DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN-PART I	
Name of the programme and specialization	2nd Semester M.Tech, Power systems
Course Title	Computer Relaying and Wide Area Measurement Systems
Course Code	EE678 **No. of Credits** 03
Pre-requisites Course Code	Digital Signal Processor, Power System Protection
Session	**Jan 2023**
Faculty	M Jaya Bharata Reddy **Department** EEE
Email	jbreddy@nitt.edu **Telephone No.** 0431-2503270
Course Type	Core course ✓ Elective course

Syllabus (approved in BoS)

*Introduction to Computer Relaying- Introduction to DSP, Use of computer relay, Analog to Digital Converters, Sampling, Anti –aliasing filters. Evolution of power system relaying from electromagnetic to static to computer relaying; Relay operating principles for computer relaying; Expected benefits of computer relaying, Computer relay architecture.

*Protection of Transmission Line using Computer Relaying, Three zone protection of transmission line, algorithms for impedance calculations-Mann-Morrison algorithm -Three sample technique -Two sample technique -First and second derivative algorithms -Numerical integration methods.

*Protection of power system equipment using Frequency domain techniques Problems associated with differential protection of transformer and bus-bar, magnetic inrush current, LSQ algorithm, Fourier analysis of transformer protection.

*Phasor Measurement Units-Introduction to Phasor measurement units (PMUS), global positioning system (GPS), Functional requirements of PMUs and PDCs, phasor estimation of nominal frequency inputs

* PMU Applications Wide Area Measurement Systems (WAMS), WAMS Applications in Smart Grid, WAMS Based Protection Concepts, Adaptive Relaying, State estimation.

COURSE OBJECTIVES

To provide the key concepts and operating principles of a computer relays and wide area measurement systems.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)

Upon completion of the course, the students will be able to
1. Demonstrate knowledge of fundamental aspects of theories, principles and practice of computer relaying.
2. Define and understand the concepts of Wide area measurement systems
3. Understand and design wide area measurement systems applications in Smart grid .

CO no.	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14
1	H	H	H	NA	M	M	M	H	M	M	M	H	M	M
2	M	H	H	NA	M	H	M	H	M	M	M	H	M	M
3	H	H	H	NA	M	M	M	H	M	M	M	H	M	M

COURSE PLAN-PART I

COURSE OVERVIEW

The goal of this course is to provide basic knowledge on computer relaying and its applications in wide area measurement systems. The internal architecture and algorithms employed in a numerical relays will be discussed. Understanding about wide area measurement systems, mathematical background for relaying algorithms and also examining line relaying algorithms for protection of power system components

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	Weeks 1 to 2 (6 contact hours, including two contact hours for problem solving)	Fundamentals of DSP, DFT, FFT	Lecture/Tutorial
2		Numerical examples/Problem Solving	Group work (exercise)
3	Weeks 3 to 5 (9 contact hours, including two contact hours for problem solving)	Computer relaying architecture	Lecture/Tutorial
4		Numerical examples/Problem Solving	Group work (exercise)
		Assessment 1	Written test
5	Weeks 6 to 8 (9 contact hours, including two contact hours for problem solving)	Implementation of different types of computer relays	Lecture/Tutorial
6		Numerical examples/Problem Solving	Group work (exercise)
7	Weeks 9 to 11 (9 contact hours, including two contact hours for problem solving)	Fundaments of PMU and WAMS	Lecture/Tutorial
8		Numerical examples/Problem Solving	Group work (exercise)
		Assessment 2	Written test
9	Weeks 12 to 14 (9 contact hours, including two contact hours for problem solving)	Application of PMU in Power System	Lecture/Tutorial
10		Numerical examples/Problem Solving	Group work (exercise)
11	Weeks 13 to 14	Compensation Assessment (CPA)	Written test
12		End Semester Examination	Written test

Mode of Assessment

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	1st Mid Semester Examination (Written test) (1st and 2nd Units)	5th Week	60 Minutes	25
2	2nd Mid Semester Examination (Written test) (3rd and 4th Units)	11th Week	60 Minutes	25
3	Take Home / Team Task	3rd to 12h week	Work will be carried out along with the course	20
4	Compensation Assessment (CPA)	13th week	60 Minutes	25
5	End Semester Examination (Written test)	14th week	180 Minutes	30

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals etc

1. *A.G. Phadke, J.S. Thorp, 'Computer Relaying for Power Systems', John Wiley and Sons Ltd., Research Studies Press Limited, 2nd Edition, 2009.*
2. *A.G. Phadke, J.S. Thorp, 'Synchronized Phasor Measurements and Their Applications', Springer Publications, 2008.*
3. *John G. Prokis and Dimitris G. Hanolakis, 'Digital Signal Processing, Principles, Algorithms & Applications' 4th Edition, Pearson Education, 2006.*

COURSE EXIT SURVEY - Shall be obtained at the end of the course

COURSE POLICY

COMPENSATION ASSESSMENT POLICY

If any student is not able to attend I and / or II Cycle test(s) due to genuine reasons with prior permission, student is permitted to attend the compensation assessment (CPA) with 25% weightage (25 marks).
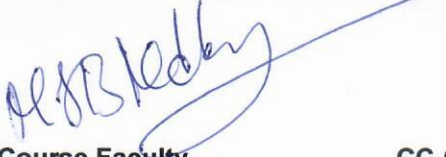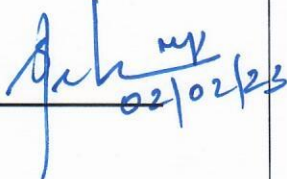
ATTENDANCE POLICY

- ➢ At least 75% attendance in each course is mandatory.
- ➢ A maximum of 10% shall be allowed under On Duty (OD) category.
- ➢ Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

ACADEMIC HONESTY & PLAGIARISM

- ➢ Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.

- ➢ Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.

- ➢ The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programs

FOR APPROVAL

Course Faculty _____   CC-Chairperson _____   HOD _____ 02/02/23

(M.Jaya Bharata Reddy)