22EEHO106	COMPUTER RELAYING AND WIDE AREA MEASUREMENT SYSTEMS		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PEC**	**Credit**		**3**
Power System Protection		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Objectives:						
To understand different techniques of digital relaying - their constructions, working principles, applications and limitations along with introduction to Wide Area Measurement System and network protection.						
UNIT I	**INTRODUCTION TO COMPUTER RELAYING**		**9**	**0**	**0**	**9**
Computer relay architecture - analog-to-digital converters - anti-aliasing filters - expected benefits of computer relaying						
UNIT II	**RELAYING PRACTICES**		**9**	**0**	**0**	**9**
Introduction to protection systems, function of protection system, protection of transmission lines, overcurrent relays, directional relays, distance relays, pilot relaying, transformer protection, reactor protection, generator protection and bus protection						
UNIT III	**MATHEMATICAL BASIS FOR PROTECTIVE RELAYING ALGORITHMS**		**9**	**0**	**0**	**9**
Fourier series, Walsh functions, Fourier transforms, probability and random process, Kalman filtering						
UNIT IV	**SYSTEM RELAYING AND CONTROL**		**9**	**0**	**0**	**9**
Phasor Measurement Unit - Measurement of frequency and phase – sampling clock synchronization – Application of phasor measurement to state estimation – Monitoring- Control applications						
UNIT V	**WIDE AREA MEASUREMENT SYSTEMS**		**9**	**0**	**0**	**9**
Wide Area Measurement Systems (WAMS) architecture – WAMS based protection concepts : Adaptive dependability and security – Monitoring approach of apparaent impedances towards relay characteristics – WAMS based out-of step relaying – Supervision of backup zones – Intelligent load shedding – Intelligent islanding – System wide integration of SIPS – Load shedding and restoration						
Total (45L) = 45 Periods						

Text Books:	
1.	Arun G. Phadke, James S. Thorp, Computer Relaying for Power Systems, Wiley, Second Edition,2009.
2.	Allan Thomas Johns, S.K. Salman, Digital Protection for Power Systems, The Institution of Engineering and Technology, Second Edition, 1995.
Reference Books:	
1.	A.G. Phadke, J.S. Thorp, Synchronized Phasor Measurements and Their Applications, Springer
2.	Walter A. Elmore, 'Protective Relaying: Theory and Applications, CRC Press

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand on protection system schemes, its co-ordination and settings for any general power network.	L2: Understanding
CO2	:	Identify the digital relaying, its fundamentals, attributes and implementation.	L2: Understanding
CO3	:	Analyze the concept synchro-phasor based power system relaying	L4: Analysing
CO4	:	Assess the algorithms and its importance	L3: Applying
CO5	:	Recall the power system monitoring using wide area measurement system	L1: Remembering

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	3	2	2	2	1	1					1	3	1	1
CO2	1	3	2	2	2	1	1					1	2	1	1
CO3	1	3	3	3	3	1	1					1	3	2	1
CO4	3	3	3	3	3	2	1					1	3	2	1
CO5	1	1	3	2	2	2	1					1	2	2	1
Avg	1.8	2.6	2.6	2.4	2.4	1.4	1	0	0	0	0	1	2.4	1.6	1

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)