POWER SYSTEM ANALYSIS

Course Code:13EE1126

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Pre requisites:

Student should know the basic concepts in Electrical power system networks, concepts to solve linear differential equations.

Course Educational Objectives:

- To teach students to formulate impedance , admittance matrices for given power system networks and formulate load flow equations .
- Solve the load flow equations by various numerical methods like Gauss Seidal method, Newton Raphsons methods, modified Newton Raphsons method.
- To teach students solution for unsymmetrical faults by symmetrical components methods.
- To introduce students the concepts of steady state stability, transient state stability and methods to improve the steady state stability of given power system networks.

Course Outcomes:

- Formulate Y_{bus} ,Z_{bus} for a given power system network.
- Solution to load flow equation for a power system network.
- Solution for power system network for unsymmetrical faults using symmetrical components.
- Power system steady state stability and transient state stability analysis

UNIT-I (12 Lectures)

POWER SYSTEM NETWORK MATRICES:

Graph Theory: Definitions, Bus Incidence Matrix, Y_{bus} formation by Direct and Singular Transformation Methods, Numerical Problems.

Formation of Z_{Bus}: Partial network, Algorithm for the Modification of Z_{Bus} Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses (Derivations and Numerical Problems).- Modification of ZBus for the changes in network (Problems)

UNIT-II (12 Lectures)

POWER FLOW STUDIES :

Necessity of Power Flow Studies – Data for Power Flow Studies – Derivation of Static load flow equations – Load flow solutions using Gauss Seidel Method: Acceleration Factor, Load flow solution with and without P-V buses, Algorithm and Flowchart. Numerical Load flow Solution for Simple Power Systems (Max. 3-Buses): Determination of Bus Voltages, Injected Active and Reactive Powers (Sample One Iteration only) and finding Line Flows/Losses for the given Bus Voltages. Newton Raphson Method in Rectangular and Polar Co-Ordinates Form: Load Flow Solution with or without PV Busses- Derivation of Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods.- Comparison of Different Methods – DC load Flow

UNIT-III (12 Lectures)

SHORT CIRCUIT ANALYSIS-1 :

Per-Unit System of Representation, Per-Unit equivalent reactance network of a three phase Power System, Numerical Problems. Symmetrical fault Analysis: Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors, Numerical Problems. Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero sequence components: Voltages, Currents and Impedances. Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without fault impedance, Numerical Problems.

UNIT-IV (12 Lectures)

POWER SYSTEM STEADY STATE STABILITY ANALYSIS :

Elementary concepts of Steady State, Dynamic and Transient Stabilities. Description of Steady State Stability Power Limit, Transfer Reactance,

Synchronizing Power Coefficient, Power Angle Curve and Determination of Steady State Stability and Methods to improve steady state stability.

UNIT-V (12 Lectures)

POWER SYSTEM TRANSIENT STATE STABILITY ANALYSIS:

Derivation of Swing Equation. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation.- Solution of Swing Equation: Point-by-Point Method. Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.

TEXT BOOKS:

1. John J Grainger, William D Stevenson Jr, *"Power System Analysis"*, Tata Mc Graw–Hill Edition,2003.

2. Hadi Saadat, *"Power System Analysis"*,2nd Edition, TMH Edition, 2003

REFERENCES:

4. I.J.Nagrath &D.P.Kothari , "*Modern Power system Analysis*", 3rd edition, Tata McGraw-Hill Publishing company, 2010

5. M.A.Pai, *"Computer Techniques in Power System Analysis"*, 2nd Edition, Tata McGraw-Hill Edition, 2006