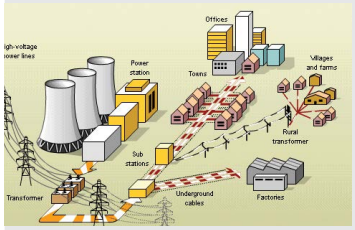
22EE303 ANALYSIS AND OPERATION OF POWER SYSTEMS



Source: https://www.mathworks.com/matlabcentral/fileexchange/59097-power-system-analysis-lab-experiments-using-matlab-manual

Hours Per Week :

L	T	P	C
3	0	2	4

PREREQUISITE KNOWLEDGE: Basic Circuit Analysis; Basic of Electrical Machines; Basic of Power Transmission and Distribution.

COURSE DESCRIPTION AND OBJECTIVES:

This course offers comprehensive knowledge on the basics of power system and its operation under steady and transient state. It also deals with the economic distribution of loads in thermal generators. The objective of the course is to model the power system and analyse the power flow, different types of faults, to understand economic dispatch and load frequency control.

MODULE-1

UNIT-1 **14L+0T+0P=14 Hours**

POWER FLOW PROBLEM:

Network Matrices: Formation of system Y-bus by inspection method, Power system Z-bus building up algorithm without mutual coupling (without derivation), simple problems up to four bus systems.

Power Flow Problem-I: Formulation of power flow problem, Types of buses, Classification of variables, Expressions for real and reactive power injections, Formulation of power flow problem, Solution of static power flow equations by Newton Raphson's method, Jacobian elements, Convergence condition, Algorithm and flow chart.

Power Flow Problem-II: Decoupled load flow, Fast decopuled load flow, Assumption, Derivation, algorithm and flow chart, numerical problems up to 3 buses; comparison of all load flow methods.

UNIT-2 **10L+0T+16P=26 Hours**

FAULT ANALYSIS:

Symmetrical Faults: Symmetrical faults, Problem formulation and solving procedure, Selection of circuit breakers.

Unsymmetrical Faults: Introduction to symmetrical components, Unsymmetrical faults analysis and expressions for fault current, Computation of all sequence impedances and sequence networks for alternators, Transformers, Transmission lines and loads.

PRACTICES:

- MATLAB code for formation of bus admittance matrix. (Y bus).
- MATLAB code for formation of Impedance matrices (Z bus).
- MATLAB code for Solution of the nonlinear equation using Newton Raphson method.
- 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.

SKILLS:

- ✓ *Formulate basic power flow problem.*
- ✓ *Classify different short circuit faults in power systems.*
- ✓ *Understand the stability problem in power system subjected to disturbances.*
- ✓ *Obtain economic dispatch for given load profile.*
- ✓ *Analyse the problem of load frequency control strategy.*

MODULE-2

UNIT-1 **14L+0T+0P=14 Hours**

POWER SYSTEM STABILITY:

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.

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-2 **10L+0T+16P=26 Hours**

LOAD FREQUENCY CONTROL:

Load Frequency Control-I: Necessity of keeping frequency constant, Definitions of control area, Load frequency control of single 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.

Load Frequency Control-II: Load frequency control of 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.

PRACTICES:

- Economic Dispatch without considering transmission line loss of a three-bus.
- Generating test system by Lambda Iteration method using MATLAB software.
- Simulation of single area load frequency control with integral controller.
- Simulation of single area load frequency control without integral controller.
- Simulation of Load - Frequency Dynamics of Two-Area control power systems.

COURSE OUTCOMES:

Upon successful completion of this course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Module No.	Mapping with POs
1	Execute the steady state load flow analysis	Apply	1	1,2,3,9,11
2	Apply the symmetrical component theory for fault calculations.	Apply	1	1,2,3,4,9,11
3	Analyse load frequency in single and 2-area systems	Analyze	2	1,2,3,4,9,11
4	Formulate the system matrices by different algorithms.	Evaluate	1	1,2,9,11
5	Judge the optimal scheduling of generators.	Evaluate	2	1,2,3,9,11

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Hadi Saadat, “Power System Analysis”, 1st edition, TMH, 1999.
2. O. I. Elgerd, “Electric Energy Systems Theory an introduction”, 2nd edition,TMH, 2006.
3. P. Kundur, “Power System Stability and Control”, 1st edition, Mc-Graw Hill, 2009