INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTOR

Course Title	**AC MACHINES LABORATORY**				
Course Code	AEE106				
Programme	B.Tech				
Semester	IV	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. K Devender Reddy, Assistant Professor				
Course Faculty	Mr. K Devender Reddy, Assistant Professor Mr. P Mabu Hussain, Assistant Professor				

I. COURSE OVERVIEW:

The aim of this course is to conduct experiments on basic principles of AC machines and various direct and indirect tests conducts on transformers like open circuit and short circuit test, Sumpner's test, heat run test. This course also deals with various direct and indirect tests conducts on three phase induction motor like brake test, no load and blocked rotor test, single phase induction motor and synchronous machine

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS006	I	Engineering Physics	4
UG	AEE004	III	DC Machines and Transformers	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
AC Machines 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 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 (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.	3	Calculations of the observations
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems	2	Characteristic curves

Program Outcomes (POs)		Strength	Proficiency assessed by
	reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.		
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.	2	Videos
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	Term observations
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	Conducting experiments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**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.	-	-
PSO 2	**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.	-	-
PSO 3	**Modern Tools in Electrical Engineering:** Comprehend the technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test, and maintain power system and industrial applications.	3	Term observations

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

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 and digital simulation software to gain practical knowledge.

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
AEE106.01	CLO 1	Calculate the efficiency and regulation of single phase transformer by conducting open circuit and short circuit test	PO1, PO4	3
AEE106.02	CLO 2	Calculate the efficiency of single phase transformer by conducting sumpner's test	PO1, PO4	3

CLO Code	CLO's	At the end of the course, the student will have the ability to	PO's Mapped	Strength of Mapping
AEE106.03	CLO 3	Classify the different types of losses occurred in transformers and separate the each loss from other loss by conducting a suitable test.	PO2, PO3	2
AEE106.04	CLO 4	Describe the operation of scott connection to convert three phase supply to two phase supply or vice versa.	PO1, PO2, PO3	3
AEE106.05	CLO 5	Examine the rise in temperature of a transformer by heat run test	PO2, PO4	2
AEE106.06	CLO 6	Determine the efficiency of single phase transformer by load test	PO1, PO2, PO3	3
AEE106.07	CLO 7	Draw the circle diagram to find the efficiency of three phase induction motor by conducting no load and blocked rotor tests.	PO2, PO4	2
AEE106.08	CLO 8	Determine the efficiency and slip by brake test on three phase squirrel cage induction motor	PO1, PO2, PO3	3
AEE106.09	CLO 9	Estimate the regulation of an alternator by different methods of testing.	PO1, PO3, PO4	3
AEE106.10	CLO 10	Determination of Xd and Xq in a three phase salient pole synchronous motor	PO1, PO2	3
AEE106.11	CLO 11	Draw the 'V' and 'inverted-V' curves of synchronous motor	PO3, PO4	2
AEE106.12	CLO 12	Determine the equivalent parameters of single phase induction motor by suitable tests.	PO1, PO2	3
AEE106.13	CLO 13	Determine the efficiency of single phase transformer by digital simulation.	PO1, PO2, PO5	3
AEE106.14	CLO 14	Describe the operation of scott connection to convert three phase supply to two phase supply or vice versa by digital simulation	PO1, PO2, PO5	3

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X. 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	3			2											
CLO 2	3			2											
CLO 3	2			2											
CLO 4	3	2	2												
CLO 5		2		2											
CLO 6	3	2	2												
CLO 7		2		2											
CLO 8	3	2	2												
CLO 9	3		2	2											
CLO 10	3	2													

CLOs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 11			2	2											
CLO 12	3	2													3
CLO 13	3	2			3										3
CLO 14	3	2			3										3

3 = High; 2 = Medium; 1 = Low

XI. 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	-

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

LIST OF EXERCISES	
Week - 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 in a single phase transformer.	
Week - 2	**SUMPNER'S TEST**
Predetermine the efficiency and regulation of two identical single phase transformers.	
Week - 3	**SCOTT CONNECTION OF TRANSFORMERS**
Conversion of three phases to two phase using single phase transformers.	
Week - 4	**SEPARATION OF CORE LOSSES IN 1 - ϕ TRANSFORMER**
Find out the Eddy current and Hysteresis losses in single phase transformer	
Week - 5	**HEAT RUN TEST ON 1- ϕ TRANSFORMER**
Determine the temperature rise in a 1- ϕ transformer using back-back test.	
Week - 6	**LOAD TEST ON SINGLE PHASE TRANSFORMER**
To determine the efficiency and regulation of single phase transformer by conducting load test.	
Week - 7	**BRAKE TEST ON 3- ϕ SQUIRREL CAGE INDUCTION MOTOR**
Plot the performance characteristics of three phase induction motor.	
Week - 8	**CIRCLE DIAGRAM OF 3 - ϕ SQUIRREL CAGE INDUCTION MOTOR**

Plot the circle diagram and predetermine the efficiency and losses of 3 - ϕ squirrel cage induction motor	
Week - 9	**REGULATION OF ALTERNATOR**
Determine the regulation of alternator using synchronous impedance method.	
Week - 10	**SLIP TEST ON 3- ϕ SALIENT POLE SYNCHRONOUS MOTOR**
Determination of Xd and Xq in a three phase salient pole synchronous motor.	
Week - 11	**'V' AND 'INVERTED –V' CURVES OF SYNCHRONOUS MOTOR**
Plot 'V' and 'inverted –V' curves to study the effect of power factor in synchronous motor.	
Week - 12	**NO-LOAD AND BLOCKED ROTOR TEST ON 1 - ϕ INDUCTION MOTOR**
Determine the equivalent circuit parameters of a single phase induction motor.	
Week - 13	**DETERMINATION OF LOSSES IN 1- ϕ TRANSFORMER USING DIGITAL SIMULATION**
Determine the efficiency and regulation by open circuit and short circuit test in a single phase transformer using digital simulation.	
Week - 14	**THREE PHASE TO TWO PHASE CONVERSION IN 1- ϕ TRANSFORMER USING DIGITAL SIMULATION**
Scott connection of transformer using digital simulation.	
Text books	
1. P S Bimbra, "Electrical Machines", Khanna Publishers, 2nd Edition, 2008. 2. Kothari, "Electrical Machines", TMH publication, 3rd Edition, 2010. 3. B. L Thereja, A.K Thereja Charles Kingsley JR., Stephen D U mans, "Electric Machinery", McGraw-Hill, 6th Edition, 1985.	
References	
1. J B Gupta, "Theory and Performance of Electrical Machines",S K Kataria & Sons Publication, 14th Edition, 2010 2. M G Say, "Alternating Current Machines", Pitman Publishing Ltd, 4th Edition, 1976. 3. S K Bhattacharya, "Electrical Machines", TMH publication, 2nd Edition, 2006.	

XIV. COURSE PLAN:

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

Week No	Topics to be covered	CLOs	Reference
1	OC and SC test on single phase transformer	CLO 1	R1:1.193
2	Sumpner's test on pair of single phase transformers	CLO 2	R1:1.19.
3	separation of core losses in 1 - ϕ transformer	CLO 3	R1:1.19.6
4	Scott connection of transformers and	CLO 4	R1:2.5
5	Heat run test on 1- ϕ transformer	CLO5	R1:1.19.6
6	Load test on 1- ϕ transformer	CLO 5	R1:1.19.6
7	Brake test on 3- ϕ squirrel cage induction motor	CLO7	R1:7.31
8	No load and blocked rotor test of 3 - ϕ squirrel cage induction motor	CLO6	R1:8.1
9	Regulation of alternator by synchronous impedance method	CLO8	R1:3.17

Week No	Topics to be covered	CLOs	Reference
10	Slip test on 3- ϕ salient pole synchronous motor	CLO9	R1:6.7
11	V' and 'inverted –V' curves of synchronous motor	CLO 10	R1:6.13
12	No-load and blocked rotor test on 1 - ϕ induction motor	CLO 11	R1:10.6
13	Determination of losses in 1- ϕ transformer using digital simulation	CLO12	R1:1.193
14	Three phase to two phase conversion in 1- ϕ transformer using digital simulation	CLO13	R1:2.5

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

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Dynamic braking of three phase induction motor	NPTEL Videos	PO1, PO2, PO3	-
2	Load characteristics of induction generator	NPTEL Videos	PO1, PO2	-

Prepared by:
Mr. K Devender Reddy, Assistant professor

HOD, EEE