IV Year B.Tech. EEE I - Semester

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EE419 ANALYSIS AND OPERATION OF POWER SYSTEM

Course Description & Objectives:

To Able to understand that in real world, how to analyze the status of power system. To understand the different heat rate curves and economic distribution of loads in thermal generators. To understand typical graphs of power system networks, and basis for Loadflow problem. To solve Loadflows in typical power systems. To understand the basic concepts of fault analysis and its importance. To understand the concept of stability and its importance in power system.

Course Outcomes:

- *Describe the components of a power system and model the same.*
- *Distribute load economically between the thermal plants*
- *Perform steady state load flow analysis using Newton – Raphson methods*
- *Analyze symmetrical faults to determine the fault level.*
- *Apply symmetrical components to analyze the unsymmetrical faults*
- *Explain steady state and transient stabilities; determine transient stability using equal area criterion*

UNIT I - Power System Analysis and Optimal Operation:

Introduction To Power System Analysis And Control: Introduction to Modern Power System Analysis and Operational Studies, Comparison between present and old structure, Importance of Planning, Analysis and Control.

Optimal Operation In Thermal Power Stations: Cost Curve – Incremental fuel and Production costs, Optimum generation allocation with and without line losses, Loss Coefficients, Numerical problems.

UNIT II - Graph Theory & Power Flow Problem:

Power System Graphs: Formation of system Y-bus by inspection method, Power system Z-bus building up algorithm (Without Derivation), Simple Problems up to four bus systems.

Power Flow Problem: Formulation of power flow problem, types of buses, classification of variables, expressions for real and reactive power injections, Solution of static power flow equations by Newton Raphson's method, Jacobian elements, convergence condition. Fast-decoupled method for power flow problem and its derivation from Newton's method, Including Q-limit check, Numerical problems for systems up to 3-buses.

UNIT III - Fault Analysis:

Importance of Fault Analysis in Power systems, Basic Assumptions in Power System Fault Analysis.

Symmetrical Faults: Symmetrical Faults, Problem formulation and solving procedure, Selection of Circuit Breakers.

Unsymmetrical Faults: Introduction to Symmetrical Components, Computation of all Sequence impedances, and Sequence networks for Alternators, Transformers, Transmission Lines and Loads. Representation of Sequence networks for LG, LL and LLG faults and Numerical Problems.

UNIT IV - Power System Stability:

Introduction to Power system stability, Classification of power system stabilities, steady state and transient stability limits. Power angle curve, Derivation of Swing equation, synchronizing power coefficient, Equal area criterion, determination of critical clearing angle, Numerical problems, Methods to improve the stability limits.

UNIT V - Load Frequency Control:

Necessity of keeping frequency constant, Definitions of Control area, Load frequency control of single and 2-area system, Block diagram representation of an isolated power system, Steady state analysis, Dynamic response, Controlled and Uncontrolled case, Tie-line bias control, Proportional plus Integral control of single area and its block diagram representation.

TEXT BOOKS:

1. J. Grainger and WD Stevenson Jr, "Power System Analysis", 1st ed., TMH, 2005.
2. D.P. Kothari, I.J. Nagrath, "Modern Power System Analysis", 3rd ed., TMH, 2008.

REFERENCE BOOKS:

1. Hadi Saadat, "Power System Analysis", 1st ed., TMH, 1999.
2. O I Elgerd, "Electric Energy Systems Theory an introduction", 2nd ed., TMH, 2006.