Computer Aided Power System Analysis - Web course

COURSE OUTLINE

The present day power systems are characterized by large highly interconnected network. Extensive system studies are required at almost all stages of its planning, operation and control.

Simulation and analysis of such a large system is possible only with the help of digital computers. Most of the time, a power system, theoretically, remains under steady state.

Load flow or power flow study is the most frequently carried out steady state analysis, which determines system voltage profile and line flows/losses. The ever growing concern towards secure operation of power systems requires security analysis to be carried out at planning as well as operation stage, which involves analyzing system states following contingencies.

A fault in the power system network results in excessive current flowing through its various components. Fault analysis is important in determining the short circuit levels, which is utilized in proper selection of equipments and determining the protection requirements. A disturbance in the system, including a fault, may sometimes lead to unstable operation of the system.

Different types of stability phenomena have been observed in the power systems, which need to be critically analyzed, utilizing appropriate dynamic model of the system.

This course will cover the modeling issues and analysis methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the power systems. Necessary details of numerical techniques to solve nonlinear algebraic as well as differential equations and handling of sparse matrices will also be included.

Contents:

General introduction to modern power systems and its analyses; Modeling of power system components; Load flow/power flow studies; Sparse matrices; Introduction to power system security; Contingency analysis; Fault analysis of large power systems; Power system stability classification; Transient and small signal stability studies considering classical models;

NP-TEL

NPTEL

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Electrical Engineering

Pre-requisites:

1. Basic power system analysis course at undergraduate level.

Additional Reading:

1. A.J. Wood and B.F. Wollenberg, *Power Generation Operation and Control*, John Wiley & Sons, 1996.
2. C.W. Taylor, *Power System Voltage Stability*, Mc Graw Hill, 1994.
3. L. Phillipson and H.L.Willis, *Understanding Electric Utilities and Deregulation*, Marcel Dekker Inc. 1998.
4. J Arrillaga, "*High Voltage Direct Current Transmission*", Peter Peregrinus Ltd, UK.

Voltage stability analysis.

COURSE DETAIL

Sl. No	Topic	No. of Hours
Module-I	**General Introduction:** Modern Power Systems Operation and Control, Different types of Power System Analysis.	02
Module-II	**AC Power Flow Analysis:** Introduction, Modeling of Power System Components, Power Flow Equations, Formation of Y_{bus} Matrix, Power Flow Solution Algorithms, Newton Raphson Load Flow Method, Fast Decoupled Load Flow Method And DC Load Flow Method, AC-DC System Power Flow Analysis- Sequential and Simultaneous Solution Algorithms .	10
Module-III	**Sparse Matrices:** Sparsity directed Optimal Ordering Schemes, Solution Algorithms - LU Factorization, Bifactorization and Iterative Methods.	03
Module-IV	**Analysis of Faulted Power System:** Symmetrical and Asymmetrical Faults, Z_{bus} Formulation, Short Circuit Analysis of Large Power Systems using Z_{bus}, Analysis of Open Circuit faults.	08
Module-V	**Security Analysis:** Basic Concepts, Static Security Analysis at Control Centers, Contingency Analysis, Contingency Selection.	06

5. Research Papers.

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Module-VI	**Stability Analysis:** Classification of Power System Stability, Classical Model of Synchronous Machines and Excitation System, Transient Stability Analysis of Multi-Machine Systems, Eigen Analysis of Dynamical Systems, Small Signal Stability Analysis using Classical Model, Basic Concepts of Voltage Stability Analysis.	10

References:

Reference Books:

1. O.I. Elgerd, *Electric Energy Systems Theory - An Introduction*, McGraw-Hill, 1988.
2. A.R. Bergen and Vijay Vittal, *Power Systems Analysis*, Pearson Education Asia, 2001.
3. J.J. Grainger and W.D. Stevenson, *Power System Analysis*, Mc Graw-Hill, New York, 1994.
4. I.J. Nagrath and D.P. Kothari, *Power System Engineering,* Tata Mc Graw Hill Publishing Co., 1994.
5. J.D. Glover, M. Sarma and T.J. Overbye, *Power System Analysis and Design*, Fourth Edition, Thomson Engineering Press, 2008.
6. P. Kundur, *Power System Stability and Control*, Mc Graw Hill, 1994.