SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B.Tech. Semester VII

Subject Name: Power System Operation and Control **Subject Code: BTEL14744**

Type of course: Professional Elective courses

Prerequisite: Power System – 2 & Interconnected Power System

Rationale: Demand of electrical energy is increasing day by day due to improvement in the life style of the people in particular and development of the countries in general. On the other hand, conventional sources of power generation are limited. Under this scenario, the power system network operates in a stressed condition. Effective management of generation, transmission and distribution of electrical power is necessary for optimal system operation, for loss minimization and to avoid the unwanted power cuts. This subject deals with the fundamentals for effective operation and control of the power system.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	-	-	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Power System Security:** Introduction, System State Classification, Normal and Alert State in a Power System, Emergency Control, Emergency Control An Example, Factors Affecting Power System Security, Contingency Analysis: Detection of Network Problems, Overview of security analysis, Sensitivity Factors: generation shift distribution factor, line outage distribution factor, Contingency Selection, Concentric Relaxation, Bounding. [2, 5]	08	20
2.	**State Estimation:** Introduction to State Estimation in Power Systems: Introduction, Power system state estimation, Maximum	10	25

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	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 estimation, Detection and Identification of Bad measurements : Chi-square technique, Estimation of quantities not being measured, Network Observability and Pseudo measurements, Application of Power Systems State Estimation [1,2]		
3.	**Reactive Power and Voltage Control:** Introduction; Reactive power requirement of an uncompensated line; Implication of surge impedance loading; Reactive loss characteristics of transmission line; Operation of a transmission line at no load condition; Operation of a transmission line under heavy loading condition; Voltage regulation of the transmission line and its relation with reactive power; Maximum power transfer in an uncompensated line; Line loadability. Reactive power-voltage (Q-V) coupling concept; Governing effects on reactive power flow; Relation between voltage and reactive power at a node in a power system; Reactive power requirement for control of voltage in long lines; Operational aspects in reactive power and voltage control; Basic principle of system voltage control; Reactive power flow constraints and their implications in loss of voltage; Effect of transformer tap changing in the post disturbance period; Effect of generator excitation adjustment in the post disturbance period; Practical aspects of reactive power flow problems leading to voltage collapse in EHV lines. Power System Voltage Stability: Definition and Classification of Voltage Stability, Mechanism of Voltage Collapse, Analytical Concept of Voltage stability for a Two-bus System, Expression for Critical Receiving End Voltage and Critical Power Angle at Voltage Stability Limit for a Two-bus Power System, Relation of Voltage Stability and Rotor Angle Stability [3,4]	**15**	**25**
4.	**Load Forecasting:** Introduction; Forecasting Methodology; Estimation of Average and Trend Terms; Estimation of Periodic Components; Estimation of $y_s(k)$: Time Series Approach; Long-Term Load Predictions Using Econometric Models; Reactive Load Forecasting [5].	**06**	**15**
5.	**Introduction to Power System Deregulation and Restructuring:** Introduction; Motivation for Restructuring of power system; Electricity market entities and model; Benefits of Deregulation;	**06**	**15**

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	Basic terminologies; Deregulation – International scenario; Milestones of deregulation in the world. **Indian power sector – Past and present status:** Growth of power sector in India – An overview, A time line of the Indian power sector, Players in the Indian power sector, Research and professional bodies. [6,7]		

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	**20**	**15**	**20**	**20**	**10**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of Publication	Publication Edition
1	Power Systems Analysis	John J. Grainger W. D. Stevenson	Jr., Tata McGrawHill International ISBN (13): 978-0-07-058515-7	2011	First
2	Power Generation Operation and Control	A. J. Wood, B. F. Woolenberg	John Wiley and Sons. ISBN: 978-81-265-0838-9	2009	Second
3	An introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems	A Chakrabarti D P Kothari A K Mukhopadhyay Abhinandan De	PHI Learning ISBN: 978-81-203-4050-3	2010	First
4	Power System Analysis Operation and Control	Abhijit Chakrabarti Sunita Halder	PHI Learning ISBN: 978-81-203-4015-2	2011	Third
5	Modern Power System Analysis	D. P. Kothari, I. J. Nagrath	TMH Publication ISBN (13): 978-0-07-107775-0	2011	Fourth

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6	Electrical Power Systems	P. Venkatesh, B.V. Manikandan, S.C. Raja, A. Srinivasan	PHI Learning ISBN: 978-81-203-4538-6	2012	First
7	Operation of Restructured Power Systems	K. Bhattacharya, H. J. Bollen, J. E. Daalder	Kluwer academic publishers ISBN: 978-1-4613-5567-0	2001	First
8	Power System Analysis	T.K. Nagsarkar M.S. Sukhija	Oxford University Press ISBN: 0-19-568451-6	2016	Second
9	Power System Analysis	Hadi Saadat	McGraw Hill Education India Pvt Ltd. ISBN: 0-07-116758-7	1999	First
10	Advanced Power System Analysis and Dynamics	L. P. Singh	New Age International ISBN: 81-224-2049-4	2007	Fifth

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Describe the concept of power system security its application as a system operator.	20
CO-2	Estimate the state of small sample power system.	25
CO-3	Analyse performance of transmission lines with respect to reactive power requirement for voltage stability.	25
CO-4	Describe the importance of load forecasting for power system planning.	15
CO-5	Describe the concepts of power system Deregulation and Restructuring.	15

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	3	3	3	3	3	2	3	2	3	3	3	3	2
CO-2	3	3	3	3	3	2	3	2	3	2	3	3	3	3	2
CO-3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO-4	1	2	1	2	3	3	2	2	2	2	-	-	3	3	3
CO-5	2	1	2	-	-	3	1	3	3	3	3	3	3	-	2
Rationale*	12	12	12	11	12	14	12	12	14	10	12	12	15	12	12

List of Open Source/learning website:

1. https://nptel.ac.in/courses/108/101/108101040/
2. https://nptel.ac.in/courses/108/106/108106026/
3. https://nptel.ac.in/courses/108/107/108107028/
4. https://nptel.ac.in/courses/108/101/108101005/

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