INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**POWER SYSTEM PROTECTION LABORATORY**				
Course Code	AEE112				
Programme	B.Tech				
Semester	VII	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	2
Chief Coordinator	Ms. B Navothna, Assistant Professor				
Course Faculty	Mr. P Shiva Kumar, Assistant Professor				

I. COURSE OVERVIEW:

The main objective of the course is to provide an overview of the principles of basic protection circuits such as miniature circuit breaker, High rupturing fuse and protection under thermal overload condition. It provides in depth analysis of Ferranti effect and surge impedance loading of a transmission line. It provides in depth knowledge on working principles of various types of relays. It also deals with earth fault protection and feeder protection schemes.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AEE007	IV	AC machines	4
UG	AEE012	VI	Power system analysis	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Power System Protection Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✘	Videos
✔	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th Expt of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Discussion
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Discussion
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	Laboratory Practices
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Projects

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	2	Laboratory Practices
PSO 2	**Problem solving skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	-	-
PSO 3	**Successful carrier and entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	1	Discussion/Laboratory Practices

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the importance of protection and plotting the characteristics of MCB and Fuse
II	Determine the parameters, surge impedance loading and reactive power compensation of transmission lines
III	Understand the concept of Ferranti effect of a transmission lines
IV	Calculate positive, negative and zero sequence impedances of synchronous machine

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEE112.01	CLO 1	Examine the functioning of miniature circuit breaker(MCB).	PO1, PO3	2
AEE112.02	CLO 2	Understand internal circuit of high rupturing capacity and tripping of bimetallic thermal overload protection.	PO1, PO2	2
AEE112.03	CLO 3	Record of ABCD Parameters of transmission line.	PO1, PO3,PO4	3
AEE112.04	CLO 4	Analyze Ferranti effect in a transmission line.	PO1, PO3,PO4	3
AEE112.05	CLO 5	Calculate surge impedance loading(SIL) of a transmission line.	PO1, PO3,PO4	3
AEE112.06	CLO 6	Explain the concept of shunt compensation to counteract the voltage rise on no load and zero regulation at different loads in a transmission line.	PO1, PO4	2
AEE112.07	CLO 7	Understand the concept of voltage improvement by reactive power control using tap changing transformer.	PO1, PO3	2
AEE112.08	CLO 8	Determine the performance of a transmission line by calculating its efficiency and regulation.	PO1, PO3,PO4	3
AEE112.09	CLO 9	Understand the working principle of impedance relay and its effect during faults in a transmission line.	PO2, PO3	2
AEE112.10	CLO 10	Understand the working principle of over current relay and its effect during faults in a transmission line.	PO1, PO3	2
AEE112.11	CLO 11	Analyze earth fault detection methods and various earth fault protection schemes.	PO1, PO3,PO4	3
AEE112.12	CLO 12	Analyze various protection schemes in radial feeder under various fault conditions.	PO 3,PO 4	2
AEE112.13	CLO 13	Calculate positive, negative and zero sequence impedances of synchronous machine by using direct method and fault analysis method.	PO3,PO4	2
AEE112.14	CLO 14	Determine of string efficiency in a string of insulators.	PO1, PO3,PO4	3

3 = High; 2 = Medium; 1 = Low

X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2		3										2		
CLO 2	2	2											2		
CLO 3	2		3	2									2		
CLO 4	2		3	2									2		
CLO 5	2		3	2									2		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 6	2			2									2		
CLO 7	2		3										2		
CLO 8	2		3	2											1
CLO 9		2	3												1
CLO 10	2		3												1
CLO 11	2		3	2											1
CLO 12			3	2											1
CLO 13			3	2											1
CLO 14	2		3	2											1

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2 PO3, PO4, PSO1	SEE Exams	PO1, PO2 PO3, PO4, PSO1,PSO3	Assignments	-	Seminars	-
Laboratory Practices	PO1, PO2 PO3, PO4, PSO1,PSO3	Student Viva	PO1, PO2 PO3, PO4, PSO1,PSO3	Mini Project	-	Certification	-

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

LIST OF EXPERIMENTS	
Expt-1	**CHARACTERISTICS OF AN MCB**
Plotting the Characteristics of Miniature Circuit Breaker (MCB).	
Expt-2	**CHARACTERISTICS OF FUSE AND THERMAL OVERLOAD PROTECTION**
Study of characteristics of High Rupturing Capacity (HRC) fuse and tripping of bimetallic thermal overload protection and its characteristics.	
Expt-3	**ABCD PARAMETERS OF TRANSMISSION LINE**
Measurement of ABCD parameters of a transmission line	
Expt-4	**FERRANTI EFFECT IN A TRANSMISSION LINE**
Study of Ferranti effect in a the transmission line	

Expt-5	**SURGE IMPEDANCE LOADING**
Study of Surge Impedance Loading (SIL) of a transmission line.	
Expt-6	**EFFECT OF SHUNT COMPENSATION**
Determine shunt compensation to counteract the voltage rise on no load and zero regulation at different loads in a transmission line.	
Expt-7	**VOLTAGE PROFILE IMPROVEMENT USING TAP CHANGING TRANSFORMER**
Study of voltage improvement by reactive power control using tap changing transformer.	
Expt-8	**EFFICINCY AND REGULATION OF A TRANSMISSION LINE**
Determine the performance of a transmission line by calculating its efficiency and regulation.	
Expt-9	**PERFORMANCE OF IMPEDANCE RELAY**
Study the working principle of impedance relay and its effect during faults in a transmission line.	
Expt-10	**PERFORMANCE OF OVER CURRENT RELAY**
Study the working principle of over current relay and its effect during faults in a transmission line.	
Expt-11	**EARTH FAULT PROTECTION**
Study of earth fault detection methods and various earth fault protection schemes.	
Expt-12	**FEEDER PROTECTION**
Study the various protection schemes in radial feeder under various fault conditions.	
Expt-13	**MEASURMENT OF SEQUENCE IMPEDANCES OF SYNCHRONOUS MACHINE**
Measurement of positive, negative and zero sequence impedances of synchronous machine by using direct method and fault analysis method.	
Expt-14	**STRING EFFICIENCY OF INSULATORS**
Determination of string efficiency in a string of insulators.	

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Learning Outcomes	Reference
1-3	Characteristics of Miniature Circuit Breaker, and Study of characteristics of High Rupturing Capacity (HRC) fuse and tripping of bimetallic thermal overload protection and its characteristics	CLO 1	T4:4.4
4-6	ABCD parameters, Ferranti effect and Surge Impedance Loading (SIL) of a transmission line	CLO 3	T4:1.7
7-12	Determine shunt compensation to counteract the voltage rise on no load and zero regulation at different loads in a transmission line.	CLO 5	T4:2.6
13-15	Study of voltage improvement by reactive power control using tap changing transformer.	CLO 6	T4:3.8
16-18	Determine the performance of a transmission line by calculating its efficiency and regulation.	CLO 8	T1:4.8
19-24	Study the working principle of impedance relay and its	CLO 9	T4:3.8

Week No.	Topics to be covered	Course Learning Outcomes	Reference
	effect during faults in a transmission line.		
25-30	Understand the working principle of over current relay and its effect during faults in a transmission line.	CLO 10	T4:3.8
31-36	Study of earth fault detection methods and various earth fault protection schemes.	CLO 11	T4:6.5
37-39	Understand the various protection schemes in radial feeder under various fault conditions.	CLO 12	T4:6.5
40-42	Measurement of positive, negative and zero sequence impedances of synchronous machine by using direct method and fault analysis method.	CLO 13	T4
43-45	Determination of string efficiency in a string of insulators.	CLO 14	T4

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S.NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	Describe the importance of various protection schemes in power sytems.	Discussion	PO1,PO3	PSO1
2	Understand the functioning of circuit breaker and fuse.	Projects	PO1, PO3	PSO1
3	Determine ABCD parameters, observe ferranti effect, effect of surge impedance loading on a transmission line.	Laboratory Practices	PO1, PO3, PO4	PSO3
4	Measurement of positive, negative and zero sequence impedances of synchronous machine by using direct method and fault analysis method.	Laboratory Practices	PO3, PO4	PSO3

Prepared by:
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