ADVANCED MATHEMATICS

MEPS – 101

Unit 1 : Partial Differential Equation
Solution of Partial Differential Equation (PDE) by separation of variable method, Numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference Methods.

Unit 2 : Matrices And Linear System Of Equations
Solution of linear simultaneous equations by Gaussian elimination and its modification, Crout's triangularization method, Iterative methods-Jacobins method, Gauss-Seidal method, Determination of Eigen values by iteration.

Unit 5 : Calculus Of Variations
Euler-Lagrange's differential equation, The Brachistochrone problems and other applications. Isoperi-metric problem, Hamilton's Principle and Lagrange's Equation, Rayleigh-Ritz method, Galerkin method.

Unit 4 : Fuzzy Logic
Operations of fuzzy sets, fuzzy arithmetic & relations, fuzzy relation equations, fuzzy logics. MATLAB introduction, programming in MATLAB scripts, functions and their application.

Unit 5 : Reliability
Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard rate, mean time t future & their relations, concepts of fault tolerant analysis.

Reference Books:
1. Higher Engineering Mathematics - by Dr. B.S. Grewal; Khanna Publishers
2. Calculus of Variations - by Elsgole; Addison Wesley.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Calculus of Variations - by Galfand & Fomin; Prentice Hall.
6. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
7. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
8. Numerical Solution of Differential Equation by M. K. Jain
9. Numerical Mathematical Analysis By James B. Scarborogh
10. Fuzzy Logic in Engineering by T. J. Ross
11. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

POWER SYSTEM ANALYSIS AND CONTROL

MEPS – 102

UNIT 1

INTRODUCTION TO POWER SYSTEM STABILITY PROBLEM: Basic concepts definitions and types: Rotor angle stability, voltage stability and voltage collapse, Mid term and long-term stability, Classification of stability, states of operation and system security system dynamic problems.

UNIT 2

REVIEW OF CLASSICAL METHOD: System model, some mathematical analysis of steady state stability, analysis of transient stability, simplified representation of excitation control.

UNIT 3

MODELING OF SYNCHRONOUS MACHINE: Introduction, synchronous machine, parks transformation, analysis of steady state performance per unit equivalent circuits of synchronous machine, determination of parameters of equivalent circuits, measurements for obtaining data, saturation models, transient analysis of a synchronous machine.

UNIT 4

EXCITATION AND PRIME MOVER CONTROLLERS: Excitation system Modeling, system representation by state evasions, prime move control systems.

UNIT 5

TRNMISSION LINE, SVC AND LOADS: D-Q transformation using L-B variables, static var compensators, loads Dynamics of a synchronous generator connected to estimate bus: system model, synchronous machine model, calculation of initial conditions, inclusion of SVC Model, Analysis of single machine system, Small signal analysis with block diagram representation, synchronizing and damping torque analysis, small signal model, nonlinear oscillators.

UNIT 6 APPLICATION OF POWER SYSTEM STABILIZERS: Basic concepts, control signals, structure and tuning of PSS, field implementation and operating experience 8 Hours.

Reference Books:

1. K.R. Padiyar, Power system dynamics, stability and control, BS Pub. Hydbid
2. P Kunder, Power system stability and control, TMH.
3. P. W. Sauer & M A Pai: Power system dynamics and stability: Pearson.

ADVANCED POWER SYSTEM ANALYSIS

MEPS-103

UNIT 1
Incidence and network matrices, formation of network matrices by singular and non-singular transformation.

UNIT2.
Algorithm for formation of single phase Bus Impedance Matrix.

UNIT 3.
Three- phase balanced network elements, Transformation matrices , Three phase unbalanced network elements , Algorithm for formation of three phase Bus Impedance Matrix.

UNIT 4.
Short circuit calculations using Z-BUS for balanced and unbalanced three phase networks, symmetrical components, sequence impedances, sequence networks,Unbalanced fault analysis for three phase to ground fault, LG fault, LL Fault, LLG Fault.

UNIT5.
Load flow studies using Y-BUS, Gauss-Seidel method ,Newton Raphson method, Fast Decoupled load flow method , representation of transformers, Sparsity technique.

UNIT 6.
Contingency Analysis for power systems using Brown's method, State estimation from on line measurements, The line power flow state estimation.

Books:-

1. G.N. Stagg and A. H.EI- Abiad , Computer Methods in Power System Analysis, McGraw –Hill ,International Edition .
2. George L .Kusic, Computer Aided Power Systems Analysis ,Prentice Hall.
3. J. Arrillaga, C.P. Arnold and S.J. Harker, Computer Modelling of Electrical Power Systems, John Willey and Sons.
4. O.I. Elgerd Electric Energy Systems -An Introduction, Tata McGraw Hill.
5. M.A. Pai, Computer Techniques in Power Systems Analysis ,Tata McGraw Hill.
6. P.M. Anderson, Analysis of Faulted Power System, IEEE Press Book.
7. Related IEEE/IEE Publication.

ADVANCED ELECTRICAL MACHINES

MEPS-104

a. Mathematical Modelling: Basic Synchronous machine parameters, Voltage, Flux linkage and inductance relations, Park's transformation - its physical concept, equations of performance.

b. Balanced Steady State Analysis: Phasor equations and phasor diagrams, Power-angle characteristics, cylindrical rotor and Salient pole machines, Short circuit ratio.

c. Transient Analysis: Three phase short circuit Armature and field transients, Transient torque, Sudden reactive loading and Unloading. Transient Analysis -a qualitative approach, Reactances and time , constants from equivalent circuit .Measurement of Reactances, Transient Power angle characteristics.

d. Synchronous - machine Dynamics: The basic electromechanical equation, Linearized Analysis, Large Angular/oscillation, Non-linear analysis.

Transformers:

a.Multi-Circuit Transformers: General theory, Equivalent circuits, Three winding transformer as a multi-circuit transformers, Determination of parameters.

b. Excitation phenomena in Transformers: Harmonics in Single – phase transformers, Harmonics in three-phase transformers, Disadvantages of harmonics, Suppression of harmonics.

c. Transformer Transients: Inrush current phenomena, Qualitative approach, Analytical approach, Inrush current in 3-phase transformers.

d. Unbalanced Operation of three-phase Transformers: Single phase load on three-phase transformers, Single - Phasing in 3-phase transformers, Effect of using tertiary winding.

Recommended Text Book:

Generalized theory of Electrical Machines by Dr. P.S. Bimbhra (Khanna Publishers.)

Reference Books:

1. Generalized theory of electrical Machines by B. Edkins.
2. Synchronous machines by Concordia.
3. Power System Stability Vol. III by E.W, Kimbark.
4. Electrical Machinery by Fitzegerald, Kingsley.
5. Electrical Machines by A. Draper.
6. Magnetic Circuits and Transformer MIT Staff.

Advance Power System Protection Relays

MEPS – 105

Unit-I

Digital Relaying Advantages of Digital Relaying systems, Block diagram of Digital Relay, Anti aliasing filters, Data window, Facilities in commercial digital relays, Different relay algorithms such as least square error method, Walsh algorithm, Man and Morrison algorithm, Discrete Full Cycle and Half Cycle Algorithm, communication protocol (IEC 61850), Time Synchronization with Wide Area Measurements

Unit - 2

Advanced Protection of Transmission Line Coordination of over current relays in an interconnected system, LINKNET structure, Concept of Sympathy Trips, Coordination of Distance Relays, Protection of Series Compensated Lines: Problems & Solutions, Teed Line,Carrier Current Protection, Phase Comparison Carrier, Carrier Aided Distance Protection,Blocking Carrier, Carrier Intercropping and Carrier Acceleration, Philosophy of Adaptive Relaying

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

Bus bar 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, auto-reclosing, frequency relays, under and over frequency relays, di/dt relays. Algorithms for transmission line, transformer & bus bar protection; out-of-step relaying Introduction to adaptive relaying & wide area measurements

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 & Switchgear, Ravindra Nath, M.Chander, Willy P