

1st Semester
MTH-504 ADVANCED MATHEMATICS

Unit 1

Solution of Partial differential Equations : Application to Boundary Value Problems. Laplace and wave Equations and electrical engineering applications to boundary value problems.

Unit 2

Solution of non-linear equations by Newton's, Kizner's method, Jacobi's and Gauss-SEIDEL iteration methods. Lagrange's & Hermite interpolation, piecewise interpolation, cubic splines, Two-point boundary value problems by numerical techniques for linear ODE.

Unit 3

Cauchy's residue theorem, evaluation of integrals by various contours, conformal mapping, Schwartz christofel transformation.

Unit 4

Linear Programming: LPP formulation, simplex methods-phase I, phases II, Big M method, Duality of LPP. Non Linear Programming: Unconstrained and constrained external problems, and their algorithms.

Unit 5

Dynamic Programming: Bellman's Principle of Optimality, Dynamic Programming Approach optimal subdivision problem, Decomposition Applications to linear programming DPP algorithms.

Reference Books:

1. Higher Engineering Mathematics by B.S.Grewal
2. Operations Research by Kanti Swaroop, P.K.Gupta and Man Mohan
3. Operations Research – Algorithmic Approach – Gillettee

PS 501: POWER SYSTEM ANALYSIS

Unit 1

Power system components and their modeling, Recent trends in Power System Analysis, Operation and Control, Power System Components, their representation & modeling. Load Flow Studies, Different basic techniques of Load flow solutions and their recent advancements, their comparison w.r.t. speed, storage, convergence & reliability, computational aspects of on-line & off line analysis, optimal load flow studies and comparison of different methods.

Unit 2

Introduction of Optimal system operation, optimal operation of Generators of a Bus Bar, Optimal Unit Commitment (UC), Economic Dispatch , Classical Economic, Economic Issues and Mechanisms in the New Market Environment. Reliability consideration, Optimal, Power system security.

Unit 3

Power System Management under normal & abnormal conditions, short circuit studies in Power System, Demand Side Load Management & Load Forecasting, Transmission issues and Effect in the New Market Environment

Unit 4

State Estimation & Contingency Analysis : Basic concept and methods, line power flow state estimates, State Estimation and Noisy measurements, monitoring the Power System.

Unit 5

Power system optimization, Emerging Modern Optimization Techniques and their application in Power Systems,

Reference Books:

1. Computer Methods in Power System Analysis - Glenn W. Stagg & Ahmed H. El-Abiad
2. Computer Methods in Power System Analysis - M.A. Pai
3. Computer Aided Power System Analysis - George L.Kusic
4. Electrical Energy Systems - O. Elgard
5. Advanced Power System Analysis and Dynamics - L.P. Singh
6. Power System Analysis and Design, Third Edition by J. Duncan Glover and Mulukuta S. Sarma, Prentice Hall, Inc., 2002
7. Modern Optimisation Techniques in Power System- Yong Hua Song, Kluwer Academic Publishers.

PS-502 ADVANCE POWER SYSTEM PROTECTION

Unit 1

Protective Relays : Relaying review, characteristics and operating equations of relays. CT's and PT's differential relay, overcurrent relay, reverse power relay, distance relays, applications of relays.

Unit 2

Static Relays : Principles of static relay comparators (Amplitude & phase comparator), Types of amplitude and phase comparators. Summation transformers, over current, differential relays, techniques in development of static relays.

Unit 3

Generator and transformer protection : Protective devices for system. Protective devices for stator, rotor, and prime mover of generator, percentage differential relays protection, three winding transformer protection, earth fault protection, generator transformer unit protection.

Unit 4

Busbar and transmission line protection : Distance protective schemes, directional wave detection relay. Phase compensation carrier protection. High impedance differential scheme, supervisory and check relay, Some features of 500 KV relaying protection.

Unit 5

Modern trends in power system protection : Different types of digital and computer aided relays, Microprocessor based relays, autoreclosing, frequency relays, under and over frequency relays, di/dt relays.

Reference Books :

1. Power System Protection and Switchgear, B.Ram – Tata Mc-Graw Hill Pub.
2. Switchgear and Protection, M.V.Deshpande - Tata Mc-Graw Hill Pub.
3. Power System Protection and Switchgear, R.Ravindra Nath and M.Chander – Willy Eastern Ltd.
4. Computer Relaying for power system by Arun G. Phadke and James S.Thorp – Johns willy.
5. Power System Protection by M.A.Date – Bharti Prakashan Vallabh Vidya Nagar, Gujrat.

PS-503 MODELLING AND ANALYSIS OF ELECTRICAL MACHINE

1. Review : Primitive machine, voltage and torque equation.
Concept of transformation change of variables & m/c variables and transform variables. Application to D.C. machine for steady state and transient analysis, and equation of cross field commutator machine.
2. Induction Machine : Voltage, torque equation for steady state operation, Equivalent circuit, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals. Voltage & torque equation for steady state operation of 1- ϕ induction motor & scharge motor.
3. Synchronous Machine : Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasor diagrams, Simplified equations of a synchronous machine with two damper coils.
4. Operational Impedances and Time Constants of Synchronous Machines : Park's equations in operational form, operational impedances and G(P) for a synchronous machine with four Rotor Windings, Standard synchronous machine Reactances, time constants, Derived synchronous machine time constants, parameters from short circuit characteristics.
5. Approximate Methods for Generator & System Analysis : The problem of power system analysis, Equivalent circuit & vector diagrams for approximate calculations, Analysis of line to line short circuit, Application of approximate method to power system analysis.

Reference Books :

1. Analysis of Electric Machinery - P.C.Krause
2. The General theory of Electrical Machines - B.Adkins
3. The General theory of AC Machines - B.Adkins & R.G.Harley
4. Generalised theory of Electrical m/c - P.S.Bhimbra
5. Electro Mechanical Energy Conversion - White & Woodson

ELECTIVE-I (i)

PS - 511 INSTRUMENTATION

1. Introduction to instrumentation and control of energy systems, display instruments, recorders.
2. Transducers, sensors, actuators such as pressure, temperature, velocity, speed, volume, torque and solar flux measuring devices, current, voltage and power factor.
3. Gas analysers, power plants and industrial instrumentation and pollution monitoring devices.
4. Signal conditioning of inputs, single channel and multichannel data acquisition system, D/A and A/D converters, data loggers, supervisory control.

5. Data transmission systems, Advantage and disadvantage of digital transmission over analog. Time division multiplexing, pulse modulation, digital modulation.

Reference Books :

1. Transducers & Instrumentation by D.V.S. Murty – PHI Prentice Hall
2. Electronic Instrumentation by H.S.Kalsi – Tata McGraw Hill
3. Electrical and Electronics Measurement and Instrumentation by A.K.Sawhney – Dhanpat Rai & Sons.
4. Instrumentation devices and systems by C.S.Rangan and G.R. Sharma – Tata McGraw Hill.

ELECTIVE I (ii)

PS-512 MICROCOMPUTER AND IT'S APPLICATIONS

Programmable Peripheral Devices

PPT 8255, various operating modes, fixing diagram, PIT 8253, programming and modes of operation, PIC 8259, operating modes.

Interfacing

Interfacing of peripherals, A/D & D/A converters, 8255, 8253, 8259 with 8/16 bit microprocessor/Data Acquisition system.

Microcontroller - 8051 Architecture, Counter/Timers, Instructions, Programming, Interfacing, Applications, Comparison of 8085, 8086, 8057 etc.

Programmable logic controller

PLC Architecture, programming, Counter/Timers and its applications.

References :

1. Microprocessor Architecture programming & applications – Gaonkar
2. Microprocessors & interfacing – D.V.Hall
3. The 8051 Microcontroller – K.J.Ayala
4. Introduction to programmable logic controller – Gary Dunning

ELECTIVE I (iii)

PS-513 DSP & IT'S APPLICATIONS

Introduction to DSP - Classification of signals, Multichannel and multi dimensional continuous v/s discrete time signals, continuous v/s discrete valued signals, continuous time sinusoidal signal, discrete time sinusoidal signals, sampling of analog signal, sampling theorem, quantification and coding of D/A conversion.

Discrete Time Signal and Systems - Discrete time signal, systems, Z-transform & Inverse Z-transform, analysis of discrete time, linear time invariant systems, co-relation of discrete time systems.

Frequency Analysis Of Signals - Frequency analysis of analog signals, frequency analysis of discrete time signals. Properties of Fourier Transform, Frequency Domain Characteristics, Time Frequency Dualities, Sampling of signals in time and frequency domain, DFT & FFT.

Design Of Digital Filter - Design of linear phase FIR filter using window & frequency sampling method. Design of equiripple linear phase filters. Comparison of design methods for linear phase FIR filters. Design of IIR filters from analog filters. Direct Design Technique for digital IIR filters.

DSP Application - Introduction to digital signal processors chips, case study of different DSP applications. Application of filters to analog & digital signal processor, FET spectrum analyzer.

Reference Books :

1. Digital Signal Processing - W.D.Stanley
2. Analog & Digital Signal Processing – Ashok Ambardar

ELECTIVE I(iv)

PS- 514 COMPUTER AIDED POWER SYSTEM ANALYSIS

UNIT I

Digital computers in power system simulations, System view point, Hierarchy of transmission and distribution system, nature and scope of power system studies, Electric supply industry structure under Deregulation, Regulatory and policy developments. Power system components, representation of transmission lines.

Transformers - Two winding and auto-transformers, tap changing transformer and loads.

UNIT II

Oriented graph, reference direction, system graph for transmission network, concept of graph theory, loop matrix, cutset matrix, incidence matrix, Topological relations, multiport representation, Bus impedance and Bus admittance matrix formulation, bus impedance algorithm.

UNIT III

Analytical formulation, methods of load flow solutions, Bus mismatch and convergence criteria, Gauss-Siedel method, Newton Raphson method, concept of decoupled methods.

UNIT IV

Thermal system, transmission losses, optimum scheduling of thermal plants taking losses into account, economic load scheduling of hydro-thermal plants.

UNIT V

Electric utility Restructuring, Power System Restructuring Models, Market-power, Transmission pricing in a Restructured Electricity Market, Congestion Management in Deregulated Market, Role of FACTS devices in competitive Power Market.

Reference Books :

1. Electrical Energy Systems Theory by O.I.Elgerd
2. Computer Methods in Power system Analysis by A.H.El.Abiad
3. Understanding FACTS concept and Technology by Hingorani N.L.

4. Power System Restructuring and Deregulation Trading Performance and IT by L.L. Lai, John Wiley & Sons Ltd. England
5. Electricity Market Investment Performance and Analysis by B. Murrey, Mc-Hill, 1998
6. Understanding Electric Utilities and Deregulation by Lorrin Phillipson & H. Lee Willis, Marcel Dekker Inc. New York, 1999
7. Power System Restructure Engineering & Economics by M. Illic, F. Faliana and L. Fink, Kluwer Academic Publisher, 1998
8. Restructured Electrical Power System Operation Trading and Volatility by Mohammad Shahidpour and Muwaffaq Almoush, Marcel Dekker, 2001

ELECTIVE I(v)
PS 515 POWER CONTROLLER

Unit 1

Various power semiconductor devices i.e. SCR, GTO, MOSFET, BJT, IGBT & MCT's & their protection, series-parallel operation, Heat sink calculations, Design of firing circuit for converters, choppers & inverters.

Unit 2

Analysis & design of 1- ϕ bridge converter, 3- ϕ bridge converter with and without freewheeling diode, effect of source impedance, power factor improvement techniques, pulse width modulated converters, Dual converters, converter for HVDC application & DC drives.

Unit 3

Analysis & design of voltage commutated, current commutated and load commutated choppers, multiquadrant choppers, chopper for traction application. Resonant choppers, SMPS.

Unit 4

Detailed analysis of 1- ϕ VSI, 3- ϕ VSI (180° mode, 150° mode & 120° mode of conduction), various inverter commutation circuits, harmonic reduction techniques, PWM inverters, Inverters for HVDC application & AC drives.

Advantages & limitation of current source inverters over VSI, 1- ϕ and 3- ϕ CSI. Resonant inverters.

Unit 5

1- ϕ to 1- ϕ , 3- ϕ to 3- ϕ cycloconverter circuits, circulating current scheme, non-circulating current operation, Mean output voltage, harmonics in supply current waveform & input-power factor. Concept of power quality

Reference Books :

1. Thyristorised Power Controllers - G.K.Dubey, Doradla, Joshi, Sinha
2. Power Electronics - C.W.Lander
3. Power Electronics - Rashid
4. Thyristorised power controlled converters & cycloconverters - B.R.Pelly
5. Power Electronics - N.Mohan
6. Power Electronics Application - Vithyathil.

PS- 541 Power System Laborator

List of Experiments:

1. Study of Bucholz relay.
2. To determine the characteristics of inverse time current relay.
3. To determine the dielectric strength of transformer oil.
4. Separation of eddy current & iron losses of single phase transformer.

5. To perform slip test on synchronous machine and to determine d-axis & q-axis reactances.
6. To measure the direct axis subtransient reactance of synchronous machine.
7. To measure the quadrature axis subtransient reactance of synchronous machine.
8. Study of 3-phase short circuit on synchronous machine.