INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION

Course Title	**Electrical Machines-II**			
Course Code	**A40212**			
Regulation	**R13**			
Course Structure	Lectures	Tutorials	Practical's	Credits
	4			4
Course Coordinator	**Mr. S. Srikanth, Assistant Professor** **Mr. G. Hari Krishna, Assistant Professor**			
Team of Instructors	**Mr. K. Devender Reddy, Assistant Professor**			

I. COURSE OVERVIEW:

This course deals with mainly definition , construction ,principle of operation, types, efficiency, regulation of the transformer-different types of test to study the characteristics, equivalent circuit , regulation and efficiency of transformer, construction, principle of operation of different types of poly-phase transformer and also deals with definition, , construction ,principle of operation, types, efficiency, starting methods of 3-phase induction motor-different types test to study characteristics, efficiency of induction motor.

II. PREREQUISITES:

Level	Credits	Periods	Prerequisite
UG	4	4	Knowledge of faraday's laws, alternating quantity is required

III. COURSE ASSESSMENT METHODS:

a) Marks distribution:

Session marks	University End Exam Marks	Total Marks
There shall be two mid tem examinations. Each id term exam consists of subjective type and objective type test. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain four questions; the student has to answer two out of them. Each carrying 5 marks The objective test paper Is prepared by JNTUH, which consists of 20 questions each carrying 0.5 marks and total of 10 marks. The student is assessed by giving two assignments, one, after completion of 1 to 2 1/2 units and the second, after the completion of 2 1/2 to 5 units each carrying 5 marks. On the total the internal marks are 25.	75	100

The average of two internal tests is the final internal marks. The external question paper is set by JNTUH consisting of part –A and part-B. Where part consists of short answer questions carrying total marks of 25 and part part-B consists of 5 essay type questions consists of internal choice each carrying 10 marks and the total of 50. The total external marks are 75.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I mid examination	90 minutes	20
2	I assignment	--	05
3	II mid examination	90 minutes	20
4	II assignment	--	05
5	External examination	3 hours	75

V. COURSE OBJECTIVE:

This course enables the students to:

i. **Understand** the construction, operation and regulation of single phase transformer.
ii. **Analyze** the efficiency and testing of transformers.
iii. **Understand** the construction and operation of three phase transformers.
iv. **Analyze** the construction, operation and the regulation, efficiency of 3-phase induction motor.
v. **Apply** the knowledge of Speed control and starting methods of 3-phase induction motor.

VI. COURSE OUTCOMES:

After completing this course the student can:

i. **Understand** the construction, operation and regulation of single phase transformer.
ii. **Analyze** the efficiency and testing of transformers.
iii. **Understand** the construction and operation of three phase transformers.
iv. **Analyze** the construction, operation and the regulation, efficiency of 3-phase induction motor.
v. **Apply** the knowledge of Speed control and starting methods of 3-phase induction motor.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Level	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.	H	Assignments
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.	H	Exercises

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.	N	-----
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.	N	-------
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.	N	-------
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	H	Design exercise, Prototypes
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	H	Exercise, Seminars, Discussions
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Discussions
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.	N	-----
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Seminars, Discussions
PO11	**Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.	H	Workshops, Prototypes
PO12	**Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	S	Seminar, Discussions

N= None **S=Supportive** **H=highly related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**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.	S	Lectures, Assignments
PSO2	**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.	N	------

PSO3	**Successful Career 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.	S	Guest Lectures

N - None **S - Supportive** **H - Highly Related**

SYLLABUS:

UNIT-I: Single phase transformer-types-constructional details-minimization of hysteresis and eddy current losses-EMF equation-operation on no- and on load-phasor diagrams-equivalent diagram-losses and efficiency-regulation-all-day efficiency-separation of losses.

UNIT-II: Testing of single phase transformers-OC and SC tests-Sumpner's test-pre-determination of efficiency and regulation-separation of losses test-parallel operation with equal and unequal voltage ratios.

UNIT III: Auto transformers–equivalent circuit-comparison with two-winding transformer Poly-phase connections of transformers –Y/Y-Y/DELTA-DELTA/DELTA-DELTA/Y-third harmonics in phase voltages-three winding transformers –tertiary windings-determination of Zp, Zs and Zt in switching-off load and on load tap changing-Scott connection.

UNIT IV: Poly-phase induction motor-construction-details of caged and wound rotor-production of rotating magnetic field-operation-rotor EMF and frequency-rotor reactance-rotor current and power factor at standstill and running condition-rotor power input-rotor cu losses and mechanical power developed and their relations-torque relations-expression for maximum and starting torque-torque slip characteristics - double cage and deep bar rotors-phase diagram-crawling and cogging

UNIT V: Circle diagram-no load and blocked rotor tests-predetermination of performance-methods of starting and starting current-and torque calculations. Change of frequency, change of poles and methods of consequent poles-cascade connections-injection of an EMF into rotor circuit-induction generator-operation.

IX. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes:

Lecture No.	Learning objectives	Topics to be covered	Reference
1	To what type of machine an transformer is.	Introduction to single-phase transformers	T1,R3
2	To know the construction of transformers.	Types and constructional details	T1,R1
3	To know the methods of Minimization of hysteresis and eddy current losses	Minimization of hysteresis and eddy current losses	T1,R3
4	To know amount of EMF induced in windings	EMF equation	T1
5,6	To know behavior of transformer	No and on load characteristics with phasor diagram	T1
7,8	To determine the specifications of transformer.	Equivalent circuit-losses and efficiency-regulation	T1
9	To know working of transformer through the day.	All-day efficiency	T1

10	To know variations in iron losses	Effect of frequency and voltage on iron losses	T1
11	Exercise	Solving problems	T1,R3
12	To know losses and efficiency of transformer	OC and SC tests	T1
13	To know losses and efficiency of identical transformers	Sumpner's test	T1
14	To estimate efficiency and regulation of transformer	Predetermination of efficiency and regulation	T1
15	To know amount of losses that effects efficiency	Separation n of losses	T1,R1
16	To improve the losses and efficiency of transformers	Parallel operation	T1,R3
17, 18	To know the importance of auto transformer in power systems	Auto-transformer-comparing with two winding transformer.	T1
19, 20	Exercise	Solving problems	T1,R3
21, 22, 23	To know construction and operation of poly phase transformers in power systems	Y/Y-Y/DELTA-DELTA/DELTA-DELTA/Y	T1
24	To know third harmonics in phase voltage	third harmonics in phase voltage	T1,R3
25	To determine Zp, Zs and Zt in switching	Tertiary winding	T1,R2
26	To know tap changing of transformer.	No and on load tap changing	T1
27	To know operation and efficiency of poly phase transformer	SCott connection	T1R1
28, 29	Exercise	Solving problems	T1,R3
30	To know what type of machine an 3-phase induction motor is	Introduction to 3-phase induction motor	T1
31	To know construction of IM	Construction	T1
32	To know Details of caged and wound rotor	Details of caged and wound rotor	T1,,R1
33, 34	To know how rotating magnetic field is developed	Production rotating magnetic fields	T1,R3
35, 36	To know working of IM	Principle of operation-rotor EMF and frequency	T1,R1
37,38	To know rotor characteristics under operation	Rotor reactance, current, power factor under standstill and operation	T1,R1
39	To know details of rotor power	Rotor input, losses and developed power and their relations.	T1,R3
39, 40, 41	To know amount of torques effecting IM	Torque derivations, starting and maximum torque	T1,R1
41.42	To know speed characteristics of IM	Torque-slip relations	T1
43, 44	To know types of rotor	Double caged and deep bar rotor.	T1
45	To know Equivalent circuit,	Equivalent circuit	T1
46,47,48	Exercise	Solving problems	T1,R3
49	To know locus diagram of IM	Concept of circle diagram	T1
50,51	To determine the regulation and efficiency of IM	No-load and blocked rotor tests	T1,R3
52	To estimate details of IM	Pre-determination of performance	T1,R1

53,54	To know how to start IM	Methods of starting and starting currents.	T1,R3
55,56	To know torque of IM	Derivation of torques and calculations	T1
57	To know how to improve speed of IM	Change of frequency by changing poles.	T1
58	To know how to improve speed of IM	Change of frequency by methods of consequence poles	T1,R1
59	To know how to improve speed of IM	Cascade connections	T1,R3
60	To know how to improve voltage.	Injection of an EMF into rotor	T1,R1
61	To know the induction generator	Induction generator-operation	T1,R3
62, 63, 64	Exercise	Problem solving	T1,R3

X. TEXT BOOKS:

1. Electrical machines, P S Bimbra. Khanna publishers.
2. Principles of electrical machines, V K Mehta, Rohit Mehta, S Chand.

XI. REFERENCES:

1. Electrical machines, I J Nagarath and D P Kothari, Tata McGraw Hill.
2. Fundamentals of electrical machines, J B Gupta, New Age.
3. Performance and design of AC Machines, M G Say, BPB.

XII. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I		S				H	H	H		S	H	S	S		S
II	H	H				S	S	S		S	S	S	S		S
III		S				H	H	H		S	H	S	H		S
IV	H	H				S	S	S		S	S	S	S		H
V		H				S	S	S		S	H	S	S		S

N - None **S – Supportive** **H - Highly Related**

XIII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOME

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I		S				H	H	H		S	H	S	S		S
II	H	H				S	S	S		S	S	S	S		S
III		S				H	H	H		S	H	S	H		S
IV	H	H				S	S	S		S	S	S	S		H

V		H				S	S	S		S	H	S	S		S

N - None **S – Supportive** **H - Highly Related**

Prepared by: Mr. K Devender Reddy, Assistant Professor

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