

PS5101 ADVANCED POWER SYSTEM ANALYSIS

DETAILED SYLLABUS

OBJECTIVES:

- To introduce different techniques of dealing with sparse matrix for large scale power systems.
- To impart in-depth knowledge on different methods of power flow solutions.
- To perform optimal power flow solutions in detail.
- To perform short circuit fault analysis and understand the consequence of different type of faults.
- To illustrate different numerical integration methods and factors influencing transient stability

UNIT I SOLUTION TECHNIQUE

Sparse Matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity. Flexible packed storage scheme for storing matrix as compact arrays – Factorization by Bifactorization and Gauss elimination methods; Repeat solution using Left and Right factors and L and U matrices.

UNIT II POWER FLOW ANALYSIS

Power flow equation in real and polar forms; Review of Newton's method for solution; Adjustment of P-V buses; Review of Fast Decoupled Power Flow method; Sensitivity factors for P-V bus adjustment

UNIT III OPTIMAL POWER FLOW

Problem statement; Solution of Optimal Power Flow (OPF) – The gradient method, Newton's method, Linear Sensitivity Analysis; LP methods – With real power variables only – LP method with AC power flow variables and detailed cost functions; Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.

UNIT IV SHORT CIRCUIT ANALYSIS

Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase – symmetrical and unsymmetrical faults.

UNIT V TRANSIENT STABILITY ANALYSIS

Introduction, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model; Factors influencing transient stability, Numerical stability and implicit Integration methods.

REFERENCES

1. A. J. Wood and B. F. Wollenberg, "Power Generation Operation and Control", John Wiley and sons, New York, 1996.

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For Questions, Notes, Syllabus & Results

2. W. F. Tinney and W. S. Meyer, "Solution of Large Sparse System by Ordered Triangular Factorization" IEEE Trans. on Automatic Control, Vol: AC-18, pp:333- 346, Aug 1973.
3. K.Zollenkopf, "Bi-Factorization: Basic Computational Algorithm and Programming Techniques; pp:75-96; Book on "Large Sparse Set of Linear Systems" Editor: J.K.Rerd,Academic Press, 1971.
4. M.A.Pai," Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006. 5. G W Stagg, A.H El. Abiad, "Computer Methods in Power System Analysis", McGraw Hill, 1968.
6. P.Kundur, "Power System Stability and Control", McGraw Hill, 1994.