INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE DESCRIPTOR

Course Title	**SOLID STATE ELECTRIC MOTOR DRIVES LABORATORY**				
Course Code	AEE109				
Programme	B.Tech				
Semester	VI	EEE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. S. Srikanth, Assistant Professor				
Course Faculty	Dr. B. Muralidhar Nayak, Professor Mr. S. Srikanth, Assistant Professor				

I. COURSE OVERVIEW:

The aim of this course is to conduct experiments on AC and DC drives. Control of DC motor drives with single phase and three phase converters and choppers are to be studied. The control of AC motor drives with variable frequency converters and variable voltage are to be conducted.

II. COURSE PRE-REQUISITES:

Level	Course code	Semester	Prerequisites	Credits
UG	AEE004	III	DC Machines	4
	AEE007	IV	AC Machines	4
	AEE010	V	Power Electronics	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total marks
Solid state electric motor drives laboratory	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	X	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	Apply principles of power electronics in speed control of various drives.
II	Demonstrate the concept of four quadrant operations of drives.
III	Discuss various drives used in industries to control torque and speed.

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Analyze the speed control of DC motors using rectifiers	CLO 1	Understand the speed control of DC shunt motor using single phase rectifier.
		CLO 2	Analyze the speed control of DC separately excited shunt motor using three phase rectifier.
		CLO 3	Demonstrate the speed measurement and closed loop control of PMDC motor using thyristorized drive.
CO 2	Describe the speed control of DC motor and induction motor with	CLO 4	Understand the four quadrant operation of PMDC motor using chopper.
		CLO 5	Describe the speed control of induction motor using AC voltage controller.

COs	Course Outcome	CLOs	Course Learning Outcome
	various converters	CLO 6	Describe the study of DC Jones Chopper circuit
CO 3	Understand the speed control of DC motor and synchronous motor with various converters	CLO 7	Analyze the speed control of DC motor with external contacts and potentiometer arrangement
		CLO 8	Understand the speed control of Synchronous motor with Variable Frequency Drive
CO 4	Demonstrate the speed control of special motors using power electronic converters with digital simulation	CLO 9	Analyze the stepper motor speed control using digital simulation
		CLO 10	Demonstrate the universal motor speed control using digital simulation
		CLO 11	Describe the SVPWM VSI fed induction motor drive simulation using MATLAB.
CO 5	Analyze the speed control of DC motors and induction motor using power electronic converters with digital simulation	CLO 12	Understand the direct torque control of induction motor drive simulation using MATLAB.
		CLO 12	Analyze the four quadrant operation of DC drives with three phase converter simulation using MATLAB.
		CLO 14	Demonstrate the simulation of BLDC motor drive using MATLAB

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
AEE109.01	CLO 1	Understand the speed control of DC shunt motor using single phase rectifier.	PO3, PO4	2
AEE109.02	CLO 2	Analyze the speed control of DC separately excited shunt motor using three phase rectifier.	PO3, PO4	2
AEE109.03	CLO 3	Demonstrate the speed measurement and closed loop control of PMDC motor using thyristorized drive.	PO2, PO4	3
AEE109.04	CLO 4	Understand the four quadrant operation of PMDC motor using chopper.	PO1, PO3	3
AEE109.05	CLO 5	Describe the speed control of induction motor using AC voltage controller.	PO3, PO4	2
AEE109.06	CLO 6	Describe the study of DC Jones Chopper circuit	PO1, PO2	3
AEE109.07	CLO 7	Analyze the speed control of DC motor with external contacts and potentiometer arrangement	PO2, PO4	2
AEE109.08	CLO 8	Understand the speed control of Synchronous motor with Variable Frequency Drive	PO2, PO4	2
AEE109.09	CLO 9	Analyze the stepper motor speed control using digital simulation	PO3, PO4, PO5	3
AEE109.10	CLO 10	Demonstrate the universal motor speed control using digital simulation	PO3, PO4, PO5	3
AEE109.11	CLO 11	Describe the SVPWM VSI fed induction motor drive simulation using MATLAB.	PO3, PO5	3
AEE109.12	CLO 12	Understand the direct torque control of induction motor drive simulation using MATLAB.	PO3, PO4, PO5	3
AEE109.13	CLO 13	Analyze the four quadrant operation of DC drives with three phase converter simulation using MATLAB.	PO3, PO5	3
AEE109.14	CLO 14	Demonstrate the simulation of BLDC motor drive using MATLAB	PO3, PO4, PO5	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's mapped	Strength of mapping
AEE109.15	CLO 15	Apply the concept of solid state electric drives to solve real time world applications	PO1, PO2	2
AEE109.16	CLO 16	Explore the knowledge and skills of employability to succeed in national and international level competitive examinations	PO1, PO2	2

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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	
CO 2	2	2	2	1	
CO 3		2		2	
CO 4			2	2	2
CO 5	1		2	2	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	
CLO 11			3		3										
CLO 12			3	2	3									2	
CLO 13			2		3										
CLO 14			3	2	3									2	
CLO 15	2														
CLO 16		2												2	

3 = High; 2 = Medium; 1 = Low

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	
Week-1	**SINGLE PHASE RECTIFIER FED DC SHUNT MOTOR**
Speed control of DC shunt motor using single phase rectifier	
Week-2	**THREE PHASE RECTIFIER FED DC SEPARATELY EXCITED MOTOR**
Speed control of DC separately excited shunt motor using three phase rectifier	
Week-3	**SPEED MEASUREMENT AND CLOSED LOOP CONTROL OF PMDC MOTOR**
Speed measurement and closed loop control of PMDC motor using thyristorized and MOSFET based chopper drive.	
Week-4	**FOUR QUADRANT CHOPPER DRIVE**
Four quadrant operation of PMDC motor using chopper	
Week-5	**AC VOLTAGE CONTROLLER FED INDUCTION MOTOR**
Speed control of induction motor using AC voltage controller	
Week-6	**DC JONES CHOPPER**
Verification of DC Jones chopper	
Week-7	**SPEED CONTROL OF DC MOTOR**
Speed control of DC motor with external contacts and potentiometer arrangement	
Week-8	**SYNCHRONOUS MOTOR SPEED CONTROL**
Speed control of synchronous motor using VFD	
Week-9	**SPEED CONTROL OF STEPPER MOTOR USING DIGITAL SIMULATION**
Stepper motor speed control using MATLAB	
Week-10	**UNIVERSAL MOTOR SPEED CONTROL USING DIGITAL SIMULATION**
Universal motor speed control using MATLAB	
WeeK-11	**SVPWM CONTROL OF INDUCTION MOTOR USING DIGITAL SIMULATION**
SVPWM VSI fed induction motor drive simulation using MATLAB	
Week-12	**DIRECT TORQUE CONTROL OF INDUCTION MOTOR DRIVE USING DIGITAL SIMULATION**
Direct torque control of induction motor drive simulation using MATLAB	
Week-13	**FOUR QUADRANT OPERATION OF DC MOTOR USING DIGITAL SIMULATION**

Four quadrant operation of DC drives with three phase converter simulation using MATLAB
Week-14 **BLDC MOTOR DRIVE USING DIGITAL SIMULATION**
Simulation of BLDC motor drive using MATLAB
Text Books:
1. PV Rao, "Power Semiconductor Drives", BS Publications, 1st Edition, 2014. 2. G K Dubey, "Fundamentals of Electric Drives", Narosa Publications, 2nd Edition, 2001. 3. SB Devan, GR Slemon, A Straughen, "Power semiconductor drives", Wiley Pvt. Ltd,. 4th Edition, 2001. 4. B K Bose, "Modern Power Electronics and AC Drives", Prentice Hall India Learning Private Limited, 2005
Reference Books:
1. P S Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2012. 2. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 7th Edition, 2007.

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	Understand the speed control of DC shunt motor using single phase rectifier.	CLO 1	T2: 5.11
4-6	Analyze the speed control of DC separately excited shunt motor using three phase rectifier.	CLO 2	T2: 5.13
7-9	Demonstrate the speed measurement and closed loop control of PMDC motor using thyristorized drive.	CLO 3	T2: 5.14
10-12	Understand the four quadrant operation of PMDC motor using chopper.	CLO 4	T2: 5.20
13-15	Describe the speed control of induction motor using AC voltage controller.	CLO 5	T2: 6.11
16-18	Describe the study of DC Jones Chopper circuit	CLO 6	T2: 5.19
19-21	Analyze the speed control of DC motor with external contacts and potentiometer arrangement	CLO 7	T2: 5.12
22-24	Understand the speed control of Synchronous motor with Variable Frequency Drive	CLO 8	T2: 7.3.2
25-27	Analyze the Stepper motor speed control using digital simulation	CLO 9	T2: 6.12
28-30	Demonstrate the Universal motor speed control using digital simulation	CLO 10	T2: 6.15
31-33	Describe the SVPWM VSI fed induction motor drive simulation using MATLAB.	CLO 11	T2: 7.16
34-36	Understand the Direct torque control of induction motor drive simulation using MATLAB.	CLO 12	T2: 7.18
37-39	Demonstrate the four quadrant operation of DC drives with three phase converter simulation using MATLAB.	CLO 13	T2: 8.19
40-42	Analyze the simulation of BLDC motor drive using MATLAB	CLO 14	T2: 8.19

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

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Vector control of induction motor using MATLAB	Laboratory practice	PO5	PSO2
2	Speed control of special motors using converters using MATLAB	Laboratory practice	PO5	PSO2

Prepared by:
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