

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07) COMPUTER METHODS IN POWER SYSTEM ANALYSIS SUBJECT CODE: 2710711 SEMESTER: I

Type of course: Core

Prerequisite: Power system analysis and simulation at UG level

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Network Formulation and Graph Theory: Introduction, Network Equations, Graph Theory, Development of Network Matrices from Graph Theoretic Approach, Augment Cut-set Incidence Matrix Cut-set and Circuit Equations, Building Algorithm for the Bus Impedance Matrix Modification of ZBUS matrix due to changes in the primitive network	4	10
2	Load Flow Studies: Introduction, Different techniques such as Gauss Soidal method, Newton Raphson method, De-Coupled method, Fast Decoupled method, Modified Fast Decoupled, Concept of Optimal Power Flow, Solution of Optimal power flow by Gradient method, Solution of Optimal power flow by Newton's method Linear Programming Methods, DC load flow, Continuation Power flow	10	25
3	Power System Security: Introduction, Factors Affecting Power System Security, Short Circuit Studies of a Large Power System Networks, Symmetrical Fault Analysis Using Bus Impedance Matrix, Algorithm for Formation of Bus Impedance Matrix, Contingency Analysis: Detection of Network Problems, Overview of security analysis, Linear Sensitivity Factors, Contingency Selection, Concentric Relaxation, Bounding	10	25
4	Introduction to State Estimation in Power Systems: Introduction, Power system state estimation, Maximum Likelihood Concept , Weighted Least Squares Estimation, Introduction, Matrix Formulation, State Estimation of an AC network, Development of Method, State Estimation by Orthogonal Decomposition, An Introduction to Advanced topics in state estimation, Detection and Identification of Bad measurements, Estimation of quantities not being measured, Network Observability and Pseudo measurements,	10	25

	Application of Power Systems State Estimation		
5	Numerical Integration Techniques: Numerical integration techniques: One step methods, Taylor series based methods, Forward -Euler's method, Runge-Kutta methods, Trapezoidal method, backward-Euler's method, Accuracy and error analysis, Numerical stability analysis, Stiff systems, Step-size selection, Differential algebraic systems, triangular factorization, Power system applications: Transient stability analysis	8	15

Reference Books:

1. Computer-Aided Power Systems Analysis (2nd Edition), George Kusic, CRC Press – Indian Edition
2. Power Generation Operation & Control, John Wiley & Sons, Inc, 1996- A. J. Wood and B. F. Wollenberg
3. Power System Analysis By stevenson and grainger TATA McgrowHill
4. AC-DC Power System Analysis, IEE London UK, 1998- Jos Arrillaga and Bruce Smith
5. Power System Analysis, Tata Mcgraw Hill, New Delhi, 1999- Hadi Sadat
6. Computational methods for Electric Power Systems, CRC press- Mariesa Crow
7. Computer Methods in Power System Analysis, Glenn Stagg and El-abiad, McGraw-Hill

Course Outcome:

After learning the course the students should be able to

1. Recent techniques and computer application for modeling of practical and large interconnected power system networks using programming languages.
2. Recent methodologies for simulation and analysis of power system networks like real and reactive power flows and optimal scheduling.
3. Effect of outage of any important component of power system on the operation and reliability of power systems.
4. Algorithm required to find out parameters for monitoring and control of power system in real time from actual measurement data.
5. Computer Algorithms used to solve *algebra-differential* pertaining to power system to assess the stability performance of power systems.

List of Experiments:

1. Formation of network matrices using any programming language
2. Develop the program for power flow analysis using Gauss iterative method
3. Develop the program for power flow analysis using GS method
4. Develop the program for power flow analysis using NR method
5. Develop the program for gain matrix (H) in state estimation
6. Develop the program for power flow analysis using FDLF method
7. Develop the program for WLSE method for DC networks
8. Develop the program for bad data detection and elimination
9. Develop the program for gain matrix (H) in state estimation
10. Develop the program for stability assessment of SMIB
11. Develop the program for solution of swing equation using various method of solution of differential equation
12. Develop the program for solution of integro-differential equation

Open Ended Problem:

Collection of data required for power flow analysis of any actual/existing system consisting of minimum ten buses. Use the same data for state estimation, stability and/or security analysis.

Computers with software like MATLAB, SciLAB, C, C++, and it is preferable to have some software packages like MiPower , ETAP, PSCAD.

List of Open Source Software/learning website:

Demo version of above mentioned software.

Pdf class notes, presentations and video lectures available at nptel.ac.in related to above topics