

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	-	-	-	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 Hours

Continuous Internal Evaluation Pattern:

Attendance	: 5 marks
Continuous Assessment Test	: 20 marks
Continuous Assessment Assignment/Industrial Visit report	: 15 marks

SYLLABUS**Module 1 (14 Hours)**

Constructional details of DC machines – armature winding – lap and wave windings. DC generator – principle of operation – EMF equation – numerical problems. Classification of DC generators– DC shunt generator – no-load characteristics– numerical problems. Armature reaction – cross magnetizing and demagnetizing effects– compensating winding – interpoles – commutation (concept only). Power flow diagram – losses and efficiency – maximum efficiency – numerical problems.

Module 2 (14 Hours)

DC motor – back EMF – torque equation Classification of DC motors. Characteristics of DC motors – numerical problems. Starting of DC motors – 3-point starter. Braking – regenerative braking, dynamic braking and plugging (concepts only). Speed control of DC shunt and series motors – field control and armature control Power flow diagram – losses and efficiency – numerical problems. Testing – Swinburne's test –numerical problems.

Module 3 (14 Hours)

Single phase transformers – constructional details – principle of operation – EMF equation – ideal and practical transformer – numerical problems. Operation on no-load and on-load – phasor diagram at different load conditions. Equivalent circuit – voltage regulation. Losses and efficiency – condition for maximum efficiency – numerical problems. Testing of transformers – polarity test – OC test – SC test – Sumpner's test – separation of losses – numerical problems.

*One assignment is based on an industrial visit to a transformer industry. Evaluation is done through the IV report and presentation, focusing on understanding and theory–practice correlation.

Module 4 (14 Hours)

Autotransformer – saving of copper. Three-phase transformer – construction – different connections of 3-phase transformers – Y-Y, Δ - Δ , Y- Δ , Δ -Y. Difference between power transformer and distribution transformer – all-day efficiency – numerical problems. Scott connection for 3-phase to 2-phase conversion (concept only). Vector groupings – Yy0, Dd0, Yd1, Yd11, Dy1, Dy11. On-load and off-load tap changing transformers.

Text Books:

1. Bimbira, P. S. (2011). *Electrical machinery* (7th ed.). Khanna Publishers.

2. Nagrath, I. J., & Kothari, D. P. (2017). *Theory of AC machines*. Tata McGraw Hill.
3. Gupta, J. B. (2022). *Theory & performance of electrical machines* (15th ed.). S. K. Kataria & Sons.

Reference Books:

1. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2003). *Electric machinery* (6th ed.). McGraw-Hill.
2. Langsdorf, M. N. (2001). *Theory of alternating current machinery*. Tata McGraw-Hill.
3. Deshpande, M. V. (2011). *Electrical machines*. Prentice Hall India.

**END SEMESTER EXAMINATION – MODEL QUESTION PAPER
(STC 2025 SCHEME)**

Course Code	25UEET302
Course Name	ELECTRICAL MACHINES I
Max. Marks: 60	Duration: 2.5 Hours

Part A (Answer all questions. Each question carries 3 marks)				
Qn No.	Question	Marks	CO	BL
1.	Explain the constructional features of armature winding and distinguish between lap and wave windings.	3	1	L2
2.	Explain the principle of operation of a DC generator and write its EMF equation.	3	1	L2
3.	Explain the significance of back EMF in a DC motor.	3	2	L2
4.	Describe the methods of speed control of DC shunt motors.	3	2	L2
5.	Illustrate the principle of operation of a single-phase transformer.	3	3	L2
6.	Describe the purpose of open-circuit and short-circuit tests on transformers.	3	3	L2
7.	Illustrate the construction and applications of an autotransformer.	3	4	L2
8.	Explain the construction and applications of an autotransformer.	3	4	L2
Part B (Answer any one full question from each Module. Each carry 9 marks)				
Module I				

Qn No.	Question	Marks	CO	BL
9.	Demonstrate the constructional parts of a DC machine and relate each part to its specific function during machine operation.	9	1	L3
OR				
10.	The open-circuit characteristics (OCC) of a DC generator driven at 400 rpm are as follows: Field Current (A) : 2,3, 4, 5, 6, 7, 8, 9. Terminal Voltage (V) : 110, 155, 186, 212, 230, 246, 260, 271. Determine the following: i) The voltage to which the machine will excite when run as a shunt generator at 400 rpm with shunt field resistance equal to 34 Ω ii) Resistance of the shunt field circuit to reduce the OC voltage to 220 V iii) Critical shunt field resistance iv) Critical speed if the shunt field circuit resistance is 34 Ω v) Lowest possible speed at which an OC voltage of 225 V can be obtained	9	1	L3
Module II				
Qn No.	Question	Marks	CO	BL
11.a.	Apply the concept of starting current to justify the necessity of a starter in a DC motor and demonstrate the operation of a three-point starter.	6	2	L3
11.b.	Explain any three methods of electric breaking in DC shunt motor.	3	2	L2
OR				
12.a.	During Swinburne's test a 250V Dc machine was drawing 3A from the 250V supply. The resistances are 250 a and 0.2 a. Find the constant loss of the machine. Also find the efficiency of the machine when it is delivering a 20A at 250V	6	2	L3
12.b.	Explain any two methods of speed control in a DC shunt motor.	3	2	L2
Module III				
Qn No.	Question	Marks	CO	BL
13. a.	Illustrate the construction and principle of operation of a single-phase transformer and explain its EMF equation with suitable diagrams.	5	3	L3
13. b.	Develop the phasor diagram of a transformer on lagging power factor load.	4	3	L3
OR				
14. a.	Illustrate the open-circuit and short-circuit tests on a transformer and determine its efficiency and voltage regulation from the test results.	5	3	L3

14. b.	Develop the condition for maximum efficiency of a transformer.	4	3	L3
Module IV				
Qn No.	Question	Marks	CO	BL
15. a.	Explain the construction and working of an autotransformer and the expression for saving of copper.	6	4	L2
15. b.	Classify the vector groups Yy0, Dd0 and Yd11.	3	4	L2
OR				
16. a.	Explain the different three-phase transformer connections (Y-Y, Δ - Δ , Y- Δ and Δ -Y) with neat diagrams.	6	4	L2
16. b.	Differentiate power transformers and distribution transformers.	3	4	L2
