25EEMJ205: Electrical Machines-I

w. e. f. Academic Year:	**2026-27**
Semester:	**B.E. 3rd (Electrical Engineering)**
Category of the Course:	**PCC**
Prerequisite:	Basic knowledge of Electrical quantities and Electromagnetic Fields.
Rationale:	Fundamental knowledge of the operating principles, construction, performance, and applications of transformers and DC machines.

Course Outcomes:

After Completion of the Course, Student will able to:

	Course Outcome (CO)	**RBT Level (Cognitive Domain)**
CO1	Understanding principles of D.C. Generator, construction, characteristics, losses, and efficiency.	Remember, Understand
CO2	Analyze performance, torque, speed control, and applications of D.C. motors	Analyze
CO3	Analyze construction, operation, testing, efficiency, and regulation of transformers	Analyze
CO4	Apply testing methods to determine losses and efficiency of D.C. machines	Apply
CO5	Apply and analyze Transformers to evaluate their performance and select suitable machines for real-world electrical and industrial applications. Electrical machine considering sustainability and efficiency.	Apply, create

Teaching and Evaluation Scheme:

Teaching Scheme					**Examination Scheme**				
L	**T**	**P**	**C**	**Hrs/Week**	**IE**	**EE**	**CIA**	**Practical**	**Total Marks**
3	0	4	5	7	40	60	30	20	150

IE: Internal Exam CIA: Continuous Internal Assessment
EE: External Exam (End Semester) Practical: Practical Exam (End Semester))

Detailed Syllabus:

Unit No.	**Topic**	**Hrs.**	**Marks % Weightage (Approx.)**
UNIT: 1	**D.C. Generator:** Principle of D.C. Generator, Construction of a D.C. Machine, Types of D.C. Generator, E.M.F equation, Voltage build up process,	**10**	**20**

	Losses in D.C. machine, Power stages in D.C. Generator, Efficiency and condition for maximum efficiency, Armature reaction and its effects, Characteristics of D.C. Generator, Application of shunt, series, and compound generators, solved example. Study of D.C. generator used in real application contributing to sustainable mobility.		
UNIT: 2	**D.C. Motor:** Working principle of D.C. motor, Back E.M.F, Voltage and power equation, Types of D.C. motor, Torque of D.C. motor, Power Stages in D.C. motor, Efficiency of D.C. motor, Performance characteristics of D.C. motors, Necessity of starter and types, Speed Control of D.C. motors, Application of D.C. motors, Solved Example. Improving energy efficiency of D.C. Motor and reducing losses	**10**	**20**
UNIT: 3	**Testing of D.C. Machines:** Methods for testing dc machines, Direct load test (Brake test), Swinburne's test, Hopkinson's test, filed test, Retardation test, Separation of iron and friction losses, Solved examples. Testing of D.C. machine and enhance sustainable production	5	10
UNIT: 4	**Single phase Transformer:** Construction and working principle, Types of transformers, EMF equation and voltage transformation ratio, Transformer on No-load and load, Ideal Transformer, Actual or Practical transformer, Vector diagram of actual transformer on load, equivalent circuit, losses in transformer, All day efficiency, voltage regulation, open circuit and short circuit test, parallel operation	15	35
UNIT: 5	**Three Phase Transformer:** Construction, types of transformer, polarity test, vector group and vector diagram for transformer, Scott connection, voltage regulation and tap changers. improving the lifecycle sustainability of three phase transformers	5	15
		45	**100**

List of Practical:

Sr. NO.	Topic	Hrs
1	To study D.C machine parts	2
2	To obtain magnetization characteristic of separately excited D.C generator	2
3	To obtain external and internal characteristics of D.C. shunt generator	2
4	To obtain external and internal characteristics of D.C. series generator	2
5	To obtain external and internal characteristics of D.C. compound generator	2
6	To study the construction and working of dc starter	2
7	To perform the speed control of D.C. shunt motor by 1.Armature control method 2.field control method	2
8	To study the construction and working principle of single phase transformer	2

9	To perform open circuit test and short circuit test on single-phase transformer and obtain efficiency and regulation at different load condition	2
10	To perform the load test on single phase transformer and find efficiency and regulation	2
11	To perform the parallel operation of transformer	2
12	To study the basic connection of 3 phase transformer	2
13	Brake Test on DC motor	2
14	Swinburne's Test on DC motor	2
15	Retardation Test on DC Machines	2
		30

Learning Resources:

1. Electrical Machines. By Nagarath &Kothari,TMH Publications
2. Electrical Technology Vol II. B. L. Theraja,S .Chand Publications
3. Electrical Machines by P S Bhimbra
4. Electrical Machines by J. B. Gupta, Kataria Pub
5. Electrical Machines by Dr.J.G. Jamnani, Mahajan publishing

Teaching Learning Method

- Group-teaching and learning
- Individual learning/self-study
- Technology-based Learning
- Peer Teaching
- Learning through problem-solving

Course Outcomes Mapping:

CO No.	Course Outcome (CO)	POs/ PSOs Mapped	Cognitive Level (RBT)	Knowledge Category	Class Sessions (Lecture)
CO1	Understanding principles of D.C. Generator, construction, characteristics, losses, and efficiency.	PO1, PO2, PO5, PSO1	Remember, Understand	Conceptual, Analytical	10
CO2	Analyze performance, torque, speed control, and applications of D.C. motors	PO1, PO2, PO3, PO5, PSO1, PSO2	Analyze	Conceptual, Procedural	10
CO3	Analyze construction, operation, testing, efficiency, and regulation of transformers	PO1, PO2, PO3, PO4, PO7, PSO2	Analyze	Conceptual, Analytical	5
CO4	Apply testing methods to determine losses and	PO2, PO5, PO11,	Apply	Procedural, Analytical	15

	efficiency of D.C. machines	PSO2			
CO5	Apply and analyze Transformers to evaluate their performance and select suitable machines for real-world electrical and industrial applications. Electrical machine considering sustainability and efficiency.	PO1, PO2, PO3, PO4, PO10, PSO1, PSO2	Apply, create	Conceptual, Procedural	5

Mapping of COs with POs & PSOs:

CO	PO											PSO	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3	3	0	0	3	0	0	0	0	0	0	3	0
CO2	3	3	3	0	3	0	0	0	0	0	0	3	3
CO3	3	3	3	1	0	0	1	0	0	0	0	0	3
CO4	0	3	0	0	3	0	0	0	0	0	2	0	3
CO5	3	3	3	1	0	0	0	0	0	1	0	3	3

3: High, 2: Medium, 1: Low

Sustainable Development Goals (SDG) Integration

To integrate Sustainable Development Goals (SDGs) into your Electrical Machines course (DC machines & transformers), the key is to connect performance, losses, efficiency, and testing with real-world sustainability outcomes like energy conservation and reduced environmental impact.

SDG Mapping with Course Outcomes

CO	Course Outcome	Relevant SDGs	Justification
CO1	Understanding principles of D.C. Generator, construction, characteristics, losses, and efficiency.	SDG 7 SDG 9	Improves efficiency in energy generation systems
CO2	Analyze performance, torque, speed control, and applications of D.C. motors	SDG 7 SDG 12	Reduces energy consumption through efficient motor control
CO3	Analyze construction, operation, testing, efficiency, and regulation of transformers	SDG 7 SDG 9	Enhances power distribution efficiency and infrastructure
CO4	Apply testing methods to determine losses and efficiency of D.C. machines	SDG 12 SDG 13	Identifies and reduces losses to minimize environmental impact
CO5	Apply and analyze Transformers to evaluate their performance and select suitable	SDG 7, SDG 9,	Supports sustainable machine selection and

	machines for real-world electrical and industrial applications. Electrical machine considering sustainability and efficiency.	SDG 12 SDG 13	efficient industrial operation