22EEHO102	EMS AND SCADA		SEMESTER			
PREREQUISITES		**CATEGORY**	**PEC**	**Credit**		**3**
Power System		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart knowledge on energy management system.
2.	To understand network analysis function of EMS.
3.	To study the function and control of SCADA.
4.	To analyze the concept of SCADA hardware and software.
5.	To study the concept of power system automation using SCADA.

UNIT I	ENERGY MANAGEMENT SYSTEM	9	0	0	9
Introduction to EMS, Objectives, Evolution of EMS, Evolution of SCADA, Function and Benefits of EMS, EMS Architecture, Practical EMS, Working of EMS, Power System Security: Introduction, Static Security Assessment, Operating states of Power System. Real Time or Online Application : Control Function, Protection Function, Operating States of Power System				
UNIT II	NETWORK ANALYSIS FUNCTION OF EMS	9	0	0	9
Real Time Function, Extended Real Time Function, State Estimation: Introduction, Conventional State Estimation Linear state estimation. Economic Dispatch and Optimal Power Flow: Introduction, Economic Dispatch, Generation Model. Economic Dispatch Problem, Optimal Power Flow problem Formulation.				
UNIT III	SCADA	9	0	0	9
Introduction to SCADA, Evolution of SCADA, Benefits of SCADA, Function of SCADA, SCADA in Process control, SCADA Application, Usage of SCADA, Real-Time Monitoring and Control using SCADA, Data Acquisition, Data Communication, Data Presentation, and Control.				
UNIT IV	SCADA HARDWARE AND SOFTWARE	9	0	0	9
Introduction, SCADA hardware Functions, Remote Terminal Units, SCADA RTU, Basic Functions, RTU Standards, Difference Between RTU and PLC, Features of SCADA. SCADA Software and Protocols: Introduction to ISO Model, DNP3 Model, Important Features of DNP3, IEC60870 PROTOCOL, HDLC, Modbus Protocol.				
UNIT V	POWER SYSTEM AUTOMATION	9	0	0	9
Power System Automation – Benefits - Architecture for Power System Automation, Classification of Power system Automation, Implementation of Power System Automation and Protection using SCADA, SCADA based Model for Automation and Digital Protection.				
		Total (45L+0T)= 45 Periods				

Text Books:	
1.	Wayne C. Turner, Steve Doty, Energy Management Hand book, The Fairmont Press, 6th Edition, 2007.
2.	Handschin, E. "Energy Management Systems", Springer Verlag, 1990.
3.	Mini S. Thomas, John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015.
Reference Books:	
1.	John D Mc Donald, "Electric Power Substation Engineering", , CRC press, 2001
2.	Handschin, E, "Real Time Control of Electric Power Systems", Elsevier, 1972.
E-References:	
1.	NPTEL Online Courses, Energy Management Systems and SCADA, IIT Madras. Link : "https://nptel.ac.in/courses/108106022/12"

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO1	:	Explore the objectives of EMS.	L2: Understanding
CO2	:	Understand the real time function of EMS.	L1: Remembering
CO3	:	Explain the real time monitoring and control of SCADA.	L4: Analyzing
CO4	:	Analyze the hardware and software functions of SCADA.	L4: Analyzing
CO5	:	Outline the power system automation and protection using SCADA.	L2: Understanding

COURSE ARTICULATION MATRIX

COs/ 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	PS O1	PS O2	PS O3
CO1	3	1						1					2		3
CO2	3		2			2							2		3
CO3	3		2										2		3
CO4	3		2										2		3
CO5	3		2										2		3
Avg	3	1	2	0	0	2	0	1	0	0	0	0	2	0	3
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															