GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: ELECTRICAL ENGINEERING
SUBJECT NAME: POWER SYSTEM ANALYSIS
SUBJECT CODE: 3710711
M.E. 1st SEMESTER

Type of course: Core I

Prerequisite: Basic courses on Power System Analysis of UG level

Rationale: Power systems are typically characterized by large size and complex nature. Therefore, its analysis for various purposes is extremely important. The assessment of load flows under the presence of complex components, fault analysis of large systems, security assessment, contingency analysis, power system state estimation and voltage stability have got importance in modern power systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Load flow**:** Overview of Newton-Raphson, Gauss-Siedel, Fast decoupled methods, convergence properties, sparsity techniques, handling Q_{max} violations in constant matrix, inclusion of frequency effects AVR in load flow, handling of discrete variable in load flow.	**6**	15
2	Fault Analysis**:** Simultaneous faults, Open conductors faults, Short Circuit Studies of a Large Power System Networks, Symmetrical Fault Analysis Using Bus Impedance Matrix, Algorithm for Formation of Bus Impedance Matrix	**9**	20
3	Security Analysis: Power System Security: Introduction, Factors Affecting Power System Security, , Contingency Analysis: Detection of Network Problems, Overview of security analysis, Linear Sensitivity Factors, Contingency Selection, Concentric Relaxation, Bounding Security state diagram, contingency analysis, generator shift distribution factors, Line outage distribution factor, multiple line outages, Overload index ranking	**8**	20
4	Power System Equivalents**:** WARD equivalents, REI equivalents	**3**	10
5	State Estimation: Introduction to State Estimation in Power Systems: Introduction, Power system state estimation, Maximum Likelihood Concept , Weighted Least Squares Estimation, Statistics in state estimation-Gaussian Probability Distribution Function, Matrix Formulation, State Estimation of an AC network, Development of Method, Structure of Jacobian in state estimation, State Estimation by Orthogonal Decomposition, An Introduction to Advanced topics in state	**10**	25

	estimation, Detection and Identification of Bad measurements : Bad by Chi-square technique, Estimation of quantities not being measured, Network Observability and Pseudo measurements, Application of Power Systems State Estimation		
6	Voltage Stability: Voltage stability, instability and collapse, Factors contributing voltage instability, Voltage Collapse Proximity Indices(VCPI) sensitivity based VCPI, Line indices, The continuation power flow, Predictor corrector technique,, Q-V and P-V curves, multiple power flow solution, optimal multiplies load flow,	**6**	10

Reference Books:

1. J.J. Grainger & W. D. Stevenson, "Power system analysis", McGraw Hill ,2003
1. A. R. Bergen & Vijay Vittal, "Power System Analysis", Pearson, 2000
2. L. P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006
3. G. L. Kusic, "Computer aided power system analysis", Prentice Hall India, 1986
4. A. J. Wood, "Power generation, operation and control", John Wiley, 1994
5. P. M. Anderson, "Faulted power system analysis", IEEE Press, 1995

6. Glenn Stagg and El-abiad, Computer Methods in Power System Analysis, McGraw-Hill

7. Mariesa Crow, Computational methods for Electric Power Systems, CRC press

8. Jos Arrillaga and Bruce Smith, AC-DC Power System Analysis, IEE London UK, 1998

9. George Kusic, Computer-Aided Power Systems Analysis (2nd Edition), CRC Press – Indian Edition

Course Outcome:

After learning the course the students should be able to:

1. Able to calculate voltage phasors at all buses, given the data using various methods of load flow
2. Able to calculate fault currents in each phase for different type of fault and location of faults
3. Rank various contingencies according to their severity
4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps, CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

List of Experiments:

- Practicals shall be based on above topics

List of Open Source Software/learning website:

- E-materials available at the website of NPTEL- http://nptel.ac.in/
- MATLAB (Trial version): Software is useful for simulation and analysis of electrical systems