

**Government of Karnataka**  
**Department of Technical Education**  
**Board of Technical Examinations, Bengaluru**

Course Title: <b>DC MACHINES AND ALTERNATORS LAB</b>	Course Code : 15EE35P
Semester : <b>III</b>	Course Group : <b>Core</b>
Teaching Scheme (L:T:P) : <b>0:2:4(in Hours)</b>	Credits : <b>3 Credits</b>
Type of course : <b>Tutorials + Practical's + Activities</b>	Total Contact Hours : <b>78</b>
CIE : <b>25 Marks</b>	SEE : <b>50 Marks</b>

<b>Pre-requisites</b>	: Knowledge about fundamentals of electrical engineering, Electrical circuits, DC machines and Alternators.
<b>Course Objectives</b>	: To impart technical skills to the students through practical training that would enable the students to conduct experiments on DC Machines and Alternators using suitable tools and equipments adopting safety measures, interpret the results, identify and locate faults, suggest remedies and perform general preventive maintenance in the Electrical Laboratory.

### **Course Outcomes:**

*On successful completion of the course, the students will be able to:*

1. Identify the physical parts of the DC machines, Alternator and special machines.
2. Conduct suitable experiments to draw and interpret the performance characteristics of DC Machines and Alternators.
3. Interpret and apply the Speed Control methods of a DC Motor.
4. Explain the need for starter, connect and run a DC shunt Motor using 3 point Starter.
5. Synchronize and Operate 3 phase Alternators in parallel.
6. Select and use suitable tools / equipments to locate faults, suggest remedies and perform general maintenance on DC machines and Alternators.

**LIST OF GRADED EXPERIMENTS:**

<b>EXPT. No.</b>	<b>GRADED EXPERIMENTS</b>	<b>HRS</b>
01.	Identify and practice to use of :- a) series test lamp, b) Megger, c) Earth tester d)Multimeter, e) Tongue tester, f) Neon tester.	03
02	Identify and practice to use of :- a) AC, DC, AC / DC meters b) Rheostats c) tachometers , Analog and Digital. d) Phase sequence indicator.	03
03.	Identify the parts of D.C. machines, note down the name plate details and interpret it.	03
04	Identify the terminals, and test the field and armature windings of a DC machine for open circuit, short circuit and ground faults using test lamp / megger, check the insulation resistance, identify and locate the possible faults.	03
05.	Identify the parts of special machines: universal motor, stepper motor and brushless DC Motor, and test the coils and windings for its working condition.	03
06	Identify the parts of a 3 point starter, test it ,and locate the faults and Suggest remedies, Note down the name plate details and interpret it. .	03
07	Identify the parts of an Alternator, note down the name plate details and interpret it.	03
08	Identify the terminals, and test the field and armature windings of a Alternator for open circuit, short circuit and ground faults using test lamp / megger, check insulation resistance, Identify and locate the possible faults and suggest remedies.	03
09	Trace and draw the layout of different electrical machines in the laboratory and their power circuit wiring, healthy condition of fuses, switches ,MCB, ELCB check them for proper voltage, identify faults if any ,and rectify.	03
10	Identify DC supply source / M-G set/ Rectifier, Main Control Panel, Distribution panel, Sub-Panels and the protection schemes in the Electrical laboratory, and maintain them, for proper operation.	03
11	Check for proper EARTHING ,in the Electrical laboratory, and maintain them for proper operation.	03
12	Draw the O.C.C (no-load or magnetization characteristics) of a Self excited DC shunt generator. Determine the critical resistance.	03
13	Draw the load characteristics of DC Shunt generator.	03
14	Connect, start and run a DC. Motor using a 3 point starter.	03
15	Control the Speed of DC shunt motor by Flux Control Method. Plot the graph.	03

16	Control the Speed of DC shunt motor by Armature voltage control. Plot the graph.	03
17	Draw the Speed v/s armature current characteristics of a DC shunt motor by indirect loading method.	03
18	Draw the magnetization characteristics of 3-ph alternator. Determine the critical resistance.	03
19	Determine regulation of a 3-ph alternator by direct loading.	03
20	Determine regulation of 3-phase alternator by conducting O.C & S.C tests by EMF method.	03
21	Conduct parallel operation of 3-ph alternators by Dark Lamp OR Bright Lamp OR Synchroscope method.	03
22	Perform general preventive maintenance on DC Machines and 3 point starters.	03
23	Perform general preventive maintenance on Alternators and Panel Boards.	03
24	Perform general preventive maintenance on fuses, switches, rheostats, ,etc	03
25	Internal Tests.	06
	<b>Total</b>	<b>78</b>

#### REFERENCE BOOKS:

1. Experiments in Basic Electrical Engineering by [S. K. Bhattacharya](#), New Age International Publications, 2007 Edition.
2. Electrical trade theory and trade practice ( 1<sup>st</sup> and 2<sup>nd</sup> year) – National Instructional Media Institute (NIMI)
3. Laboratory courses in Electrical Engineering. by S.G. Tarnekar, P. K. Karbanda and others, S. Chand Publishers.
4. Electrical Machines by M.V.Deshpande- PHI Publications.
5. Electrical Motors Application and control by M.V.Deshpande- PHI Publications.

## e-Resources:

1. [www.controlmanual.com](http://www.controlmanual.com) / testing and maintenance of electrical machines.
2. [accessengineeringlibrary.com/.../electrical-equipment-handbook-troubles](http://accessengineeringlibrary.com/.../electrical-equipment-handbook-troubles).
3. [www.slideshare.net/.../electrical-powerequipmentmaintenanceandtesting](http://www.slideshare.net/.../electrical-powerequipmentmaintenanceandtesting).
4. <https://www.crcpress.com/Electrical...Equipment-Maintenance...Testing...>
5. [electrical-engineering-portal.com](http://electrical-engineering-portal.com) › Resources.
6. <https://books.google.co.in/books?isbn=1574446568>
7. <http://www.scribd.com/doc/39578646/New-First-year-Electrical-lab-manual#scribd>
8. <http://mrcet.ac.in/newwebsite/pdfs/Labmanuals-13/ECE/LabManuals/DC%20LAB%20%28180%29%20II-I.pdf>

## Composition of Educational Components:

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's taxonomy) such as:

Sl. No.	Educational Component	Weightage (%)
1	Remembering	20
2	Understanding	30
3	Application/ Analysis	50
<b>Total</b>		<b>100</b>

**Mapping Course Outcomes with Program Outcomes:  
(Course Outcome linkage to Cognitive Level)**

Course Outcome		Experiment linked	PO Mapped	Cognitive Level	Lab Sessions
CO1	Identify the physical parts of the DC machines, Alternator and Special machines.	1 to 10	2, 3, 8, 9, 10	R/U/A	30
CO2	Conduct suitable experiments to draw and interpret the performance characteristics of DC Machines and Alternators.	12,13,17, 18,19,20	2, 3, 8, 9, 10	U/A	18
CO3	Interpret and apply the Speed Control methods of a DC Motor.	15,16	2, 3, 8, 9, 10	U/A	06
CO4	Explain the need for starter, Connect and run a DC shunt Motor using 3 point Starter.	14	2, 3, 8, 9, 10	U/A	03
CO5	Synchronize and Operate 3 phase Alternators in parallel.	21	2, 3, 8, 9, 10	U/A	03
CO6	Select and use suitable tools/equipments to test and locate faults, suggest remedies and perform general maintenance on DC machines and Alternators.	11,22,23,24	2, 3, 8, 9, 10	U/A	12

**U-Understanding; A-application/ Analysis; App-Application**

**Course-PO Attainment Matrix**

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
DC MAHINES AND ALTERNATORS LAB	-	3	3	-	-	-	-	3	3	3

**LEVEL 3- HIGHLY ADDRESSED, LEVEL 2-MODERATELY ADDRESSED, LEVEL 1-LOW ADDRESSED.**  
METHOD IS TO RELATE THE LEVEL OF PO WITH THE NUMBER OF HOURS DEVOTED TO THE COS WHICH ADDRESS THE GIVEN PO.  
IF  $\geq 40\%$  OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 3  
IF 25 TO 40% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 2  
IF 5 TO 25% OF CLASSROOM SESSIONS ADDRESSING A PARTICULAR PO, IT IS CONSIDERED THAT PO IS ADDRESSED AT LEVEL 1  
If  $< 5\%$  of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

## Course Delivery:

The Course will be delivered through Tutorial, classroom interaction, group discussion, practical exercises , and Student Activities.

## Tutorial - 1Hr:

Staff-in-charge will

1. Explain the concept of experiment to be conducted.
2. Teach required selection of meters/ Electrical Machines/Equipment specified connecting wires for the experiment to be conducted.
3. Use multimedia (animations and videos) for demonstrating dis-assemble, assemble identifying the parts and maintenance of equipments.
4. Ask the students to draw the circuit and interpret it's working.
5. Give clear instructions about safety precautions to be followed while conducting experiment.

**Note:** Tutorial includes Identification of tools / equipments for testing electrical machines, listing the parts of DC Machines, 3 point starter, Alternator, Identify and locate faults, suggest suitable remedies, etc.

## Conduction/ Execution - 2 Hr:

Student will rig up the circuit diagram and conduct experiment in a small groups (2 to 3) under the supervision of the staff-in-charge.

## Course Assessment and Evaluation Scheme:

	What		To Whom	Frequency	Practical Marks	Evidence Collected	Course Outcomes
Direct Assessment	CIE (Continuous Internal Evaluation)	I A Tests	Students	Two IA tests for Practical (Average marks of both the tests are considered)	10	Blue Books	1 to 6
		Classroom Assignments		Student activity	05	Hand written report	1 to 6
		Record Writing		Record Writing (Average of Marks allotted for each expt.)	10	Record Book & log book	1 to 6
		TOTAL		25			
	SEE (Semester End Examination)	End Exam	Students	End Of the Course	50	Answer Scripts at BTE	ALL Cos
Indirect Assessment	Student Feedback on course		Students	Middle Of The Course	Feed Back Forms		ALL Cos
	End Of Course Survey			End Of The Course	Questionnaire		All Cos

\*CIE – Continuous Internal Evaluation

\*SEE – Semester End Examination

### Note:

1. I.A. test shall be conducted as per SEE scheme of valuation. However obtained marks shall be reduced to 10 marks. Average marks of two tests shall be rounded off to the next higher digit.
2. Rubrics to be devised appropriately by the concerned faculty to assess Student activities.

## SUGGESTED STUDENTS ACTIVITIES:

Student has to submit a self hand written report of minimum 3 pages of any **ONE** activity listed below.

1. Tests conducted on Electrical machines as per industrial standards / requirements.
2. Fault identification and repair of DC machines, Alternator and special machines.
3. Applications of special machines like universal , Brushless motor, stepper motor, etc.
4. Prepare Maintenance schedule for motors and generators in the Electrical lab and perform maintenance as per schedule and record it.
5. Prepare models and charts related to DC machines and Alternator
6. Dis-assemble and assemble procedure / techniques as per standard practice.
7. Rewinding practice of DC machine and Alternator.
8. Prepare a suitable panel board for Electrical machines and equipments.
9. Visit nearby Industry/Substation/Power Generating Station, and prepare a report on the Motors and Generators used ,and their purpose.

### MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY ( Course Coordinator)

Dimension	Scale					Students score (Group of five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	3				
2	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2				
3	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	5				
4	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	4				
<p><b>Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks</b></p> <p><b>One activity on any one CO (course outcome) may be given to a group of FIVE students</b></p> <p style="text-align: right;"><b>Grand Average/Total</b></p>						14/4				
						=3.5				
						≈4				



**Example only: MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY-  
Task given- Industrial visit and report writing**

Dimension	Scale					Students score (Five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1. Organisation	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed	3				
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles	2				
3. Conclusion	Poor	Less Effective	Partially effective	Summarises but not exact.	Most Effective	5				
4. Conventions	Frequent Error	More Error	Some Error	Occasional Error	No Error	4				
Total marks						14/4=3.5 ≈4				

**LOG BOOK FORMAT**

**LAB NAME:**

**SEM:**

**STAFF IN-CHARGE:**

Sl.no	Date	Activities performed	Signature of in charge

## MODEL QUESTION BANK:

01. Identify the parts of D.C. machines and test it.
02. Identify the terminals and test the field and armature windings of a DC machine for open circuit, short circuit and ground faults using test lamp / megger, check the insulation resistance,
03. Identify and locate the possible faults in a DC machine and suggest remedies.
04. Identify and locate the faults in a 3 point starter and suggest remedies.
05. Identify the parts of an Alternator test it.
06. Identify the terminals and test the field and armature windings of a Alternator for open circuit, short circuit and ground faults using test lamp / megger, check the insulation resistance.
07. Identify and locate the possible faults in an alternator and suggest remedies.
08. Conduct an experiment to draw the no-load / magnetization characteristics of a Self excited DC shunt generator.
09. Conduct an experiment to determine the critical resistance of a DC shunt generator.
10. Conduct an experiment to draw the load characteristics of DC Shunt generator.
11. Connect, start and run a DC. Motor using a 3 point starter. Reverse the direction of rotation.
12. Conduct an experiment to Control the Speed of self excited DC shunt motor by Flux Control Method.
13. Conduct an experiment to Control the Speed of self excited DC shunt motor by Armature voltage control.
14. Conduct an experiment to demonstrate the relationship between speed and field current of a DC motor.
15. Conduct an experiment to demonstrate the relationship between speed and armature current of a DC motor.
16. Conduct an experiment to demonstrate the relationship between speed and armature voltage of a DC motor.
17. Conduct an experiment to draw the Speed v/s armature current characteristics by indirect loading method.
18. Conduct an experiment to draw the no load /magnetization characteristics of 3-ph alternator.
19. Conduct an experiment to determine the critical resistance of an Alternator.
20. Conduct an experiment to determine the voltage regulation of a 3-ph alternator by direct loading.
21. Conduct an experiment to determine regulation of 3-phase alternator by conducting O.C & S.C tests by EMF method.
22. Conduct parallel operation of 3-ph alternators by Dark Lamp OR Bright Lamp OR Synchroscope method.

### Scheme of Valuation for SEE (Semester End Examination)

Sl. No.	Particulars	Marks
1.	Identifying the parts and selection of meters/equipment.	05
2.	Circuit diagram with Procedure for one experiment.	10
3.	Connections ,Conduction and Tabulation of Readings	20
4.	Calculation and Results	05
5.	Viva-voce	10
<b>Total</b>		<b>50</b>

## LIST OF LAB EQUIPMENTS :

For a batch of 20 Students

Sl. No.	Name of Equipment and Specification	Quantity Required
1	Induction motor driven D.C. Compound gen. I.M 25Hp,440V 3phase, D.C.gen.15kW,110/220V	One set
2	Static converter Input-3phase, 440V,50Hz. Out put -15kW,0-220V Continuously variable.	One set
3	Central distribution board with control gear and power supply panel for all M/C.	One
4	M-G. Set D.C.-D.C. 1/3kW 110/220V D.C. (shunt)with starter. with panel board indicating motor, Generator, meters brought out connections to connecting terminals.	One sets
5	M-G. Set D.C.-D.C. 1/3kW 110/220V D.C. (Compound) with starter. with panel board indicating motor, Generator, meters brought out connections to connecting terminals.	One set
6	I.M.-5HP,3 phase,440V 50Hz D.C. gen 3kW,110/220D.C. Set. with starter with panel board indicating motor, Generator, meters brought out connections to connecting terminals.	One set
10	Pole changing /winding study motor	One
11	F.HP-motors Universal/hysteresis and servo motors.	One each
12	Variacs 3phase	Two
13	Variacs single phase	Six
14	Loading Rheostats 2kW,5kW	Two
15	Loading Rheostats-lamp loads.	Two
16	3 phase choke coil-continuously variable	Two
17	3 phase Capacitor bank.	Two
18	Wire wound rheostats –assorted ranges.	30
19	Tachometers (Analog -3 and Digital-3)	06
20	Portable DC Moving coil ammeter –multirange (0-1-2-5-10-20)	30
21	Portable DC Moving coil Voltmeters –multirange (0-2-10-15-30-75-150-300V)	20
22	Portable Moving iron ammeter –multirange (0-1-2-5-10-20)	20
23	Portable Moving iron Voltmeters –multirange (0-5-10-15-30-75-150-300-600V)	20
24	Multimeters analog and digital	04
25	Watt meters i) Dynamometer type lpf 75/300/600V,1/2A ii) Dynamometer type upf 75/300/600V,5/10A iii) Dynamometer type upf 75/300/600V,15/30A	02 04 04
26	3 phase watt meters 0-300/600V 15/30A	02
27	Portable pf meters	02
28	Frequency meters read type and digital type	02
29	Synchronous scope	02
30	Phase sequence indicator	02
31	Knife switches SPST,DPST,DPDT,TPST,TPDT etc.	40
32	Galvanometers centre zero type	10

33	Megger 500 V, 1000V, 1500 V	03
34	Earth tester.	03
35	Tong tester analog and digital	04
36	Compass needles	05
37	Work benches	10
38	Steel almirahs	10
39	Steel racks	10
40	Iron clad switches 30A,60A,100A.	20
41	D-G set 20 kVA ,3phase, 50Hz	01
42	Change over switch 60A,100A	04