MEHP – 101 ADVANCE MATHEMATICS

UNIT 1

Solution of Partial Differential Equation (PDE) by separation of variable method, numerical solution of PDE (Laplace, Poisson's, Parabola) using finite difference methods, Elementary properties of FT, DFT, WFT, Wavelet transform, Haar transform.

UNIT 2

Probability, compound probability and discrete random variable. Binomial, Normal and Poisson's distributions, Sampling distribution, elementary concept of estimation and theory of hypothesis, recurred relations.

UNIT 3

Stochastic process, Markov process transition probability transition probability matrix, just and higher order Markov process, Markov chain. Queuing system, transient and steady state, traffic intensity, distribution queuing system, concepts of queuing models (M/M/1: Infinity/ Infinity/ FC FS), (M/M/1: N/ Infinity/ FC FS), (M/M/S: Infinity/ Infinity/ FC FS)

UNIT 4

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

UNIT 5

Introduction and definition of reliability, derivation of reliability functions, Failure rate, Hazard rate, mean time t future & their relations, concepts of fault tolerant analysis, Elementary idea about decision theory and goal programming.

Reference Books:

1. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Hill.
2. Advance Engineering Mathematics by Ervin Kreszig, Wiley Easten Edd.
3. Applied Numerical Methods with MATLAB by Steven C Chapra, TMH.
4. Introductory Methods of Numerical Analysis by S.S. Shastry,
5. Introduction of Numerical Analysis by Forberg
6. Numerical Solution of Differential Equation by M. K. Jain
7. Numerical Mathematical Analysis By James B. Scarborogh
8. Fourier Transforms by J. N. Sheddon
9. Fuzzy Logic in Engineering by T. J. Ross
10. Fuzzy Sets Theory & its Applications by H. J. Zimmersoms

MEHP – 102 Power System Dynamics Analysis & Control

UNIT 1
INTRODUCTION TO POWER SYSTEM STABILITY PROBLEM: Basic concepts and definitions: 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.

UNIT4
EXCIT_-\TION AND PRIME MOVE 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. Hydbd
2. P Kunder, Power system stability and control, TMH.
3. P. W. Sauer & M A Pai: Power system dynamics and stability: Pearson.

MEHP – 103 Advance Power System Protection Relays

Unit 1

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

Unit 2

STATIC RELAYS: Introduction, advantages and disadvantages, classification logic ckts, smoothing circuits, voltage regulator square wave generator, time delay ckts level detectors, summation device, sampling circuit, zero crossing detector, output devices. COMPARATORS: Replica Impedance, mixing transformers, general equation of phase and amplitude comparator, realization of ohm, impedance and off set impedance characteristics, duality principle, static amplitude comparators, coincidence circuit, Hall effect devices, Magneto receptivity, zener diode phase comparator multi input comparators.

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. B.Ram, Power System Protection and Switchgear, Tata Mc-Graw Hill Pub.
2. M.V.Deshpande, Switchgear and Protection, Tata Mc-Graw Hill Pub.
3. Ravindra Nath, M.Chander Power System Protection & Switchgear, NewAge
4. Computer Relaying for power system, Arun Phadke, James Thorp, Johns W P
5. Power System Protection, M.A.Date, Bharti Prakashan, Vallabh Vidya N,(Guj).
6. Madhavan Rao, T S Power System protection Patra
7. S P Basu SK Choudhris, Power system protection oxford and IBH publishing.

MEHP – 104 HV DC TRANSMISSION

Unit 1 HV DC TRANSMISSION
Introduction. Comparison of AC and DC transmission. Applications of DC transmission. Description of DC transmission systems. Planning for HVDC transmission Modem trends in DC transmission. 10 hrs.

Unit 2
Simplified analysis of Gratez circuit, Detailed analysis of converters. 6 hrs control power reversal limitations of manual control, constant voltage versus constant current control, desired features of control, actual control characteristics, constant minimum ignition angle control, constant current control, constant extinction angle control stability of control tap changer control power control and current limits, frequency analog and digital controllers HVDC link operation & regulation. MTDC systems. 8 hrs.

Unit 3 PROTECTION
General DC reactors, prevention of consequent commutation failures, converter faults, clearing line faults and Re-energizing the line, DC circuit breakers, surge arrestors, over voltage protection 8 hrs.

Unit 4 HARMONICS AND FILTER CIRCUITS:
Characteristic and Uncharacteristic harmonics Troubles caused by harmonics means of reducing harmonics telephone interference, Harmonic filters, Design of AC filters, DC filters. 8 hrs.

Unit 5 SIMULATION OF HV DC SYSTEM:
Introduction, system simulation: Philosophy and Tools HVDC system simulation, modeling of HVDC systems for digital dynamic simulation 10 hrs.

Reference Books:

1. K R Padiyar, HVDC power transmission systems-Technology and system nteractions, Wiley Eastern Ltd 1992
2. E W Kimbark Direct current transmission- Volume I Wiley futerscience, 1971.
3. Arrilaga, High Voltage Direct current transmi;ssion peter peregrinus ltd 1983
4. Uhlmann, power transmission by Direct current springer ver~ag, 1975.
5. S.Rao EHV -AC & HVDC Transmission engineering and Practice, Khanna Publishers, 1990.

MEHP – 105 Generation & Measurement Of High Votlage

Unit1

BREAKDOWN PHENOMENA: Classification of HV insulating media, Properties of important HV insulating media under each category. Gaseous dielectrics: Primary and secondary ionization processes. Criterion for gaseous insulation breakdown based on Townsend's theory. Limitations of Townsend theory. Streamer theory- Breakdown in non-uniform fields. Corona discharges. Breakdown in electro negative gases. Paschen's law and its significance. Time lags of breakdown. Breakdown in solid dielectrics, intrinsic breakdown, Avalanche breakdown, Thermal breakdown and Electromechanical breakdown. Breakdown of Liquid dielectrics: Suspended particle theory, Electronic breakdown, Cavity breakdown (Bubble theory) Electro- convection breakdown.

Unit 2.

GENERATION OF HIGH VOLTAGES: HV-AC transformer, Need for cascade connection and working of transformers units connected in cascade. Series resonant circuit- Principle of operation and advantages. Tesla coil. HVDC-voltage doublers circuit. Cockcroft- Walton type high voltage DC set. Calculation of voltage regulation, ripple and optimum number of stages for minimum voltage drop. Introduction to standard Lightning and switching, impulse voltages Analysis of single stage, impulse generator working on Marx impulse. Rating of impulse generator, Components of multi stage impulse generator. Triggering of impulse generator by three electrode gap arrangement, triggering gap and oscillograph time sweep circuits. Generation of switching impulse voltage. Generation of high impulse current.

Unit 3.

MEASUREMENT OF HIGH VOLTAGES: Electrostatic voltmeter-Principle, construction and limitations, Generating voltmeter principle and construction. Series resistance micro ammeter of HVDC measurement. Standard sphere gap for measurement of HV AC, HVDC and impulse voltages Factors affecting the measurements. Potential dividers- .Resistance dividers, Capacitance dividers, Mixed RC potential divider. Surge current measurement- Klydanograph and magnetic links.

Unit 4.

NON-DESTRUCTIVE INSULA TION TESTING TECHNIQUES: Dielectric loss and loss angle measurement using Schering bridge Transformer ratio Arm Bridge. Need for discharge detection and PD measurement aspects. Factors affecting discharge detection. Discharge detection methods-straight and balance methods.

Unit 5.

HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS: Definitions of important terminologies, tests on isolators, circuit breakers, cables, insulators and transformers.

Reference Books:

1.E. Kuffel W S Zaengl, High Voltage Engineering fundamental, Pergamon P
2.M.S. Naidu and V Kamaraju, High voltage, Hill publishing company ltd.
3.C L Wadhwa, High Voltage Engineering New Age International Pvt Ltd.
4.Schwab A High Voltage Measurement Techniques MIT Press Cambridge.
5.Hylten-Cavallins N, High Voltage Laboratory Planning.
6. Dieter K, An Introduction to High Voltage experimental techniques Wiley E
7. Rakosh Das Begamudre, Extra high voltage AC transmission Engg Wiley E
8. Transmission and Distribution Reference book- Westing house.

w.e.f. July-2013