Energy Technology – S. Rao, Parulkar
3. Non-conventional Energy Systems – Mittal, Wheelers Publication.

Reference Books:

1. Wind and solar systems by Mukund Patel, CRC Press.
2. Solar Photovoltaics for terrestrials, Tapan Bhattacharya.
3. Wind Energy Technology – Njenkins, John Wiley & Sons
4. Solar & Wind energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern.
5. Solar Energy – S.P. Sukhatme, Tata McGraw Hill.
6. Solar Energy – S. Bandopadhay, Universal Publishing.
7. Guide book for National Certification Examination for EM/EA – Book 1

EE 8225 APPLIED CONTROL THEORY

MODULE – I

Concepts of State, State Variables: Development of state-space models. State and state equations, State equations from transfer function Transfer function from state equations. State transition matrix, Solution of State equation, Transfer Matrix, State variables and linear discrete time systems

(7)

MODULE – II

Controllability and Observability: Controllable and observable State models, Controllability and observability for discrete time systems.

(5)

MODULE – III

State Variable Feedback: Asymptotic state observers. Control system design via pole placement.

(4)

MODULE – IV

Optimal Control Systems: Introduction, Performance indices, Optimal control problems-Transfer function approach, State variable approach; Parameter optimization.

(5)

MODULE – V

Non-Linear Systems: Introduction. Common nonlinearities. Methods of studying non-linear systems: Linearization; Describing function analysis; Phase plane analysis.

(8)

MODULE – VI

Stability of Non-Linear Systems: Stability concepts. Stability analysis using Lyapunov's Direct method; Popov's stability criterion.

(3)

MODULE – VII

Adaptive Control Systems: Performance indices. Adaptive Controllers, Identification of dynamic characteristics of the plant

(4)

Text Book:

1. Digital Control & State Variable Methods – H. Gopal, Tata McGraw Hill.
2. Control Systems Engineering- I.J. Nagrath & M. Gopal.

Reference Books:

1. Modern Control System Theory- M. Gopal.
2. Modern Control Engineering- K. Ogata.
3. Control Systems- N. K. Sinha.

EE 8227 VLSI – DESIGN

MODULE – I
Circuits and System Representation: Behavioral, Structural and physical representation, Example of a triangular waveform generator and its behavioral, Structural and physical description.

MODULE – II
Basic CMOST Technology: Basic n-well CMOS Process, p-well process, Twin-tub process, Silicon on insulator, CMOS process enhancements, Metal interconnect, Polysilicon/refractory metal interconnect, Local interconnect, Circuit elements like resistors, Capacitors, EAROM, Bipolar transistors and thin film transistor.

MODULE – III
Layout Design Rules: Layer representations, CMOS n-well rules, Design rule backgrounder, Layer assignment, Latch-up problem, Latch-up triggering, Internal latch-up prevention techniques, Resistance estimation, Capacitance estimation.

MODULE – IV
Basic Physical Design of Simple Logic Gates: Investor, NAND and NOR gates, Complex logic gates layout, CMOS standard cell design, Gate array layout, Sea-of-gates layout, General CMOS logic gate layout guidelines, Layout optimization for performance, Transmission gate layout consideration, 2-input multiplexers, I/O structures, V_{oo} and V_{ss} pads, Output and input pads, Tristate and bi-directional pads, Miscellaneous pads.

MODULE – V
CMOS Analogue Design Method: Opamp design, Feedback and frequency compensation, Opamp as a comparator, Sample and hold, Analogue layout considerations, Transistor layouts, Centroid design, Capacitor matching, Resistor layout, Noise consideration.

MODULE – VI
CMOS Digital Design Methods: Structured design strategies, Hierarchy, Regularity, Modularity, Locality, Design options like PL, Reprogrammable gate arrays, XILINX PGA, Standard cell design, behavioural synthesis, RTL synthesis, Logic optimization, Structural to layout synthesis, Placement, Routing, Automatic placement example.

MODULE – VII
CMOS Subsystem Design: Single bit address, Bit parallel adder, Transmission gate adder, Asynchronous counter, Synchronous counter, RM, Finite state machines, Multilevel logic.

Text Books:

1. Principle of CMOS VLSI Design A System Perspective, Weste Neil HE and Eshraghian K, Pearson Education, 1993.
2. Analog Integrated circuit Design – David Johns & Ken Martin, Wiley India.

Reference Books:

1. CMOS Circuit Design, Layout & Simulation – R. Jacob Baker, Harry W. Li & David E. Boyce, Prentice Hall of India Pvt. Ltd.
2. Design of Analog CMOS Integrated Circuits – Behzad Razavi, TMH Educat. Pvt. Ltd.
3. COMS Analog Circuit Design – Phillip E. Allen & Douglas R. Holbarg, Oxford University Press.
4. Basic VLSI Design – Douglas A. Pucknell, PHI.
5. Physics of Semiconductor Devices – Simon M. Sze, John Wiley & Sons.

EE 8229 TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

MODULE – I

Transformers: Specification, Installation- Location and sites, Selection and design of foundation details (like bolts size, their number, etc.) code of practice for terminal plates, polarity and phase sequence, Oil tanks, drying of windings with & without oil, general inspection.

(6)

MODULE – II

Commissioning Test: Following tests as per national & International standards, Volt ratio test, Earth resistance oil strength, Bochholz & other relays, tap changing gear, Fans & pumps, Insulation test, impulse test, polarizing index, load & temperature raise test. Specific Test- Determination of performance curves like efficiency, regulation etc., Determination of mechanical stress under normal & abnormal conditions, Maintenance Schedule

(7)

MODULE – III

Induction Motors: Specifications for different types of motors, Duty, el L.P., protection. Installation- Location of the motors (including the foundation details) & its control apparatus, Shaft & alignment for various coupling, fitting of pulleys & couplings, Drying of windings

(6)

MODULE – IV

Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing. Electrical Tests - Insulation test, earth resistance, High voltage test, starting up failure to speed up to take the load type of test, routine test, factory test and site tests (in accordance with ISI code). Specific Tests : Performance & temperature rise tests, stray load losses, shaft elements, re-rating & special duty capability. Maintenance Schedule.

(7)

MODULE – V

Synchronous Machines: Specifications, Installation- Physical inspection, Rating nameplate details, Foundation details, Alignments, Excitation systems, Cooling & control gear, drying out. Commissioning Tests- Insulation, Resistance measurement of armature & field wings, Wave from & telephone interference factors, Line charging capacity.

(7)

MODULE –VI

Performance Tests: Various tests IP estimate the performance for generator & motor operations slip maximum lagging currents, Maximum reluctance power tests, Sudden short circuit tests, transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, Separation of losses, temperature rise tests, Retadation tests. Factory Tests - Gap length, magnetic centrity balancing vibration, bearing performance

(5)

MODULE – VII

Switchgear & Protective Devices: Standards, types, Specification, Installation, Commissioning tests, Maintenance schedule, Type & routine tests.

(6)

Text Books:

1. S. Rao, Testing & Commissioning of electrical equipment, Khanna Publishers
2. B.V.S. Rao, Testing & Commission of electrical equipment

Reference Books:

1. Relevant Bureau of Indian Standards
2. Transformers - BHEL
3. J & P transformer Handbook
4. J & P Switch gear Hand Book