SYLLABI

EEM-101 Advanced Power System Analysis:

Load Flow – Network modeling – Conditioning of Y Matrix – Load flow – Newton Raphson method – Decoupled – Fast decoupled Load flow – three phase load flow.

DC power flow – Single phase and three phase –AC-DC load flow – DC system model – Sequential solution Techniques – Extension to Multiple and Multi-terminal DC systems – DC convergence tolerance – Test System and results.

EEM-102 Power Quality Problems and Solutions

Power Quality, Power Quality Problems, Solutions to PQ problems, Active Power Filters, Hybrid Power Filters, United Power Quality Conditioners (UPQC).

Active Solution, High Power Factor Converters, Applications of Artificial Neural Networks and Fuzzy Logic for the improved power quality of high power factor converters, Simulation Studies.

EEM-103 Control of Electrical Energy Systems:

Automatic Generation Control (AGC) and Reactive Power / Voltage control using: classical, optimal, variable structure, adaptive and intelligent (fuzzy & neural) control techniques. Application of Energy Storage Devices to Power System Control.

MTM-101 Advanced Mathematics

Discrete Structures: Inductive definition of sets, recursive procedures, inductive proofs, finite and infinite sets, countable and uncountable sets. Binary relations and digraphs, properties of relations, equivalence relations, ordering relations, operations on relations, paths and closures, directed graphs and adjacency matrices. Properties, inductively defined functions, special classes of functions. Structures, semi groups, monoids, groups, lattices, homomorphisms, congruent relations.

Linear programming problems, simplex method, Duality in Linear Programming, Sequencing, application of LP to industrial problems. Non Linear programming methods – Quadratic form, Hessian Matrix, Positive definite & negative definite. Lagrange multiplier, Wolfe's mthod. Queueing Theory.

EEM-104 Power System Simulation Lab-I.

1. Development of load flow programs and their application
2. Matlab – Simulink, Power system block set Optimization, Fuzzy logic and Neural Network, tool boxes.
3. General Algebraic Modelling Systems (GAMS) - Application to Power System.

Elective-I Syllabi at Annexure-I

EEM-105 Power System Dynamics & Stability

Basic Concepts of dynamical systems and stability, Modeling of power system components for stability studies, generators, transmission lines, excitation and prime mover controllers, flexible AC transmission (FACTS) controllers.
Analysis of single machine and multi-machine systems. Small signal angle instability (low frequency oscillations): damping and synchronizing torque analysis, eigenvalue analysis.
Mitigation using power system stabilizers and supplementary modulation control of FACTS devices. Small signal angle instability (sub-synchronous frequency oscillations): analysis and counter-measures. Transient Instability: Analysis using digital simulation and energy function method. Transient stability controllers.

EEM-106 Power System Optimization:

Economic load dispatch in thermal and hydro-thermal systems; reactive power optimization; optimal power flow. Linear programming and non-linear programming techniques to optimal power flow problems. Security constrained optimization. Unit commitment and maintenance scheduling. Use of artificial neural networks in multi-objective thermal power despatch. Genetic algorithim for economic despatch.

EEM-107 Stand-Alone Energy Systems

Introduction to Stand-Alone Energy Systems: Wind, Micro-hydel and Diesel Power Generation Systems.

Hybrid Power Systems: Various combinations like wind-diesel and wind-solar systems.
Modeling and Analysis of hybrid power systems.

Introduction to various energy storage devices.

Power quality control of various stand-alone/hybrid systems: Power electronic interface with the load and existing grid, Role of PWM Converters in grid interface and power quality control of these systems.

EEM-108 HVDC Systems

Comparison between HVAC and HVDC systems.
Converter operation (normal and abnormal), Converter charts.
Harmonics and filters.
HVDC control system.
Misoperation of converters, Faults in HVDC system and their protection.
Measurements, Parallel operation of AC-DC systems, DC transmission system.

EEM-109 Power System Lab-II

Simulation of Hybrid Energy Systems using Matlab. Analysis of Power System Options for remote area using software packages. Development of mathematical model and analysis of hybrid energy systems.

Elective-II Syllabi at Annexure-I

EEM-110 Power Systems Restructuring and Deregulation

Overview of key issues in electric utilities restructuring, Deregulated Models, competitive electricity market, different methods of transmission pricing, congestion management electric energy trading, present scenario of deregulation around the world.

EEM 111 Seminar

EEM-112 Minor Project

Elective-III & IV Syllabi at Annexure-I

EEM-113 Dissertation

ANNEXURE-I

ELECTIVES I-IV

EEM-114 Advanced Instrumentation Technology

Operating principles, construction and performance of industrially important transducers for measuring: displacement, speed, vibrations, pressure, temperature and electrical power.
Quarter, half and full bridge circuits, Active filters.
Differential instrumentation and charge amplifiers, carrier amplifier system.
D.C., A.C., pulse, and digital telemetry systems, short range radio telemetry, multi-channel telemetry schemes.
Virtual instrumentation, interfacing sensors to the PC, Use of virtual instrumentation, Hardware and software for electrical and non-electrical quantities.
Digital filters: IIR and FIR filters, Adaptive filters, DFT and FFT techniques.

EEM-115 SCADA Systems

Meaning and importance of telemetry, remote control, remote signaling and SCADA.
Messages and signals, signal formation, conversion and transmission.
Analog, pulse and digital modulation techniques.
Amplitude modulation, AM transmitter and receiver.
Frequency modulation, FM transmitter and receiver.
Phase modulation, Pulse modulation techniques, Digital transmission techniques, Error detecting and correcting codes.
Signal transmission media, Power-line carrier communication, terrestrial and satellite radio links, Optical fibre communications.
Multiplexing techniques, Telemetry error, D.C., Pulse and Digital telemetry methods and systems., Multi-channel telemetry schemes.
Remote control and remote signaling, principle of independent messages and combinatorial principle.
Multi-wire, FDM and TDM remote control schems.
Supervisory Control and Data Acquisition (SCADA), layout, functions and operation of SCADA system.Remote terminal unit details, control centre details, communications in SCADA systems.

EEM- 116 Energy Management and Energy Audit

Energy scenario and energy audit, energy action planning, financial management, project management, energy monitoring and targeting, global environmental concerns.

EEM-117 Modeling & Simulations of Power System Components

Important characteristics of power system models with dynamics and control strategies. Identification of power system modeling tasks, knowledge representation, electronic data interchange, data models, power system simulation techniques, transmission control, data management, data communication, software standards. Application of Matlab / Simulink. Modelling of generation, transmission, distribution and consumption of electrical power & conversion into mechanical power. Development of complex, self-contained power systems, such as those in automobiles, aircraft, manufacturing plants and power utility applications.

ECEM-159 Embedded systems and real-time applications

Embedded system concepts. Hardware organization and architecture, Micro-controllers, Technological aspects of embedded systems, ADC/DAC, Input / Output devices, Memory devices, Synchronous / Asynchronous data transfer. Serial / parallel communication ports, programming embedded systems. Embedded board level design concepts. Introduction to MEMS. Interfacing of LCD, Sensors, Stepper motor, diff case studies.

EEM-118 **Selected Topics in Power & Energy Systems:** Recent Topics in Electrical Energy Systems

EEM-119 Power System Reliability

Generator System Models State Load Model. Probability Methods. Unit Unavailability Outage Probability . Generating Capacity Limits . Recursive Techniques . Capacity Expansion Analysis . Scheduled Outages . Reliability Indices . Frequency Duration Method.
Interconnected Systems. Two Systems with Tie . Probability Array Methods . Reliability Indices . Variable Reserve And Maximum Peak Load Reserve . Multi Connected Systems.
Operating Reserve . PJM Method . ORR . UC Risks . Economics & Reliability . Hot Reserve . Rapid Start Units . Security Function Approach.

Distribution System . Interruption Indices . System Performance . risk prediction . Radial Systems . Effect Of Load Transfer . Line Failures . Parallel And Mesh Networks . Industrial Systems.

EEM-120 Neural Network and Fuzzy System

Artificial Neuron Model, Neural Network Architectures, Learning Methods, Feedforward networks, Recurrent Networks, Radial Basis Function Networks, Associative Memory, Adaptive Resonance Theory, Applications of Neural Networks, Neural Network Based Control.

Fuzzy Sets, Set-theoretic Operations, Membership Functions, Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Implications & Aggregation, Defuzzification, Applications of Fuzzy Systems, Fuzzy Logic Based Control.

EEM-121 Flexible AC Transmission Systems

FACTS: Basic concept, Power flow and stability, Phenomenon of voltage collapse, Basic theory of line-compensation.

Classifications and configurations of FACTS controllers, Review of voltage source inverters.
Static Shunt Compensators: SVC and STATCOM-TCR, TSC, Control techniques, System stability.

Static Series Compensators: GCSC, TSSC, TCSC AND SSSC, Control techniques.
Static Voltage and Phase-Angle Regulators: Power flow control, TCVR and TCPAR.

Combined Compensators: Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC).

Modeling of FACTS Devices.

Coordination of FACTS Devices with HVDC links.

FACTS optimization, Transients and Dynamic stability enhancement.

Advanced FACTS Devices, Case studies and other applications of FACTS controllers.

EEM-122 Advanced Power System Protection:

Simulation methodologies of complex power systems and transducers, transient behaviour of transducers, signal conditioning and sampling for on line relay applications. Algorithms for protective relaying, digital protection schemes for transmission lines, generators and transformers, substation control, microprocessor based testing of relays, hardware considerations. Adaptive protection, New relaying principles based on AI techniques, ANN approach and fuzzy logic methods for fault detection and fault location.

EEM-123 Intelligent Control of Electrical Energy Systems

General understanding of more advanced control design techniques e.g cascade control model based control, adaptive control and fuzzy logic control

Expert systems, Fuzzy Logic, Neural Networks, Genetic algorithms, applications in : alarm processing, fault diagnosis in power systems, reactive power and voltage control, stability control for power systems. Intelligent control techniques for Wind Diesel Hybrid energy systems- Modelling Simulation & case studies. Problems and solution techniques in the area of control of energy converting systems.

EEM-124 Energy System Planning:

Forecasting – Needs uses and current status of forecasting – Fundamentals of quantitative forecasting – Explanatory and time serious forecasting – least square estimates – Peak load forecasting – Accuracy of forecasting methods. Regression and en** methods- Box Jenkins time serious methods.

Problems facing electricity industry-long term forecasting techniques – methods of long term forecasting – spatial load forecasting – Multivariate procedures – short term forecasting techniques.

Forecasting and planning. The role of forecasting in planning – comparison and selection of forecasting methods. The accuracy of forecasting methods. Pattern of the Data and its effects on individual forecasting method. Time horizon effects on forecasting methods. Generation planning – fundamental economic analysis – generation planning optimized according to generating unit categories – distribution & transmission system planning.