4/4 B.Tech. FIRST SEMESTER

EE7T1 POWER SYSTEM OPERATION AND CONTROL Credits: 4

Lecture: 4 periods/week **Internal assessment: 30 marks**
Tutorial: 1 period /week **Semester end examination: 70 marks**

Objectives:

This subject deals with Economic operation of Power Systems, Hydrothermal scheduling and modelling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

Learning outcomes

After completing the course the student shall

1. Be able to explain the functional content of economic load dispatch, unit commitment and load frequency control
2. Be able to create simple architectures for simple area load frequency control and two area load frequency control
3. Under stand importance of reactive power compensation
4. Have knowledge of emerging trends in systems used for power system operation and control.

Unit I Economic Operation of Power Systems

Optimal operation of Generators in Thermal Power Stations, - heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

Unit II Hydrothermal Scheduling

Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, scheduling problems-Short term hydrothermal scheduling problem.

Unit III Modelling of Turbine, Generator

Modelling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models.

Modelling of Generator (Steady State and Transient Models): Description of Simplified Network Model of a Synchronous Machine (Classical Model), Description of Swing Equation (No Derivation) and State-Space II-Order Mathematical Model of Synchronous Machine.

Unit IV Modelling of Governor, Excitation system

Modelling of Governor: Mathematical Modelling of Speed Governing System – Derivation of small signal transfer function.

Modelling of Excitation System: Fundamental Characteristics of an Excitation system, Ttransfer function, Block Diagram Representation of IEEE Type-1 Model

Unit V Single Area Load Frequency Control

Necessity of keeping frequency constant.

Definitions of Control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case - Proportional plus Integral control of single area and its block diagram representation, steady state response

Unit VI Two-Area Load Frequency Control
Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias control – Load Frequency Control and Economic dispatch control.

Unit VII Reactive Power Control
Overview of Reactive Power control – Reactive Power compensation in transmission systems – advantages and disadvantages of different types of compensating equipment for transmission systems; load compensation – Specifications of load compensator, Uncompensated and compensated transmission lines: shunt and Series Compensation.

Unit VIII Restructuring of power systems
Deregulated environment of power systems - Need and conditions for deregulation, Introduction of Market structure, Market Architecture, Spot market, forward markets and settlements. Review of Concepts marginal cost of generation, least-cost operation, incremental cost of generation. Power System Operation: Old vs New

Learning resources

Text books:

1. Power system stability and control by prabha kundur TaTaMcGraw Hill
2. Modern Power System Analysis – by I.J.Nagrath & D.P.Kothari Tata M Graw – Hill Publishing Company Ltd, 2nd edition.
3. Generation of electrical energy by B. R. Gupta , S. Chand and Company.

Reference books:

1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., THOMPSON, 3rd Edition.
2. Electric Energy systems Theory – by O.I.Elgerd, Tata Mc Graw-hill Publishing Company Ltd., Second edition.
3. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
4. Power System Analysis by Hadi Saadat – TMH Edition.