Scheme and Syllabus of Master of Technology (Electrical Engineering) Batch 2013

By
Board of Studies Electrical Engineering
### Semester – I

<table>
<thead>
<tr>
<th>Course Code</th>
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MTMA-101 RESEARCH METHODOLOGY

Internal Marks: 40                L    T    P
External Marks: 60                3    1    0
Total Marks: 100

METHODS OF RESEARCH: Nature and Objectives of research; historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal.

INTRODUCTION TO STATISTICAL ANALYSIS: Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis. Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution. Basic ideas of testing of hypotheses; Tests of significance based on normal, t and Chi-square distributions. Analysis of variance technique.

DESIGN OF EXPERIMENTS: Basic principles, study of completely randomized and randomized block designs. Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography. Use of common softwares like SPSS, Mini Tab and/or Mat Lab. For statistical analysis.

BOOKS RECOMMENDED:
MTEE-101 POWER SYSTEM ANALYSIS AND DESIGN

Internal Marks: 40  L  T  P
External Marks: 60  3  1  0
Total Marks: 100

OVERVIEW: Review of modeling of power system components, formulation and modifications of the Impedance and Admittance matrices, storage techniques.

OPTIMAL POWER FLOW: Review of load flow with and without tap changing and phase shifting transformer, load flow for radial (distribution) systems, Optimal power flow (OPF) problem formulation and solution techniques.


NETWORK FAULTS AND CEEONTINGENCY ANALYSIS: Fault computation using Z – Bus, Short Circuit Calculation for Three Phase Network using z-bus, Contingency analysis for power system.

POWER SYSTEM SECURITY: Factors affecting security, Contingency analysis, Network sensitivity using load flow, correcting the generation dispatch by using sensitivity method and linear programming.


BOOKS RECOMMENDED:

MTEE-102 ADVANCED POWER ELECTRONICS

Internal Marks: 40  L  T  P
External Marks: 60  3  1  0
Total Marks: 100

REVIEW OF SEMICONDUCTOR DEVICES: Conduction Process in semiconductors, pn Junction, Charge control description, Avalanche breakdown, Power diodes, Thyristors, Gate Turn Off thyristor (GTO), VI characteristics, Dynamic characteristics, ratings, protection, heat transfer by conduction, radiation and convection, heat sink design, driving circuits.

POWER MOSFET AND IGBT: Basic structure, I-V Characteristic, Physics of device operation, switching characteristics, operating limitation and safe operating area.

EMERGING DEVICES AND CIRCUITS: Power junction Field effect transistor (FET), Integrated Gate-Commutated Thyristor (IGCT), Field Control Thyristor, Metal oxide semiconductor (MOS) Control Thyristor etc. Power ICs, New semiconductor materials.

SNUBBER CIRCUITS: Types of Snubber circuits, needs of Snubber circuit with diode, thyristor and transistors, Turn-off Snubber, over voltage snubber, turn on snubber, Snubber for bridge circuit configurations, GTO Snubber circuit.

GATE AND BASIC DRIVE CIRCUITS: Design Consideration, De-coupled drive circuits, Electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations.

BOOKS RECOMMENDED:

POLYPHASE SYNCHRONOUS MACHINES: Mathematical: Basic Synchronous machine parameters, Voltage, Flux linkage and inductance relations, Park’s transformation – its physical concept, equations of performance

BALANCED STEADY STATE ANALYSIS: Phasor equations and phasor diagrams, Power-angle characteristics, Cylindrical rotor and Salient pole machines, Short circuit ratio.

TRANSIENT ANALYSIS: Three phase short-circuits, Armature and field transients, Transient torque, Sudden reactive loading and Unloading. Transient Analysis - a qualitative approach, Reactances and Time – Constants from equivalent circuits, Measurement of Reactances, Transient Power – angle characteristics.

SYNCHRONOUS – MACHINE DYNAMICS: The basic electromechanical equation, Linearized Analysis, Large Angular/oscillation, Non-linear analysis.

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


TRANSFORMER TRANSIENTS: In-rush current phenomena, Qualitative approach, Analytical approach, In-rush current in 3-phase transformers.


BOOKS RECOMMENDED:
2. Concordia, *Synchronous machines*.
7. MIT Staff , *Magnetic Circuits and Transformer*.
MTEE-104 DIGITAL CONTROL SYSTEM

Internal Marks: 40
External Marks: 60
Total Marks: 100

L T P
3 1 0


Recommended Books:

4. Ogata, K., Modern Control Engineering, Prentice Hall.
MTEE-201 POWER SYSTEM OPERATION AND CONTROL

Internal Marks: 40
External Marks: 60
Total Marks: 100

INTRODUCTION: Characteristics of power generation units (thermal, nuclear, hydro, pumped hydro), variation in thermal unit characteristics with multiple valves, Economic dispatch with and without line losses, lambda iteration method, gradient method, Economic dispatch without line losses, economic dispatch with line losses, lambda iteration method, gradient method, Newton’s method, base point and participation factors.

TRANSMISSION LOSSES: Coordination equations, incremental losses, penalty factors, B matrix loss formula (without derivation), methods of calculating penalty factors.

UNIT COMMITMENT: constraints in unit commitment, priority list method, Dynamic programming method and Lagrange relaxation methods.

HYDRO THERMAL CO-ORDINATION: Introduction to long range and short range hydro scheduling, Types of short range scheduling problem, Scheduling energy. The short term hydro-thermal scheduling problems and its solution by Lambda-Gamma iteration method and gradient method

GENERATION WITH LIMITED ENERGY SUPPLY: take or pay fuel supply contract, composite generation production cost function, gradient search techniques.

OPTIMAL POWER FLOW FORMULATION: gradient and Newton method, linear programming methods.

AUTOMATIC VOLTAGE REGULATOR: load frequency control, single area system, multi-area system, tie line control.

BOOKS RECOMMENDED:
2. G L.K .Kirchmayer, Economic Operation of Power Systems, John Willey and Sons,N.Y.
MTEE-202 ADVANCED RELAYING AND PROTECTION

Internal Marks: 40  
External Marks: 60  
Total Marks: 100


RELAY SCHEMATICS AND ANALYSIS: Over Current Relay- Instantaneous/Inverse Time –IDMT Characteristics; Directional Relays; Differential Relays- Restraining Characteristics; Distance Relays: Types- Characteristics.

PROTECTION OF POWER SYSTEM EQUIPMENTS: Generator, Transformer, Transmission Systems, Busbars, Motors; Pilotwire and Carrier Current Schemes.

SYSTEM GROUNDING: Ground faults and protection; Load shedding and frequency relaying; Out of step relaying; Re-closing and synchronizing.


INTEGRATED AND MULTIFUNCTION PROTECTION SCHEMES: SCADA based protection systems, Testing of Relays.

BOOKS RECOMMENDED:

INTRODUCTION: Challenges in computer simulations, Mechanics of simulation, solution techniques for time domain analysis, introduction of widely used circuit-oriented simulators like Pspice, MATLAB, PSIM, equation solvers, simulation of power electronics circuits and converters.


D.C. MACHINES DYNAMICS: Ideal machine; dynamic equation; transfer function and block diagram; linear analysis of D.C. generators; effects of saturation; analysis and performance under disturbances. Switching and surge voltage transients in transformers.

INDUCTION MACHINES: Transients and dynamics; basic electro mechanical equations; linearized and non-linearized analysis; operation on harmonic supplies; unbalanced operation.

SYNCHRONOUS MACHINE TRANSIENTS: Coupled circuit viewpoint; approximate physical picture; equivalent circuit under transient conditions and its applications; synchronous motor operation with variable/fixed load torque and excitation; equal-area criterion for the study of transient stability.

BOOKS RECOMMENDED:

3. Concordia C., Synchronous machines, Theory and Performance, John Wiley and Sons.
5. Ong Chee Mun, Dynamic Simulation of Electric Machinery using MatLab and Simulink, Pentice Hall (India), New Jersey.
MTEE-204A  INTELLIGENT TECHNIQUES AND APPLICATIONS

 Internal Marks: 40
 External Marks: 60
 Total Marks: 100

L T P

ARTIFICIAL INTELLIGENCE: Definition, problem solving methods, searching techniques, knowledge representation, reasoning methods, predicate logic, predicate calculus, multivalue logic.

FUZZY LOGIC: Concepts, fuzzy relations, membership functions, matrix representation, de-fuzzification methods

ARTIFICIAL NEURAL NETWORK: Introduction, multi-layer feed forward networks, back propagation algorithms, radial basis function and recurrent networks.

EVOLUTIONARY TECHNIQUES: Introduction and concepts of genetic algorithms and evolutionary programming, Differential Evolution

HYBRID SYSTEMS: Introduction and Algorithms for Neuro-Fuzzy, Neuro-Genetic, Genetic-Fuzzy systems

AI APPLICATIONS IN POWER SYSTEMS: Load flow, economic load dispatch, load forecasting, transient stability and power system stabilizers

BOOKS RECOMMENDED:
7. RajshekaranS. and Pa G.A.V.i, Neural Network, Fuzzy logic And Genetic Algorithm, PHI.
MTEE-204B  INDUSTRIAL DRIVES AND AUTOMATIONS

Internal Marks:  40
External Marks:  60
Total Marks:  100

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3   1   0

INTRODUCTION: Definition, Types of loads, steady state and transient stability of Drive, state of art of power electronics and drives, selection of motor rating.


SYNCHRONOUS MOTOR DRIVES: Adjustable frequency operation, voltage fed drive, current fed self-controlled drive.

AUTOMATION USING DRIVES: Introduction, various components of automation, different sensors used in automation, PLC introduction and ladder programming, industrial application of automation, sensor less vector control and DTC drive, Recent trends in automation and case studies.

BOOKS RECOMMENDED:
1. Dubey G.K., Power Semiconductor Controlled Drive, Prentice Hall, New Jersey.
3. Murphy J.M.D. and Turnbull F.G., Power Electronics Control of AC Motors, Franklin Book Co.
MTEE-204C RENEWABLE ENERGY RESOURCES

Internal Marks: 40 | L T P
External Marks: 60
Total Marks: 100

ENERGY RESOURCES: Renewable energy sources, Environment, Energy and Global Climate Change energy parameters, cogeneration, rational use of energy, energy efficiency and conservation, distributed energy systems and dispersed generation, atmospheric aspects of electric energy generation, Impact of renewable energy generation on environment, GHG emissions from various energy sources, Electromagnetic Radiation from Extra High Voltage Overhead lines


HYDROGEN ENERGY SYSTEM: Hydrogen Production, Hydrogen Storage, Development of Hydrogen Cartridge, Gas Hydrate


BOOKS RECOMMENDED:

MTEE-204D HIGH VOLTAGE ENGINEERING AND TEST TECHNIQUES

Internal Marks: 40  L  T  P
External Marks: 60  3  1  0
Total Marks: 100

INTRODUCTION: Power Systems Development and High Voltage Engineering; Contents of High Voltage Engineering; Applications of High Voltage Technology.

TRAVELING WAVES: Transient and traveling waves; Effects of Line Terminations; Junction of several lines; Bewley Lattice Diagram; Traveling wave in transformer and generator.

LIGHTNING IN POWER SYSTEMS: Lightning formation; Lightning overvoltages (strike and backflashover) in power systems; Lightning overvoltages protection devices in power systems; Lightning protection system of high buildings.

SWITCHING OVER VOLTAGES: Types of internal overvoltages; The importance of switching overvoltages; Causes of various internal overvoltages; Control of switching overvoltages; EMTP and its applications.

ARRESTERS AND INSULATION COORDINATION: Surge arresters (MOA) and its performances; Voltage-Time Characteristics and coordination; Surge arresters selection and location in power systems; Principles of insulation coordination; Statistical and conventional insulation coordination.

HIGH VOLTAGE CABLES: Configuration and design features of high voltage cables; Testing of high voltage cables; Diagnostics of high voltage cables.

AIR AND SF6 BREAKDOWN: Fundamental aspects of air and SF6 breakdown, U-curve and gap factor; Sparkover characteristics; SF6 gas insulation performance.

GAS INSULATED SUBSTATION: Gas Insulated Substation (GIS) and its importance; Configuration and design features of GIS; Prospects of GIS.

HIGH VOLTAGE TEST OF ELECTRICAL APPARATUS: Nondestructive insulation testing; Destructive insulation testing: AC, DC, and Impulse testing of apparatus; New high voltage measurement technology; Safety in high voltage lab. Applications of high voltages technology in other area.

BOOKS RECOMMENDED:
1. Khalifa M., High-Voltage Engineering, Theory and Practice, Marcel Dekker, Inc.
MTEE-205A SPECIAL ELECTRIC MACHINES

Internal Marks: 40
External Marks: 60
Total Marks: 100


LINEAR MACHINES: Linear devices and actuators, Linear electric machines: Classification, application, constructional aspects, design and method of analysis of various types, Goodness factor. Transverse-edge, entry-end, exit end, short primary, short secondary effects in linear electric motors, Force, energy and power LEM's for low speed medium speed and high speed applications. Electromagnetic levitation and guidance schemes-attraction, repulsion

ADVANCED MOTORS AND DRIVE SYSTEMS: Principle, construction, operation and drive application of Square wave Permanent Magnet (PM) brushless motor drives, sine wave PM brushless motor drives, PM and synchronous reluctance based motors, switched reluctance motors, Energy efficient motors.

RECOMMENDED BOOKS:
4. Andreas J.C., *Energy Efficient Motors*, Marcel Dekker
MTEE-205B MICROPROCESSOR AND MICROCONTROLLERS

Internal Marks: 40  L  T  P
External Marks: 60  3  1  0
Total Marks: 100

MICROPROCESSOR: 8086 Internal Architecture, Addressing modes, program development steps, 8086 instruction set, Assembler directives, Assembly language, program development tools.

PROGRAMMING OF 8086: Simple sequence programs, jumps, flags, conditional Jumps, IF-THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.

PERIPHERAL INTERFACING: Parallel versus serial transmission, synchronous and asynchronous serial data transmission. Interfacing or hexadecimal keyboard and display unit, parallel, serial interface Standards.

MICROPROCESSOR APPLICATIONS TO POWER ENGINEERING: Protective Relaying: over-current, impedance, MHO, reactance, bi-directional relays.

MEASUREMENTS: Frequency, power angle and power factor, Voltage and Current, kVA, kW, and kVAR, maximum demand. Resistance, Reactance, Temperature Controls.

Microcontroller: PIC18 family- Microcontroller, architecture, Addressing Modes, Timers, Counters, Interrupts, Serial Communication, Instruction Set and Programming Concepts and applications to Electric Drive Systems

BOOKS RECOMMENDED:
2. Ram B, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai and Sons,
3. Hall, Douglas V. Microprocessors and interfacing: Programming and Hardware, Tata McGraw Hill
7. Gaonkar R. S., Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC, Thomson learning
MTEE-205C REAL TIME INSTRUMENTATION

Internal Marks: 40  
External Marks: 60  
Total Marks: 100

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INTRODUCTION: Static and Dynamic characteristics, Error analysis; transducers and sensors; their characteristics and parameters; role of instrumentation in monitoring, control and industrial automation.


DATA ACQUISITION SYSTEM: Role of dedicated computers, analog and digital control, computer systems for real time applications, distributed and supervisory control, SCADA and its organization and structure, centralized, hierarchical and decentralized control schemes, man machine interface, energy management system.

REAL TIME CONTROL APPLICATIONS: Instrumentation and conditioning of drive signals, data acquisition of drive system, energy management system for AGC, VAR Control, state estimation, security monitoring, economic dispatch, on line load management. Power system digital relaying, Power plant instrumentation.

BOOKS RECOMMENDED:
1. Torsten Cegrell, Power System Control Technology, PHI, India.
MTEE-205D OPTIMIZATION TECHNIQUES

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INTRODUCTION TO OPTIMIZATION: Statement of an optimization problem, Classification of optimization problems, Optimization techniques, Engg. applications of optimization.

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with in equality constraints.

LINEAR PROGRAMMING: Standard form of linear programming, Graphical solution, Simplex method, Two-phase simplex method, Computer implementation of the simplex method, Duality theory.

TRANSPORTATION PROBLEM: North-West Corner rule, Least cost method, Vogel approximation method, testing for optimality.

NON-LINEAR PROGRAMMING:

One–Dimensional Minimization Methods: Unimodal function, Dichotomous search, Fibonacci search, Golden Section, Cubic interpolation method, Direct root, Newton Raphson Method


Constrained Optimization Techniques: Interior Penalty function method, Exterior penalty function method, Method of Multipliers, KKT Conditions

FURTHER TOPICS IN OPTIMIZATION: Critical path method (CPM), Program evaluation and review technique (PERT). Multiobjective Optimization Techniques, Weighting method, ε-constraint method. Simulated annealing method

BOOKS RECOMMENDED:

INTRODUCTION: Energy efficient machines, energy cost and two part tariff, energy conservation in industries and agricultural sector - a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.


POWER FACTOR: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor

APPLICATION OF ELECTRIC MOTORS: Varying duty applications, Voltage variation, Voltage Unbalance, over motoring, Poly-phase induction motors supplied by adjustable frequency power supplies.

INDUCTION MOTORS AND ADJUSTABLE DRIVE SYSTEMS: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.

ECONOMICS OF ENERGY EFFICIENT MOTORS AND SYSTEMS: Motor life cycle, Direct Savings and pay back analysis, efficiency evaluation factor, present worth method with constant power costs, present worth method with increasing power costs, net present worth method.

BOOKS RECOMMENDED:
MTEE-301B POWER SYSTEM DYNAMICS and STABILITY

Internal Marks: 40
External Marks: 60
Total Marks: 100

Overview: Angular Stability, Transient stability, steady state stability, dynamic stability, Small Signal, Voltage Stability

Modeling of Power System Components: Generators (Non-linear and linear models using d-q transformation, power capability curve); Excitation System (IEEE standard models); Turbine and Speed governing System; Loads (Induction motors and composite loads);

Transient Stability Analysis: Single Machine - Infinite Bus System; Equal Area Criterion; Multi-machine Stability; Network Reduction and Numerical Integration Methods; Methods of Improvement


Sub-Synchronous Oscillations: Sub Synchronous Resonance (SSR) Phenomenon; Counter measures to SSR problems

Voltage Stability: P-V and Q-V curves, Impact of Load and Tap-changer Dynamics; Static Analysis, Sensitivity and Continuation Methods; Dynamic Simulation, Introduction to Bifurcation Analysis; Proximity Indices, Methods to enhance Stability Margin.

Books Recommended:
**MTEE-301C  EHVAC AND HVDC TRANSMISSION SYSTEM**

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**OVERVIEW:** Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission.

**EHV AC SYSTEMS:** Limitations of extra-long AC transmission, Voltage profile and voltage gradient of conductor, Electrostatic field of transmission line, Reactive Power planning and control, traveling and standing waves, EHV cable transmission system.

**STATIC VAR SYSTEM:** Reactive VAR requirements, Static VAR systems, SVC in power systems, design concepts and analysis for system dynamic performance, voltage support, damping and reactive support.

**HVDC SYSTEM:** Converter configurations and their characteristics, DC link control, converter control characteristics; Monopolar operation, converter with and without overlap, smoothing reactors, transients in DC line, converter faults and protection, HVDC Breakers.

**CORONA AND INTERFERENCE:** Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference.

**HARMONIC FILTERS:** Generation of harmonics, design of AC filters, DC filters.

**POWER FLOW ANALYSIS IN AC/DC SYSTEMS:** Component models, solution of DC load flow, per unit system for DC quantities, solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems, Multi terminal systems.

**BOOKS RECOMMENDED:**

MTEE-301D POWER SYSTEM TRANSIENTS


INSULATION CO-ORDINATION: Over voltage limiting devices, dielectric properties, breakdown of gaseous insulation, tracking and erosion of insulation, high current arcs, and metallic contacts.

COMMUNICATION LINKS: PLCC, Microwave, Telephone line, Satellite, Fibre optic. Requirements of various communication equipments used in power systems. Computer networking in power systems.

BOOKS RECOMMENDED:
MTEE-302A  POWER SYSTEM RELIABILITY

Internal Marks:  40  L  T  P
External Marks:  60  3  1  0
Total Marks:  100

PROBABILITY AND RELIABILITY: Review of probability concepts, probability distributions, applications of binomial distribution to engineering problems, probability distribution in reliability evaluation, reliability indices, network modeling and evaluation of simple and complex networks, system reliability evaluation using probability distributions, frequency and load duration techniques, key indices of power system reliability and their calculations.

GENERATION SYSTEM RELIABILITY EVALUATION: Concept of loss of load probability (LOLP), Energy demand, EDNS (Energy demand not served), Evaluation of these indices for isolated systems, generation system, reliability analysis using the frequency and duration techniques.

TRANSMISSION SYSTEM RELIABILITY EVALUATION: Evaluation of LOLP and EDNS, indices for an isolated transmission system, interconnected system reliability, bulk power system reliability.

DISTRIBUTION SYSTEM RELIABILITY EVALUATION: Reliability analysis of radial systems with switching.

BOOKS RECOMMENDED:
MTEE-302B  POWER SYSTEM PLANNING

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INTRODUCTION: Power System planning, objective, stages in planning and design, Key indices of power system reliability and their calculations, Linkage between reliability and capacity planning.

GENERATING SYSTEM CAPABILITY PLANNING: Probabilistic models of generating units, growth rate, Rate of generation capacity, Outage performance and system evaluation of loss of load and loss of energy indices, Power supply availability assessment.

INTERCONNECTED SYSTEMS: Multi area reliability analysis, Power pool operation and power exchange energy contracts, quantification of economic and reliability benefits of pool operation.

DEMAND/ENERGY FORECASTING: Electricity consumption pattern, Peak demand and energy forecasting by trend and economic projection methods.

POWER SYSTEM EXPANSION PLANNING: Formulation of least cost optimization problem involving capital, operation and maintenance costs of candidate units of different types.

INVESTMENT PLANNING MODELS: Traditional generation expansion planning models, integrated resource planning models, production cost simulation models.

BOOKS RECOMMENDED:

MTEE-302C  LOAD AND ENERGY MANAGEMENT

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LOAD FORECASTING: Classification and characterization of loads, Approaches to load forecasting, Forecasting methodology, Energy forecasting, Peak demand forecasting, Non-weather sensitive forecast and Weather sensitive forecast, Total forecast, Annual and monthly peak demand forecasts. Applications of state estimation to load forecasting.


ENERGY DEMAND FORECASTING: Static and dynamic analysis of energy demand, elements of energy demand forecasting, methodologies and models for energy demand forecasting, techno-economic approach in energy demand forecasting.

TRENDS AND CASE STUDIES: Energy management strategy, symbiotic relation between information, energy models and decision making, case studies like industrial energy forecasting, transportation energy forecasting, residential, commercial and agricultural energy forecasting.

BOOKS RECOMMENDED:

MTEE-302D ORGANIZATION AND FINANCE IN POWER SECTOR

MANAGEMENT AND ITS GOALS: Organization and Management; The management process; Managerial skills and Managerial performance; Policy and Objectives of a Power Utility; The Goal of a Firm.

UTILITY FINANCIAL ACCOUNTING: Balance Sheet, Income Statements and Cash Report; Depreciation; Interest charges during construction; Financial Statement Analysis.

INVESTMENT PROPOSAL: Interest and compounding; Measure of price - public versus private perspective; Economic evaluation of investment proposal; Internal Rate of return, Pay-Back Period

LEVELIZED COSTS OF GENERATION: Generating system costs; Basic concept of cost levelization; Levelized bus bar cost.

ELECTRICITY TARIFFS: Traditional Approach; Long-run Marginal costs; General Principles of Tariff Construction; Objectives of tariff.

UTILITY ORGANIZATION: Functional structure; Divisional Structure; Matrix structure; Hybrid structure.

INDUSTRY STATUS AND TRENDS: Main concerns of electric utilities; Performance of electric utilities; Power Sector changes; Dynamic, spot and real time pricing; Regulatory aspects - towards deregulation; System Planning under Evolving Utility Structures Computerized Management Game.

BOOKS RECOMMENDED: