INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE DESCRIPTOR

Course Title	**ELECTRICAL MACHINES LABORATORY- II**				
Course Code	AEEB17				
Programme	B.Tech				
Semester	IV	EEE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	1.5
Chief Coordinator	Mr. A Satish Kumar, Assistant Professor				
Course Faculty	Mr. A Satish Kumar, Assistant Professor Mr. K Devender Reddy, Assistant Professor				

I. COURSE OVERVIEW:

This course deals with various direct and indirect test conducts on transformers, three phase induction motor, single phase induction motor and synchronous machine.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHSB10	II	Engineering Physics	4
UG	AEEB13	III	Electrical Machines - I	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total marks
Electrical Machines Laboratory - II	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

X	Chalk & talk	X	Quiz	X	Assignments	X	MOOCs
√	LCD / PPT	X	Seminars	X	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 week 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		**Strength**	**Proficiency assessed by**
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Calculations of the observations
PO2	**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	Characteristic curves

Program Outcomes		Strength	Proficiency assessed by
PO3	**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	Seminar
PO4	**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	Conducting experiments
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	Characteristic curves

3= High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency assessed by
PSO1	**Problem Solving Skills:** Exploit the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	-	-
PSO2	**Professional Skills:** Identify 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.	2	Term observations
PSO3	**Modern Tools in Electrical Engineering** To be able to utilize of technologies like PLC, PMC, process controllers, transducers and HMI and design, install, test , maintain power systems and industrial applications.	-	-

3= High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Evaluate losses and determine the efficiency of single phase and three phase electrical machines
II	Determine the voltage regulation, efficiency and temperature rise in various transformers
III	Apply PLC to gain practical knowledge

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Analyze the performance characteristics of single phase transformer by conducting various direct and indirect tests	CLO 1	Calculate the efficiency and regulation of single phase transformer by conducting direct and indirect tests.
		CLO 2	Classify the different types of losses occurred in transformers and separate the each loss from other loss by conducting a suitable test.
		CLO 3	Describe the operation of Scott connection to convert three phase supply to two phase supply or vice versa.

COs	Course Outcome	CLOs	Course Learning Outcome
		CLO 4	Examine the rise in temperature of a transformer by heat run test.
CO 2	Describe the performance characteristics and speed control of three phase induction motor using PLC	CLO 5	Draw the performance characteristics of three phase induction motor by conducting direct test
		CLO 6	Draw the circle diagram to find the efficiency of three phase induction motor by conducting no load and blocked rotor tests
		CLO 7	Speed control of three of induction motor and implementation of star delta starter by using PLC
CO 3	Understand the various methods of calculating the voltage regulation of synchronous alternators	CLO 8	Estimate the regulation of an alternator by different methods of testing
CO 4	Demonstrate V and inverted V curves of synchronous motors	CLO 9	Draw the 'V' and 'inverted-V' curves of synchronous motor and also determine the direct axis and quadrature axis reactance by slip test.
CO 5	Understand the equivalent circuit parameters of single phase induction motor	CLO 10	Determine the equivalent parameters of single phase induction motor by suitable tests.

X. COURSE LEARNING OUTCOMES:

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
AEEB17.01	CLO 1	Calculate the efficiency and regulation of single phase transformer by conducting direct and indirect tests.	PO3, PO4	2
AEEB17.02	CLO 2	Classify the different types of losses occurred in transformers and separate the each loss from other loss by conducting a suitable test.	PO3, PO4	2
AEEB17.03	CLO 3	Describe the operation of Scott connection to convert three phase supply to two phase supply or vice versa.	PO2, PO4	3
AEEB17.04	CLO 4	Examine the rise in temperature of a transformer by heat run test.	PO1, PO3	3
AEEB17.05	CLO 5	Draw the performance characteristics of three phase induction motor by conducting direct test	PO3, PO4	2
AEEB17.06	CLO 6	Draw the circle diagram to find the efficiency of three phase induction motor by conducting no load and blocked rotor tests	PO1, PO2	3
AEEB17.07	CLO 7	Speed control of three of induction motor and implementation of star delta starter by using PLC	PO2, PO4	2
AEEB17.08	CLO 8	Estimate the regulation of an alternator by different methods of testing	PO2, PO4	2
AEEB17.09	CLO 9	Draw the 'V' and 'inverted-V' curves of synchronous motor and also determine the direct axis and quadrature axis reactance by slip test.	PO3, PO4, PO5	3
AEEB17.10	CLO 10	Determine the equivalent parameters of single phase induction motor by suitable tests.	PO3, PO4, PO5	3

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)				
	PO1	PO2	PO3	PO4	PO5
CO 1	2	2	2	3	
CO 2	2	2	2	3	
CO 3		2		3	
CO 4			2	3	2
CO 5	2		2	3	3

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC 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	2											
CLO 2			2	2										2	
CLO 3		3		3											
CLO 4	3		3												
CLO 5			2	2										2	
CLO 6	3	3													
CLO 7		2		2										2	
CLO 8		2		2											
CLO 9			3	2	3									2	
CLO 10			2	3	3									3	

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XIII. ASSESSMENT METHODOLOGIES – DIRECT:

CIE Exams	PO1 PO2 PO3 PO4 PO5	SEE Exams	PO1 PO2 PO3 PO4 PO5	Assignments	-	Seminars	-
Laboratory practices	PO1 PO2 PO3 PO4 PO5	Student viva	PO1 PO2 PO3 PO4 PO5	Mini project	-	Certification	-
Term paper	-						

XIV. ASSESSMENT METHODOLOGIES – INDIRECT:

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

XV. SYLLABUS:

LIST OF EXPERIMENTS	
Expt. 1	**OC AND SC TEST ON SINGLE PHASE TRANSFORMER**
Determine the equivalent circuit parameters; predetermine the efficiency and regulation by open circuit and short circuit test on a single phase transformer.	
Expt. 2	**SUMPNER‟S TEST**
Predetermine the efficiency and regulation of two identical single phase transformers.	
Expt. 3	**LOAD TEST ON SINGLE PHASE TRANSFORMERS**
Determination of efficiency by load test on a single phase transformer.	
Expt. 4	**SCOTT CONNECTION OF TRANSFORMERS**
Conversion of three phase to two phase using single phase transformers	
Expt. 5	**SEPARATION OF CORE LOSSES IN SINGLE PHASE TRANSFORMER**
Find out the eddy current and hysteresis losses in single phase transformer.	
Expt. 6	**HEAT RUN TEST ON SINGLE PHASE TRANSFORMERS**
Determine the temperature rise in three single phase transformers set.	
Expt. 7	**BRAKE TEST ON THREE PHASE SQUIRREL CAGE INDUCTION MOTOR**
Plot the performance characteristics of three phase induction motor**.**	
Expt. 8	**CIRCLE DIAGRAM OF THREE PHASE SQUIRREL CAGE INDUCTION MOTOR**
Plot the circle diagram and predetermine the efficiency and losses of three phase squirrel cage induction motor	
Expt. 9	**REGULATION OF ALTERNATOR BY EMF METHOD**
Determine the regulation of alternator using synchronous impedance method.	
Expt. 10	**REGULATION OF ALTERNATOR BY MMF METHOD**
Determine the regulation of alternator using amperes turns method.	
Expt. 11	**SLIP TEST ON THREE PHASE SALIENT POLE SYNCHRONOUS MOTOR**
Determination of Xd and Xq in a three phase salient pole synchronous motor.	
Expt. 12	**V‟ AND INVERTED „V‟ CURVES OF SYNCHRONOUS MOTOR**
Plot „V‟ and inverted „V‟ curves to study the effect of power factor in synchronous motor.	
Expt. 13	**EQUIVALENT CIRCUIT PARAMETERS OF SINGLE PHASE INDUCTION MOTOR**
Determine the equivalent circuit parameters of a single phase induction motor	
Expt. 14	**STARTING AND SPEED CONTROL OF INDUCTION MOTOR USING PLC**
Implementation of star-delta starter using PLC; Speed control of three phase slip ring induction motor with rotor resistance cutting using PLC.	

Reference Books:
1. P S Bimbhra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008. 2. M V Deshpande, "Electrical Machines", PHI Learning Private Limited, 3rd Edition, 2011. 3. R K Srivastava, "Electrical Machines", Cengage Learning, 2nd Edition, 2013.
Web References:
1 https://www.ee.iitkgp.ac.in 2 https://www.citchennai.edu.in 3 https://www.iare.ac.in

XVI. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	References
1-3	Determine the equivalent circuit parameters; predetermine the efficiency and regulation by open circuit and short circuit test on a single phase transformer.	CLO1	T1: 5.2
4-6	Predetermine the efficiency and regulation of two identical single phase transformers.	CLO1	T1: 5.4
7-9	Determination of efficiency by load test on a single phase transformer.	CLO1	T1: 5.47
10-12	Conversion of three phase to two phase using single phase transformers	CLO1	T1: 5.5
13-15	Find out the eddy current and hysteresis losses in single phase transformer.	CLO1	T1: 5.10
16-18	Determine the temperature rise in three single phase transformers set.	CLO1	T1: 5.12
19-21	Plot the performance characteristics of three phase induction motor.	CLO2	T1: 6.7
22-24	Plot the circle diagram and predetermine the efficiency and losses of three phase squirrel cage induction motor	CLO2	T1: 6.7
25-27	Determine the regulation of alternator using synchronous impedance method.	CLO3	T1: 7.09
28-30	Determine the regulation of alternator using amperes turns method.	CLO3	T1: 7.15
31-33	Determination of Xd and Xq in a three phase salient pole synchronous motor.	CLO4	T1: 7.16
34-36	Plot „V" and inverted „V" curves to study the effect of power factor in synchronous motor.	CLO4	T1: 7.18
37-39	Determine the equivalent circuit parameters of a single phase induction motor	CLO5	T1: 8.19
40-42	Implementation of star-delta starter using PLC; Speed control of three phase slip ring induction motor with rotor resistance cutting using PLC.	CLO3	T1: 8.19

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Operate the synchronous motor as synchronous condenser to improve the line power factor	Laboratory practice	PO5	PSO2
2	Analyze the different braking methods of three phase induction motor	Laboratory practice	PO5	PSO2

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