Syllabus of M. Tech. in Electrical Engineering (Electrical Power Systems)

Semester - I

Advanced Power System Operation and Control
Economic load dispatch, hydrothermal scheduling systems, power system security, optimal real and reactive power dispatch, state estimation, Q-V and P-f control loops, mechanism of real and reactive power control, tie-line bias control, optimal, sub-optimal and decentralised controllers, discrete-mode AGC, distributed digital control, emergency control, preventive control, system wide optimization, SCADA.

Advanced Protective Relaying and Switchgear
Review of principles of power system protection, Numerical relays: Introduction, comparison with conventional relays, numerical over current, distance and differential relays. Digital signal processing aspects, digital relaying algorithms, Travelling wave relays, adaptive relaying, carrier-aided protection of transmission lines. TRV envelops and rating concepts, restriking transients, duties of CBs, SF_6 and VCBs, testing of HV and EHV CBs.

Power System Dynamics
Basic Concepts of dynamical systems and stability. Modelling of power system components for stability studies, Analysis of single machine and multi-machine systems, Small signal angle instability – analysis and counter-measures, Use of power system stabilizers and supplementary modulation control of FACTS devices, Transient instability etc.

EHVAC and HVDC Transmission
Introduction to EHV transmission, transmission line trends and preliminaries, calculation of line and ground parameters, Corona effects including power loss and audible noise, radio interference, series and shunt compensations, Design of EHVAC transmission, Electrostatic and magnetic fields of EHV lines. D.C power transmission technology, analysis of HVDC converter, HVDC system control, converter faults and protection, smoothing reactor, reactive power control, harmonics and filters, multi-terminals HVDC systems, modelling and simulation of HVDC system.

Applied Linear Algebra and Matrix Computations
Vector spaces, Linear dependence, Linear transformations with respect to basis, Polynomials: The algebra of polynomials, matrix polynomials, annihilating polynomials and invariant subspaces, Jordan forms and applications, Numerical linear algebra: Direct and iterative methods of solutions of linear equations; Matrices, Least squares problems; Eigenvalue problem. **Matrix Computations :** Basic iterative methods for solutions of linear systems and their rates of convergence. Generalized conjugate gradient, Krylov space and Lanczos methods. Iterative methods for symmetric, non-symmetric and generalized eigenvalue problems. Singular value decompositions. Fast computations for structured matrices. Polynomial matrix computations. Perturbation bounds for eigenvalues.

Communication Skills for Engineers
Meaning and importance of communication skills, Introduction to technical writing, Memorandum, minutes of meetings, correspondence techniques-inviting experts, inviting quotation, complaint letters and letters of regret and adjustment, Summarizing technical material, Writing research papers.

Semester - II

Computer Aided Power System Analysis
Loadflow for AC systems, fast decoupled load flow, optimal power flow, Z - matrix for short circuit studies, state estimation, LO algorithm, fast decoupled state estimation, security and contingency studies, unit commitment, load frequency control, AI applications

Advanced Power System Stability
Detailed machine modelling of turbine-generator and associated systems, excitation systems and PSS, transient stability and small signal stability for large systems, SSR and system modelling for SSR studies, Voltage stability: P-V and Q-V curves, static analysis, sensitivity and continuation method, dynamic analysis, local and global bifurcations, margin prediction, stability of AC-DC systems.

Power Electronics in Power System
Steady state and dynamic problems in AC systems, FACTs, Principles of series and shunt compensation, static VAr compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator and UPFC. Modelling and analysis of FACTS controllers. Power Quality problems in distribution systems, harmonics, harmonics creating loads, modelling,

harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, mitigation of power quality problems.

Substation Engineering and Automation
Introduction, classification, design, construction and commissioning process, Selection and location of site for substations, Air-insulated substations, Gas-insulated substations, High voltage switching equipments, High voltage power electronic substations, Interface between automation and the substation, Substation Integration and automation, SCADA, Substation grounding and design criteria, Grounding and lightning, Substation fire protection and communications, Key diagrams of substations

Energy Management
Energy Scenario, Energy management approach, Energy Monitoring and Targeting, Energy efficiency in electrical utilities, Energy efficient technologies in electrical system, Environmental Aspects of Energy and Pollution Control, Energy performance assessment for equipment and utility systems.

Power System Simulation Lab
Modeling of generators, governors, exciters, transformers, transmission lines, shunt capacitors and reactors, static load as per IEEE/IEC standard. Modern power systems operation and control, power system deregulation, static and dynamic modeling, load flow and stability studies

Power System Transients (Elective)
Origin and nature of transients and surges, surge parameters of plant, equivalent circuit representations, lumped and distributed circuit transients, Earth and earth-wire effects, current chopping in circuit breakers, short line fault condition and its relation to circuit breaker duty, trapped charge effects, effect of source and source representation in short line fault studies, lightning phenomena, Control of transients, influence of tower footing resistance and earth resistance, traveling waves in distributed parameter multi-conductor lines.

Digital Signal Processing and its Applications (Elective)
Discrete Time Signals, Discrete systems - attributes, Z-Transform, Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems, Design of FIR Digital filters, Design of IIR Digital Filters, Effect of finite register length in FIR filter design.

Power System Reliability (Elective)
Basic Probability Theory: Review of probability concepts, probability distributions, application of binomial distribution to engineering problems, network modeling, system reliability evaluation using probability distributions, frequency and duration techniques.Generation, Transmission and Distribution System Reliability Evaluation: Concept of LOLP and E(DNS), evaluation of these indices for isolated systems, reliability analysis using the frequency and duration techniques.

Restructured Power System (Elective)
Fundamentals of restructured system, Market Architecture, Load Elasticity, Social welfare maximization, OPF: Role in vertically integrated systems and in restructured markets, Congestion Management, Optimal Bidding, Risk assessment and Hedging, Transmission Pricing and Tracing of power, Ancillary Services, Standard Market Design, Distributed Generation in restructured markets, Developments in India, IT applications in restructured markets, Working of restructured power systems.

SEMESTER – III

Major Project: Part - I
The Major Project Part-I is aimed at training the students to analyze any problem in the field of power systems independently. The project may be analytical, computational, experimental or combination of them based on the latest developments in area mentioned.It should consist of objectives of study, scope of work, critical literature review and preliminary work done pertaining to the project undertaken.

Modeling Simulation and Evolutionary Techniques:

Modeling classification: mathematical, physical and analog models. Estimation of model parameter. System identification. Experimental nature of simulation. Step involves in simulation studies validation of simulation models. Computer simulation of continuous and discrete system.
Neral network. Different network configurations. Feed forward and recurrent networks; Training algorithms; identification;
pattern recognition; system modeling and state estimation.

Fuzzy logic concept; Fuzzy relations and membership functions; Defuzzification; Fuzzy controllers. Genetic Algorithm concepts; schemata; coding; Reproduction; Cross over mutation; Scaling and fitness.
Nuero Fuzzy networks, Genetic algorithm in Fuzzy controllers.

Book:- Rajaraman

ELECTIVE ANY ONE

1.   Non conventional Energy System and Energy Converters:

Review of energy source, Importance of non conventional source such as Solar, Bio gas, Wind, Tidal and associated systems. Study of typical energy converters such as High performance machine, special generator driven by Bio gas engine, wind turbines etc, mini hydro generators, MHD, Fuel Cells, Bulb generators.
Modern state-of-art and futuristic system.

Book:- Nagpal

2.   Power System Reliability:

Fundamental concepts of reliability, generation system reliability, operating research, evaluation,   transmission and distribution system reliability, inter connected system reliability, bulk power system reliability.
Application of power electronically actuated strategic for enhancement of reliability and security. Book:- Testing Method of Reliability, A.Simpson, K.C.Kapur & L.R.Labenson

3.   Selected Topics in Machines:

Design limitations in large electrical machines. Effect of discontinuity in magnetic circuit on performance. Design of high performance, high efficiency machines. Effect on other design parameters.
CAD on electrical machines. Winding configurations and computer aided design of distributed windings. Multy phase configuration in synchronous and induction machines-security consideration and economics.
Abnormal operation of induction machines. Excitation spectra aspects on induction generator in rush current phenomenon in transformer, effect of space harmonics.

Book:- M.G.Say, Dr S.K.Sen, A.K.Sawney

SEMESTER – IV

Major Project: Part - II
Major Project Part-II is a continuation of the work done by the student during Semester III. The student is required to submit the project report (thesis) as a partial fulfillment of the M. Tech. degree. The project report is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical computation and experimental aptitude of the student, as applicable.