

INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORM

Course Title	Electrical Machine	Electrical Machines-III										
Course Code	A50218	450218										
Regulation	R15	R15										
Course Structure	Lectures	Tutorials	Practical	Credits								
Course structure	04	01	-	4								
Course Coordinator Mr. K Devender Reddy, Assistant professor												

I. COURSE OVERVIEW:

This course deals with mainly definition, construction, principle of operation, types, efficiency, regulation of the synchronous generator -different types of tests to study the characteristics and regulation of synchronous generators, construction, principle of operation of synchronous motor and also deals with construction ,principle of operation of single phase motors such as single phase induction motor, split phase motor, ac series motor, universal motor, stepper motor and shaded pole 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.	75	100
The student is assessed by giving two assignments, one, after completion of 1 to 4 units and the second, after the completion of 4 to 8 units each carrying 5 marks. On the total the internal marks are 25.		
The average of two internal tests is the final internal marks.		
The external question paper is set by JNTUH consisting of 8 questions each carrying 15 marks out of which 5 questions are to be answered their by external examination is of total 75 mark		

IV. EVALUATION SCHEME:

S.No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment		05
3	II MidExamination	90 minutes	20
4	II Assignment		05
5	External Examination	3 hours	75

V. COURSE OBJECTIVE:

At the end of the course, the students will be able to:

- i. To attain the knowledge of synchronous machine construction, operation.
- ii. To attain the knowledge of determining the regulation of synchronous generators.
- iii. To attain the knowledge of parallel operation of synchronous generators.
- iv. To attain the knowledge of operation and efficiency of synchronous motors.
- v. To attain the knowledge of single phase motors and special machines.

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

- 1. Gets the knowledge of synchronous machine construction, operation and load characteristics.
- 2. Gets the knowledge of determining the regulation of synchronous generators.
- 3. Gets the knowledge of parallel operation of synchronous generators.
- 4. Gets the knowledge of operation of synchronous motor and phasor diagram.
- 5. Gets the knowledge of construction and operation of single phase induction motors.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

	Program outcomes	Level	Proficiency assessed by
PO1	Engineering knowledge : Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	Н	Assignments
PO2	Problem analysis : Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	S	Excercises
PO3	Design/development of solutions: Design solutions for complex engineering problems anddesign 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.	Н	
PO4	Conduct investigations of complex problems : Use research-based knowledge and researchmethods including design of experiments,	Ν	

	analysis and interpretation of data, and synthesis of the information to provide valid conclusions.		
PO5	Modern tool usage : Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	
PO6	The engineer and society : Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	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.	Н	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 indiverse teams, and in multidisciplinary settings.	S	
PO10	Communication : Communicate effectively on complex engineering activities with the engineeringcommunity 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 theengineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Workshops, Prototypes
PO12	Life-long learning : Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.	S	Seminar, Discussions

N= None

IX.

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
7	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	
L L A B	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
,	<u>.</u>	N - None S - Supportive H	- Highly	Related

UNIT-I

Synchronous machines & Characteristics: Constructional features of round rotor and salient pole machines-armature windings-integral slot and fractional slot windings; distributed and concentrated windings-distribution, pitch and winding factors-EMF equation. Harmonics in generated EMF-suppression of harmonics-armature reaction-leakage reactance-synchronous reactance and impedance-experimental determination-phasor diagram-load characteristics.

UNIT-II

Regulation of synchronous generator: Regulation by synchronous impedance method, MMF method, ZPF method and ASA methods-salient pole alternators-two reaction analysis-experimental determination of Xd and Xq(slip test) phasor diagrams-regulation of salient pole alternators.

UNIT III

Parallel operation of synchronous generator: synchronizing alternators with infinite bus barssynchronizing power torque-parallel operation and load sharing-effect of change of excitation and mechanical power input. Analysis of short circuit current waveform-determination of sub transient, transient and steady state reactance.

UNIT IV

Synchronous Motors: Theory of operation-phasor diagram-variation of current and power factor with excitation-synchronous condenser –Mathematical analysis for power developed.

Power circles: Excitation and power circles-hunting and its suppression-methods of startingsynchronous induction motor

UNIT V

Single phase motors and special machines: Single phase induction motor-constructional features-double revolving field theory. Equivalent circuit – split phase motors-capacitor start capacitor run motors. Principles of AC series motor-universal motor, stepper motor shaded pole motor.

X. COURSE PLAN:

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

Lecture no.	Learning objectives	Topic to be covered	Reference
1	To know what type of	Introduction to synchronous generators and	T1,R3
	machine a synchronous	working principle	

	generator is.		
2	To know the construction of synchronous machines.	Types and constructional details	T1,R1
3, 4	To know the construction of windings	Armature winding types and construction	T1,R1
5	To know the different types of factors	Distribution, pitch & winding factors	T1R3
6	To know amount of emf induced in windings	Emf equation	T1
7	To know harmonics in generated EMF	Harmonics in generated EMF and suppression of harmonics	T1
8,9	To know armature reaction	Armature reaction and leakage reactance	T1
10, 11	To determine synchronous reactance and impedance	Experimental determination of synchronous reactance and impedance	T1
12	To draw the phasor diagram	Phasor diagram of synchronous generator	T1
13	To draw the characteristics	Load characteristics of synchronous generator	T1R3
14	Exercise	Solving problems	T1
15	To estimate regulation of synchronous generator	Regulation by synchronous impedance method	T1
16	Exercise	Solving problems	T1
17,18	To estimate regulation of synchronous generator	Regulation by MMF method	T1
19	Exercise	Solving problems	T1
20,21	To estimate regulation of synchronous generator	Regulation by ZPF and ASA methods	T1R1
22	Exercise	Solving problems	T1
23,24	To determine Xd and Xq	Two reaction analysis and experimental determination of Xd and Xq(slip test), phasor diagram	T1R3
25	To estimate regulation of salient pole alternators	Regulation of salient pole alternators.	T1
26	Exercise	Solving problems	T1R3
27	To know parallel operation of synchronous generator	Introduction to parallel operation of synchronous generators and conditions	T1
28	To know synchronizing the alternators with infinite bus bars	Synchronizing of alternators with infinite bus bars	T1R3
29	To determine synchronizing power torque	synchronizing power torque	T1R2
30	Exercise	Solving problems	T1R3
31,32	To know parallel operation and load sharing of alternators	parallel operation and load sharing of alternators	T1
33,34	To know the effect of change of excitation and mechanical power input	Effect of change of excitation and mechanical power input	T1R1
35	To analyze the short circuit current waveform	Analysis of short circuit current waveform	T1R3
36,37	To determine sub transient, transient and steady state reactance	Sub transient, transient and steady state reactance	T1

38	Exercise	Solving problems	T1R3
39	To know the operation of synchronous motors	Theory of operation of synchronous motor	T1R1
40	To know how to draw phasor diagram	Phasor diagram	T1R3
41,42	To know variation of current and power factor with excitation	variation of current and power factor with excitation	T1R1
43	To know operation as synchronous condenser	Operation of Synchronous condenser	T1R1
44,45	To know mathematical analysis for power developed	Mathematical analysis for power developed	T1R3
46,47	To know excitation and power circles	Excitation and power circles	T1R1
48	To know hunting	Hunting and its suppression	T1
49,50	To know the methods of starting	Methods of starting of synchronous motor	T1
51	Exercise	Solving problems	T1R3
52	To know the operation of synchronous induction motor	operation of synchronous induction motor	T1
53	Exercise	Solving problems	T1R3
54	To know the operation of single phase induction motor	The operation of single phase induction motor	T1
55	To know the construction details	Constructional features of single phase motors	T1R3
56	To know double revolving field theory	Double revolving field theory	T1R1
57,58	To know equivalent circuit and its parameters	Equivalent circuit and its parameters	T1R3
59	To know operation of split phase motors	Operation of split phase motors	T1
60,61	To know operation of capacitor start capacitor run motors	Operation of capacitor start capacitor run motors	T1
62	To know principles of AC series motor	Principles of AC series motor	T1R1
63	To know principles of universal motor	Principles of universal motor	T1R3
64	To know principles of stepper motor and shaded pole motor	principles of stepper motor and shaded pole motor	T1R1
65	Exercise	Problem solving	T1R3

XI. Text books:

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

XII. References:

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

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

Course Objectives				Program Specific Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Ι	N	S	Ν	Ν	Ν	Н	Н	Н	Ν	S	Н	S	Н	Н	S
Π	Н	Н	N	N	N	S	S	S	Ν	S	S	S	Н	Н	S
III	N	S	N	N	N	Н	Н	Н	Ν	S	Н	S	Н	Н	Н
IV	Н	Н	Ν	N	N	S	S	S	Ν	S	S	S	Н	Н	S
V	Ν	Н	Ν	Ν	Ν	S	S	S	Ν	S	Н	S	Н	Н	S

S-Supportive

H - Highly Related

XIV. 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		
Ι	Ν	S	Ν	Ν	Ν	Η	Н	Н	Ν	S	Н	S	Н	Н			
II	S	S	S	Н	Ν	Ν	Ν	N	Ν	N	S	S	Н	S	S		
III	Н	Н	N	N	N	S	S	S	N	S	S	S	Н	S	Н		
IV	Н	Н	Н	S	N	N	N	S	N	N	N	S	Н	S			
V	S	S	S	Н	S	S	N	N	N	S	S	N	Н	Н	S		

S – Supportive

H - Highly Related

Prepared by: Mr. K Devender Reddy, Assistant Professor

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