INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

Department of Electrical and Electronics Engineering

COURSE DESCRIPTION FORMS

Course Title	**Electrical Machines - I**			
Course Code	**A30206**			
Regulation	**R15**			
Course Structure	**Lectures**	**Tutorials**	**Practical's**	**Credits**
	4	**1**	**-**	**4**
Course Coordinator	Mr. K Devender Reddy, Assistant Professor			
Team of Instructors	Mr. K Devender Reddy, Assistant Professor			

I. COURSE OVERVIEW:

Electrical machines course in one of the important courses of the Electrical discipline. In this course the different types of DC generators and motors which are widely used in industry are covered and their performance aspects will be studied

II. PREREQUISITES:

Level	Credits	Periods	Prerequisite
UG	4	4	Knowledge of electromagnetic fields 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 1to 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	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:

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

i) To attain the knowledge of Electro mechanical energy conversion.
ii) To attain the knowledge of Energy balance and magnetic force.
iii) To attain the knowledge of DC generators construction and operation.
iv) To attain the knowledge of Armature reaction and winding structures.
v) To attain the knowledge in motors and starters.

VI. COURSE OUTCOMES:

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

i) Gets the knowledge of Electro mechanical energy conversion
ii) Gets the knowledge of Energy balance and magnetic force.
iii) Gets the knowledge of DC generators construction and operation
iv) Gets the knowledge of Armature reaction and winding structures.
v) Gets the knowledge in Load characteristics of DC generators.
vi) Gets the knowledge in Parallel operation of DC generators.
vii) Gets the knowledge of DC motors construction and operation.
viii) Gets the knowledge of Speed control of DC motors.
ix) Gets the knowledge in Testing of D.C machines
x) Gets the knowledge in different starters

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 multidisciplinary 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 multidisciplinary 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**

IX. SYLLABUS:

UNIT I:

Electromechanical Energy Conversion: Electromechanical Energy conversion – forces and torque in magnetic field systems – energy balance – energy and force in a singly excited magnetic field system, determination of magnetic force - co-energy – multi excited magnetic field systems.

UNIT II:

D.C. Generators & Armature Reaction: D.C. Generators – Principle of operation – Action of commutator – constructional features – armature windings – lap and wave windings – simplex and multiplex windings – use of laminated armature – E. M.F Equation – Problems. Armature reaction – Cross magnetizing and de-magnetizing AT/pole – compensating winding – commutation – reactance voltage – methods of improving commutation

UNIT III:

Types of D.C Generators & Load Characteristics: Methods of Excitation – separately excited and self-excited generators – build-up of E.M.F - critical field resistance and critical speed - causes for failure to self-excite and remedial measures. Load characteristics of shunt, series and compound generators – parallel operation of d.cseries generators – use of equalizer bar and cross connection of field windings – load sharing

UNIT IV:

D.C. Motors & Speed Control Methods: D.C Motors – Principle of operation – Back E.M.F. - Torque equation – characteristics and application of shunt, series and compound motors – Armature reaction and commutation.

Speed control of DC Motors: Armature voltage and field flux control methods. Ward-Leonard system. Principle of 3 point and 4 point starters – protective devices

UNIT V:

Testing of D.C. Machines: Losses, Constant & Variable losses – calculation of efficiency – condition for maximum efficiency. Methods of Testing – direct, indirect and regenerative testing – brake test – Swinburne's test – Hopkinson's test – Field's test – Retardation test – separation of stray losses in a DC motor test

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 the energy conversion	Electromechanical Energy conversion	T_1
2,3	To know the Force and Torque	Forces and torque in magnetic field systems	T_1
4	To know the Energy balance	Energy balance	T_1
5,6	To know the excitation	Energy& force in a singly excited magnetic field	T_1
7,8	To know the co-energy	Determination of magnetic force- co-energy	T_1
9,10	To know multi excited system	Multi excited magnetic field systems	T_1
11	To know principle of generator	D.C. Generators Principle of operation	T_1
12	To know function of commutator	Action of commutate	T_1
13	To know machine construction	Constructional Feature	T_1
14	To know windings	Armature windings	$T_{1,}$
15	To know machine application	lap windings	T_1
16	To know machine application	Wave windings	T_1
17	To know machine application	Simplex and multiplex windings	T_1
18	To know about laminations	Use of laminated armature	T_1

19	To know amount of EMF induced in windings	E.M.F Equation	T_1
20,21	Exercise	Solving problems	T_1
22	To know reaction of machine when loaded	Armature reaction	T_1
23	To know the effects of armature reaction	Cross magnetizing and de-magnetizing AT/pole	T_1
24	To know the effects of armature reaction	Compensating windings	T_1
25	To know behavior of commutator	Commutation Process	T_1
26	To know how to improve the performance	Methods of improving commutation	T_1
27,28	To know methods of excitation	Methods of Excitation	T_1
29	To know amount of ELF induced in windings	Build-up of E.M.F	T_1
30	Exercise	Solving problems	T_1
31	To know the machine performance	Characteristics of D.C Generators O.C.C	T_1
32	To know solve the failure of emf problems	critical field resistance and critical speed, causes for failure to self-excited machine and remedial measures	T_1
33	To know how to improve efficiency	load characteristics of shunt Generator	T_1
34	To know how to improve efficiency	load characteristics of series, load characteristics of Compound generator	T_1
35	To know how to interconnect the generators	Need for parallel operation, and conditions	T_1
36	To know how to interconnect the generators	Parallel operation of DC series	T_1
37	To know load division	Load sharing of Generators	T_1
38	To know how to share the load	Use of equalizer bar and cross connection of field windings	T_1
39	To know principle of D.C. Motor	D.C Motors Principle of operation	T_1
40	To know amount of EMF induced in windings	Back E.M.F.	T_1
41	To know torque	Torque equation	T_1
42,43	Exercise	Solving problems	T_1
44	To know how to improve efficiency	Characteristics & Applications of shunt	T_1
45	To know how to improve efficiency	Characteristics & Applications of series Characteristics & Applications of compound motors	T_1
46	To know reaction of machine when loaded	Armature reaction and commutation	T_1
47	To know how to regulate the speed	Speed control of D.C. Motors	T_1
48	To know the efficiency	Ward-Leonard system	T_1
49	To know how to start	Principle of 3 point starters&4 point starters	T_1
50	To know the protective devices	protective devices	T_1
51	To Know the losses	Losses –constant and variable losses	T_1
52	To know the efficiency	Calculation of Efficiency	T_1
53	To know the max loading capacity	Condition for maximum Efficiency	T_1

54,55	Exercise	Solving problems	T_1
56	To know the efficiency and losses	Methods of testing-direct test	T_1
57	To know the efficiency and losses	Indirect and regenerative test	T_1
58	To know the efficiency and losses	Brake test	T_1
59	To know the efficiency and losses	Indirect testing: Swinburne's method	T_1
60	To know the efficiency and losses	Regenerative or Hopkinson's method Field's test for series machines	T_1
61	To know the efficiency and losses	Retardation test separation of stray losses in a dc motor test	T_1
62	To know the efficiency and losses	separation of stray losses in a dc motor test	T_1

XI. TEXT BOOKS:

1. Electrical Machines by J. B. Guptha
2. Principles of Electrical Machines by V. K. Mehta, Rohit Mehta

XII. REFERENCES:

1. Electrical Machines by I. J. Nagarath & D. P. Kothari
2. Electrical Machines by P.S. Bimbra

XIII. 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	H	N	S	N	N	S	H	N	S	S	S	S	H	H	S
II	N	N	N	N	N	S	H	N	S	S	S	S	H	H	S
III	H	H	H	N	N	S	S	N	S	S	S	S	H	H	H
IV	H	S	S	S	N	S	S	N	S	S	S	S	H	H	S
V	H	H	H	S	N	S	S	N	S	S	S	S	H	H	S

N – None 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
I	N	S	N	N	N	H	H	H	N	S	H	S	H	H	
II	S	S	S	H	N	N	N	N	N	N	S	S	H	S	S
III	H	H	N	N	N	S	S	S	N	S	S	S	H	S	H

IV	H	H	H	S	N	N	N	S	N	N	N	S	H	S	
V	S	S	S	H	S	S	N	N	N	S	S	N	H	H	S
VI	N	S	N	N	N	H	H	H	N	S	H	S	H	H	H
VII	H	H	N	N	N	S	S	S	N	S	S	S	H	H	S
VIII	H	H	H	S	N	S	N	N	N	S	S	N	H	H	S
IX	N	H	N	N	N	S	S	S	N	S	H	S	H	S	S
X	N	S	S	H	H	H	S	S	N	N	S	S	H	S	H

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

.

Prepared by: Mr. K Devender Reddy, Assistant Professor

HOD, ELECTRICAL AND ELECTRONICS ENGINEERING