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

MODULE – II

MODULE – III

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.

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

MODULE – VI

MODULE – VII
Coupled Circuits (Dot rule), Self and mutual inductances, Coefficient of coupling.
Basic Indicating Instruments: Moving coil and moving iron type instruments.

Text Books:
1. Hughes Electrical Technology, Revised by McKenzie Smith, Addison Wesley.

Reference Books:
MODULE – I
Introduction to Signals and Systems: Definition, Basis of classification, Representation of common signals and their properties, System modeling.

MODULE – II

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

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.

MODULE – V

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

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.

Text Books:
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
MODULE – I
Network Theorem: Substitution theorem, Tellegen's theorem, Reciprocity theorem

MODULE – II

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

MODULE – IV

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

MODULE – VI
Bandpass filter approximation, Frequency transformation, Insertion Loss Synthesis: Coefficient matching technique, Darlington's method.

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

Text Book:
1. V.K. Aatre, Network Theory & Filter Design

Reference Book:
MODULE – I
Introduction: Overview of power generation scenario from thermal, hydro and nuclear and non-conventional sources.

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

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.

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.

MODULE – V
Diesel Electric Station: Site selection, layout, main components, choice and characteristics of diesel engines, diesel engines, diesel plant efficiency and heat balance, maintenance.

MODULE – VI

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.

Text Books:
1. Power Plant Engineering - PK Nag TMH publications

Reference Books:
1. Elements of Electrical Power Station Design – MV Deshpande, Pitman and Sons Ltd.
**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.  

**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.  

**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.  

**MODULE – IV**  
**Electronic Instruments:** Electronic voltmeter, Digital voltmeter, vector voltmeter, Vector Impedance meter and Q-meter.  

**MODULE – V**  
**Display Devices & Recorders:** Digital display, LED, LCD, Strip chart recorder, X-Y recorder.  

**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.  

**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.  

**Text Books:**  

**Reference Book:**  
3. Deoblin - Electrical Measurement.  
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.

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.

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.

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.

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.

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.

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.

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
3. Electrical Machines - Nagrath & Kothari, TMH Delhi
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.

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.

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

MODULE – IV
Filter Function Approximations and Transformations. Review of approximations of ideal analog filter response, Butterworth filter, Chebyshev Type I & II.

MODULE – V
Frequency Transformations: Frequency transformation in analog domain, frequency transformation in digital domain.

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

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.

Text Books:

Reference Book:
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).

MODULE – II

MODULE – III

MODULE – IV

MODULE – V

MODULE – VI

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

Text Book:

Reference Book:
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

Reference Books:
2. A.P. Malvino, Digital Computer Electronics
3. S. K. Venkatram, Advanced Microprocessor & Microcontroller
4. A. P. Mathur, Introduction to Microprocessors
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.

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.

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.

MODULE – IV

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.

MODULE – VI

MODULE – VII

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
**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.  

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

**MODULE – III**

**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.

**MODULE – V**

**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.

**MODULE – VII**

**Text Book:**

**Reference Books:**
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.

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.

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.

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

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

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.

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

Text Books:

Reference Books:
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:

Reference Books:
2. Graham C. Goodwin, "Control System Design", PHI.
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

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

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.

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.

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.

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.

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.

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.

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
5. C. L. Wadhwa, Genaration Distribution and Utilization of Electrical energy
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.

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

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

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

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.

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

MODULE – VII
Introduction to Carrier: Aided Protection and Numerical Protection

Text Books:
2. Switch Gear and Protection Sunil S. Rao, Khanna Publications

Reference Books:
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.

MODULE – II

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.

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.

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

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.

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.

Text Books:
2. Power System Analysis - L. P. Singh

Reference Books:
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:
MODULE – I
Introduction, Medical instrumentation system Man instrumentation system, Brief idea of cardiovascular, Nervous & respiratory system.

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.

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 transducers, biochemical transducers.

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.

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, deï pace maker

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.

Text Books:
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.
MODULE – I

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.

MODULE – III

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

MODULE – V

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

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

Text Books:
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
Module 1:

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:**

**Reference Books:**
2. M. Gopal, "Digital Control & State Variable Method", TMH.
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. (5)

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
INTRODUCTION

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

INTERNET (COMPUTER NETWORKS)
MODULE – I & II

MODULE – III & IV

MULTIMEDIA
MODULE – V

MODULE – VI

EXPERT SYSTEMS, KNOWLEDGE-BASED INDUSTRIES & INTERNET
MODULE – VII
A PARADIGM
MODULE – VIII
Information Technology as a Tool and Backbone for Modern Education System

Text Books:
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.

MODULE – II
**Inverse Kinematics:** Inverse kinematics problem. General properties of solutions. Tool configuration. Robotic work cell.

MODULE – III

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.

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

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

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.

Text books:

Reference Books:
MODULE – I
Introduction: Electric Field Stresses, Gas/Vacuum as Insulator, Liquid Breakdown, Solid Breakdown, Estimation and Control of Electric Stress

MODULE – II

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

MODULE – V

MODULE – VI

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

Text Book:
1. High Voltage Engineering, MS Naidu and V. Kamaraju, TMH New Delhi.

Reference Book:
2. Electrical Breakdown of Gases, JM, Meek and JD, Crages, John Wiley, New York.
**MODULE – I**
Mexwell’s coefficients, Sequence inductance and capacitance, Charge Matrix, Effect of Ground wire.

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

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

**MODULE – IV**
Switching over-voltages in EHV Systems

**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.

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

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

**Text Books:**
1. Extra High Voltage AC Transmission Engineering (2nd Ed.) by R.D. Begamudre, Wiley Eastern Ltd.

**Reference Books:**
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

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, Superheterodyne 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:**

**Reference Book:**
MODULE – I


MODULE – II


MODULE – III


MODULE – IV


MODULE – V


MODULE – VI


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.

Text Books:
3. Fundamentals of Electrical Drives , G.K.Dubey , Narosa publication, New Delhi

Reference Books:
MODULE – I

MODULE – II

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 grammar and meaning of verbs syntactic use of semantic knowledge- organization of operating, etc.

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.

MODULE – V

MODULE – VI

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

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

Text Books:
3. Artificial Intelligent System - Padhy, Oxford Publishers
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 microcontroller 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:**
2. PIC 16F877 data book
3. Hamid A. Toliyat, Steven Campbell-DSP-Based Electro-mechanical Motion Control, CRC Press

**Reference Books:**
1. ARM processor Data book

**Resource Department/Center**
1. Electrical and Electronics Engineering
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.


Module - 2
Membership Function: Features of membership functions, standard forms and boundaries, Fuzzyification, Membership value assignment.

Module – 3

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 organised networks.

Module - 6
Discussion of Neural Networks and Fuzzy Logic Application in areas of Power Electronics and motor control.

Text Books:

References Books:
1. Elements of Artificial Neural Networks - Kishan Mehrotra, Chilakuri K. Mohan, Sanjay Ranka (Penvam International Publishing (India)
Module – I
Energy Scenario: Classification of Energy Sources, Energy resources (Conventional and non-conventional), 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.

Module – II
Solar Energy: Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photovoltaic (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.

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.

Module – IV

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.

Module – VI

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.

Text Books:
2. Energy Technology – S. Rao, Parulkar

Reference Books:
1. Wind and solar systems by Mukund Patel, CRC Press.
3. Wind Energy Technology – Njenkins, John Wiley & Sons
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

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

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

MODULE – IV

MODULE – V

MODULE – VI

MODULE – VII

Text Book:

Reference Books:
1. Modern Control System Theory- M. Gopal.
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

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, $V_{DD}$ 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:

Reference Books:
4. Basic VLSI Design – Douglas A. Pucknell, PHI.
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.

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

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

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.

MODULE – V

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

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

Text Books:
2. B.V.S. Rao, Testing & Commission of electrical equipment

Reference Books:
1. Relevant Bureau of Indian Standards
2. Transformers - BHEL
4. J & P Switch gear Hand Book