22EEHO103	POWER SYSTEM STATE ESTIMATION AND SECURITY CONTROL		SEMESTER			
PREREQUISITES		**CATEGORY**	**PEC**	**Credit**		**3**
Power Generation, Transmission and Distribution System; Power System Analysis and Stability		**Hours\Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To acquire fundamental knowledge on power system state estimation.
2.	To familiarise on network observability analysis.
3.	To get conceptual aspects in power system state estimation and strategies to enhance the secure power system operations.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

State estimation- Energy management system- SCADA system- Energy control centers- Security monitoring and control- Concepts of reliability, security and stability - State transitions and control strategies- Data acquisition systems - Modulation techniques, MODEMS, Power line carrier communication.

UNIT II	**POWER SYSTEM STATE ESTIMATION**	**9**	**0**	**0**	**9**

Static state estimation: Active and reactive power bus measurements – Line flow measurements - Line current measurements – Bus voltage measurements - Measurement model and assumptions - Weighted least square state estimation algorithm- Maximum likelihood estimation - Decoupled formulation of WLS state estimation- Fast decoupled state estimation.

UNIT III	**NETWORK OBSERVABILITY ANALYSIS**	**9**	**0**	**0**	**9**

Tracking state estimation: Algorithm - Computational aspects – Measurement redundancy - Accuracy and variance of measurements - Variance of measurement residuals- Detection, identification and suppression of bad measurements - Pseudo measurements- Virtual measurements- External system equivalencing- Network observability - Observability analysis using phasor measurement units.

UNIT IV	**DISTRIBUTION SYSTEM STATE ESTIMATION**	**9**	**0**	**0**	**9**

Distribution system state estimation- State of the art methods – Comparison of different DSSE algorithms- Developments in measurement system and DSSE design- Pseudo measurements- System architecture.

UNIT V	**SECURITY ASSESSMENT AND ENHANCEMENT**	**9**	**0**	**0**	**9**

Contingency analysis: Linearized AC and DC models of power systems for security assessment - Line outage distribution factors and generation shift factors for DC and linearized AC models - Single contingency analysis using these factors. Contingency ranking and security indices-Correcting the generator dispatch for security enhancement using linearized DC models – Methods using sensitivity
factors - Compensated factors. Emergency and restorative control procedures.

Total (45 L + 0 T)= 45 Periods

Text Books:

1.	Ali Abur, “Power System State Estimation Theory and Implementation”, Marcel Dekker, 2004.
2.	Wood, A.J., Wollenberg, B.F., and Sheble, G.B., “Power Generation, Operation and Control”, John Wiley and Sons, 3rd Edition, 2013.
3.	Mahalanabis, Kothari and Ahson, “Computer Aided Power System Analysis and Control”, Tata McGraw Hill Publishers, 1991.

Reference Books:

1.	Abhijit Chakrabarti and Sunita Halder, “Power System Analysis Operation and Control”, PHI Learning, 2010.
2.	G.L. Kusic, “Computer Aided Power System Analysis”, Prentice Hall of India, 1989.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Understand the conceptual aspects in power system state estimation.	L2: Understanding
CO2	:	Demonstrate various state estimation methods.	L3: Applying
CO3	:	Acquire proficiency to perform observability analysis.	L4: Analysing
CO4	:	Demonstrate the distribution state estimation.	L3: Applying
CO5	:	Realize the security assessment and enhancement strategies.	L3: Applying

COURSE ARTICULATION MATRIX															
COs\ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	1	3	3	1	1		1				1	2	1	3	1
CO 2	1	2	3	2	2		2				1	2	1	3	1
CO 3	1	2	3	2	2		2				1	2	1	2	1
CO 4	1	2	2	1	1		1				1	2	1	2	1
CO 5	1	2	3	2	2		2				1	2	1	1	1
Avg	1	2.2	2.8	1.6	1.6	0	1.6	0	0	0	1	2	1	2.2	1
3/ 2/ 1 – indicates strength of correlation (3- High, 2-Medium, 1-Low)															