Syllabus of Examination for First Semester
M. Tech (Integrated Power System) Full Time

IFIP01: ADVANCED POWER ELECTRONICS

Section - A
Over view of power semiconductor device: structure, characteristics, rating and protection (Thyristors, BJT, MOSFET, IGBT, MOS controlled Thyristors etc.). Comparison of controlled switches.
- Inverters: Type, (Hard switch/soft switch Inverter, Voltage source inverter current source inverter) Operation with different types of loads. Performance parameter Harmonic elimination, control of output voltage using different switching techniques.

Section - B
DC to DC: switch mode converters: Basic concepts, Analysis of switch on and switch off transients.
- Types, DC to DC converter comparison, soft switching, close loop control.
- Resonant Converters: Comparison of PWM and resonant converter, Classification, Basic resonant circuit, concepts, Analysis and design of SRC (series), PRC (Parallel), SPRC (Series-Parallel) resonant converters, DC-DC as well as AC-DC resonant converter, Application for induction heating and reduction in THD and p. f. improvement, Different methods to control the output voltage.
- Electric Utility Application: Various types of SVCs (Static voltage compensator), Power conditioners and uninterruptible power supplies, protection of supply.

Ref. Books:

IFIP02: ADVANCED CONTROL THEORY

Section - A
Review of state variable analysis, Controllability and Observability.

Section - B

Ref. Books:

IFIP03: HVDC POWER TRANSMISSION

Section - A
Development of HVDC technology comparison between HVAC and HVDC. Applications of HVDC transmission. Type of DC transmission. Selection of converter configuration.
- Derivation of converter equations with Two valve conduction, Three valve conduction, Four valve conduction.
Control of HVDC converters and systems:

- Requirements from control systems of HVDC converter. Rectifier compounding.
- Inverter compounding. Converter control characteristics. Converter firing schemes. Individual phase control (IPC), Equidistant pulse control (EPC)
- Draw backs of individual phase control. Draw backs of EPC.
- Fault development and protection. Interaction between AC-DC power systems.
- Overvoltage on AC/DC side. Multiterminal HVDC systems. Control of MTDC systems.
- Modeling of HVDC systems. Per unit system representation for power flow solution. Representation for stability studies.

Ref. Books:

IFIP04: SWITCHGEAR & PROTECTION

Section – A

(With emphasis on implementation using static relays)
Transformer Protection: Various fault occurring on transformers & complete protection against these faults.

Section – B

Machine Protection: Protection of alternators & large motors
Bus-protection: Schemes for complete protection of EHV bus bars.
Instrument transformers for relaying: Performance of conventional CT/VT as well as capacitive
voltage transformers. Principle of operation of magneto optic CT/VT.
Philosophy of numerical relaying: Anti-aliasing filters, sampling. Measurements principle using Fourier and other algorithms and its application for implementation of various numerical relays.

Reference Books:
1. English Electric Relay Application Guide
2. Power System protection by Elmore (ABB)
3. Power System protection (Vol. I & II) by Warrington
4. Art and Science of Protective Relaying: C.R. Mason
5. Power System Protection by Ungratdal (Marcel Dekker Pub.)
6. Transmission Network Protection by Y.G. Pahlavankar (Marcel Dekker Pub)

IFIP05 POWER SYSTEM MODELING

Section – A

Synchronous Machines:
- Simplified model of Synchronous Machines.
- Steady state equation and phasor diagram. Determination of Machines parameters from manufacturers data.
- Linear model of single Machines Infinite bus system.

Section – B

Load modeling for different types of loads.
- Transformers on nominal ratio, off nominal ratios. Tap representation three-phase models of transformer
- Transmissions lines modeling, equivalent ‘pi’ model, mutually coupled three-phase lines, line
- Sectionalisation, overhead line parameters. Modeling of Excitation, essential elements of automatic feed
- back control system, concept of voltage drop compensation and modeling Prime mover controllers.

Ref. Books:
**IIIPI01: PROCESSOR APPLICATIONS TO POWER SYSTEM**

**Section – A**

Microprocessor in PC: 8086/8088/8087 architecture, organization, bus structure and timings, floating point arithmetic, 8086/8088/8087 instruction set, assembly language programming, interrupts and Interrupt structure of 8086. Memory structure and interfacing 8086/88, DRAM/SRAM interfacing. Basic I/O interfacing concepts: Memory mapped I/O and I/O mapped I/O Programmable peripheral devices (8255), Programmable interrupts controller (8259), Keyboard and display interface (8279, 8251), USART, ADC/DAC interface.

**Section – B**

Micro controller: MCS-51 (8031, 8051, 80152), architecture, instruction set, Programming and their applications. Programming techniques for looping, indexing and bit manipulation. Interfacing ADC/DAC display LCD display with stepper motor, with 8251, power factor improvement system. Introduction to DSP processor and its application to power system, harmonic analysis, FFT etc.

Ref. Books:
1. Hall, Microprocessor & Interfacing: Programming & hardware; Mc-Gray Hill books.
2. Gackar: Microprocessor Architecture, Programming application with 8085, penram international publishing (India).
3. Texas instruments DSPs.
5. Ramakant Galkwada: OP-amps & Linear ICs; Prentice Hall of India.

**IIIPI02: ADVANCED ELECTRICAL DRIVES & CONTROLS**

**Section – A**

Dynamics Of Electric Drives
- Classification of electric drives – Basic elements of an electric drive
- Dynamic condition of electric system
- Stability consideration of electric drives
- Analysis of electric machinery
- Reference frame theory
- Theory of symmetrical IM and synchronous machines

Motor Control
- Induction motor control systems a.c. Regulations and static switches,
- Control of effective rotor resistance
- Recovery of slip energy
- Variable frequency control of a.c. motor
- Cycloconverter control of slip frequency,
- Forced commutated inverter drive, analysis,
- Performance and stability of synchronous and asynchronous drives.

**Section – B**

Synchronous servomotor drives with sinusoidal waveforms, with trapezoidal waveforms. Load commutated inverter drives, Control of AC/DC machines
- State variable approach
- Scalar control method /Vector control method, comparison, Space vectors: stator space current, stator voltage space vector, stator flux linkage space vector, transformation of space vector coordinates from one reference frame to another.
- Adaptive control principals.

Digital Control of Drives
- Application of microprocessor / Computers to Electric AC/DC Drives.
- Switched reluctance motor control.
Ref. Books:
2. Electro Mechanical Energy Convection with Dynamics of Machines - Rakosh Das Begumudse Wiley Estern.
4. Variable frequency AC motor Drive system, David Finney - IEE Press.
7. Power Electronics Circuit devices and Applications, M. Rashid, Priterice Hall.
8. Power Electronics, Converters, Applications and design, Mohan Undeland, Robbins John Wiley.

IIIP03 : SPECIAL TOPICS IN POWER SYSTEMS

Section – A

Sub synchronous Research (SSR) Definitions, Modeling for SSR, Determination of SSR Methods of analysis SSR, (a) Eigen value analysis (b) Frequency domain analysis. Analysis of SSR with fixed series compensation and HVDC converter control. Counter measures for SSR. (a) System planning considerations. (i) Series Vs shunt compensation (ii) System modifications (iii) series capacitance protection & reinserion. (b) Filtering Schemes. (i) Static blocking filter (ii) By pass damping filter (c) Damping scheme (i) N.G. Hingorani Damping scheme (ii) Dynamic Stabilizers.


Section – B

Static VAR Compensators (SVC) Types of SVC Characteristic of ideal and realistic SVC their Operation, Composite characteristics, modeling of SVC, Six pulse TOR Application of SVC, Flexible AC TRANSMISSION systems (FACTS) Basic concepts, Voltage source converters, Current source converter, Comparison of STATCOM and SVC, Static Voltage and phase angle regulators, TCVR and TCPAR Combine compensator UPFC (Unified power flow). IPFC (Interline power flow controller), devices and controllers.

Power System Stabilizers (PSS) : Introduction, Basic concepts, Choice of Control Signals Tensional interaction with PSS.

Ref. Books:
6. 'AI Techniques In power systems' IEE Power Engg. Series 22, Edited by Kevin Warwick Artinur Ekwue & Raj Aggarwal.

IIIP04: ENERGY SYSTEM MANAGEMENT

Section – A


Optimum generation allocation to thermal units:

Hydro-thermal Coordination: Advantages of coordination, Optimal scheduling of hydrothermal system. Optimal operation of Hydrothermal scheduling, Combined working of Runoff river palm with steam plant. Pumped storage hydro plants.
Section – B

Unit Commitment: Optimal Unit commitment, Solution to unit commitment by Dynamic programming. Optimal unit commitment with security.
Loss Minimization by reactive power control: Smith & Tong Direct method
Disadvantages of Smith Ting, Indirect method
Active and Reactive power optimization: Introduction, Problem formulation
Solution Techniques (a) Non linear programming methods (b) Dynamic programming methods.

Ref. Books:
1. Power system operation and control by PSR Murthy
2. Economics operation of Power Systems by L. K. Kirchmayer

IIIFP05: POWER SYSTEM SIMULATION

IIIIP01: POWER SYSTEM STABILITY

Section - A
Fault analysis of large power systems, Calculation of three-phase balanced and unbalanced faults, Method of symmetrical components, Fault levels in a typical systems, Power in symmetrical components, Transient stability -(a) Consideration of rotor angle (b) consideration of time, Review of Classical Methods, Dynamic and Transient Stability Investigations And Simulation of Single Machine Infinite bus and Multi Machine systems.

Section - B
Effects of grounding on stability, Effects of various disturbances, parameters and controls on stability, Prevention of stability pull out.
Roll of automatic Voltage Regulator (AVR) on improving stability, Effect of Excitation Control and turbine governing, Augmentation by stability of conventional methods.

Ref. Books

IIIIP02 POWER SYSTEM PLANNING

Section - A
Brief outline of conventional commercial power plants: Thermal, hydro, Nuclear, Solar, Wind etc Division of each type of power plant in total installed capacity, Concept of adequacy & security, system analysis, Selection of units, Load forecasting, Classification of load forecasting uncertainty, The concept of reliability, Reliability indices, component reliability, Hazard models conventional UP and DOWN times, absolute and relative measures, Power System Reliability, outage definitions, Construction of reliability models, Generation planning, Generation system model, loss of load indices, forced outage rates, loss of energy indices, Reserve capacity evaluation, Frequency and Duration Method, System risk indices, Generation Expansion Planning.

Section - B
Transmission Planning: Probability array method of two inter connected system, Equivalent assisting unit approach to two inter connected system, factors affecting the emergency assistance available through interconnections, Weather effects on Transmission lines, Load Point Indices, Composite Generation, Data Requirements, various configurations, application to practical system, system & load point indices, Transmission Reliability Evaluation, Distribution System Reliability: Basic concept, Customer Oriented Indices in Distribution System of Planning, parallel & mesh networks Effect of transferable load economic considerations, Planning of Generation using Non-conventional (Renewable) energy sources.

Ref. Books:
1. Reliability Evaluation of Power system by Billington and Allan
2. Reliability Modeling in Elect. Power System by J. Endrenyi
3. Electric Power Distribution systems by Turan Gonen
5. Non-conventional energy Sources by G.D. Rai

IIIIP03: POWER SYSTEM DESIGN

System Planning and design based on considerations of Load forecast, Voltage levels, Frequency drops, etc. A typical of Electrical design and its Protection.