



VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
 [AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
 Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 80013

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2025
 Third Semester
 Electrical and Electronics Engineering
 U23EE303 – ELECTRICAL MACHINES - I
 (Regulation 2023)

Time: Three Hours

Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	How can a strong magnetic field be established and nearly confined along a specified path?	2	K1	CO1
2.	Show with the help of λ -I graph that the energy and co-energy of a linear magnetic field are equal.	2	K2	CO1
3.	What do you understand by magnetic neutral axis of a DC machine? How does this axis shift in DC generator under the influence of armature reaction?	2	K1	CO2
4.	List the factors involved in the voltage build up process of a shunt generator.	2	K1	CO2
5.	Why is the Speed-Torque characteristic of a DC shunt motor not linear in the high torque region?	2	K1	CO3
6.	Derive the Speed-Torque relation for a separately excited DC motor under steady state. (Hint :Use KVL around the armature loop)	2	K2	CO3
7.	State the reason for the given statement: Core flux is nearly constant when the transformer is operated from no-load to full load.	2	K1	CO4
8.	Identify the reason for conducting SC test on the HV side of a transformer. Why the core loss is negligible in this case?	2	K2	CO4
9.	Infer any two applications of the autotransformers in an electrical power system.	2	K2	CO5
10.	Interpret the reason for having the star side of a star/delta transformer is HV side in a transmission system, while in a distribution system the star side is in the LV side.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.	Questions	Marks	KL	CO
11. a)	Two coils have self and mutual inductances of $L_{11} = L_{22} = \frac{2}{(1+2x)}$; $L_{12} = (1-2x)$. The coil resistances may be neglected. If the current i_1 is maintained constant at 5 A and $i_2 = -2$ A, find the mechanical work done when x increases from 0 to 0.5 m. Assume $\Phi - i$ relationship is linear.	13	K2	CO1
	(OR)			
b)	The $\lambda - I$ relationship for an electromagnetic system is given by $i = \left[\frac{\lambda g}{0.09} \right]^2$ which is valid for the limits $0 < i < 4$ A and $3 < g < 10$ cm. For current $i = 3$ A and airgap length $g = 5$ cm, find the mechanical force on the moving part using field energy and co-energy of the field.	13	K2	CO1
12. a)	Explain the effect of armature reaction in DC generators and methods of compensating it. Illustrate the effects with neat diagrammatic representation.	13	K2	CO2
	(OR)			
b)	A 250 kW and 750 kW, 550 V generators operate in parallel, delivering a total load of 1500 A. The voltage regulation of a smaller machine is 0.058 pu and the larger unit is 0.035. Assume the voltage regulation characteristic is linear. The effect of armature reaction is negligible. Determine i. The current delivered by each machine ii. The terminal voltage	(8+5)	K3	CO2
13. a)	i. Explain the characteristics of DC shunt, series, and compound motors. ii. A 4-pole DC motor with wave-connected armature has 540 conductors. Flux per pole = 25 mWb, armature current = 50 A. Find the torque developed.	7 6	K2	CO3
	(OR)			
b)	A 230 V, 250 rpm, 100 A separately excited dc motor has an armature resistance 0.05Ω . The motor is connected to 230 V DC supply and rated DC voltage is applied to field winding. It drives a load whose speed torque characteristics is given by $T_L = 500 - 10\omega$, where ω is the rotational speed expressed in rad/sec and torque in N-m. Find the steady state speed at which the motor will drive the load, and the armature current drawn by it from the source. Neglect rotational losses of the machine.	13	K2	CO3
14. a)	A single-phase transformer has a voltage regulation of 10% when delivering full load at upf, and 15% when delivering the same load at 0.8 pf lag. What would be the voltage regulation if the transformer is half full load at 0.8pf leading.	13	K3	CO4

(OR)

- | | | | | | |
|-----|-----|--|----|----|-----|
| b) | i. | Explain the procedure of conducting open-circuit and short-circuit test on a single-phase transformer. | 7 | K2 | CO4 |
| | ii. | A 20 kVA, 2000/200 V transformer has full-load copper loss of 200 W and iron loss of 150 W. Find the efficiency at full load and 0.8 pf lag. | 6 | | |
| 15. | a) | A 220/110 V (HV/LV), 11kVA single-phase two winding transformer is to be employed as an autotransformer to supply (a) 330V from a 110V supply mains. (b) 110V from a 330V supply mains When tested as a two winding transformer at rated load and at 0.85 pf its efficiency is 97%. Determine its kVA rating as an auto transformer and its efficiency at rated load at 0.85 pf (lag). | 13 | K2 | CO5 |

(OR)

- | | | | | |
|----|---|----|----|-----|
| b) | Explain the types of connections in three phase transformers by considering its winding arrangements, principle and applications. | 13 | K2 | CO5 |
|----|---|----|----|-----|

PART – C

(1 x 15 = 15 Marks)

- | Q.No. | Questions | Marks | KL | CO |
|-------|---|-------|----|-----|
| 16. | a) A transformer requires reactive power, even when it has to deliver an output load at unity power factor. Justify this need. If you were assigned the task of modelling the transformer that draws minimum or near zero reactive power for its operation, how would you approach this problem?. | 15 | K3 | CO4 |

(OR)

- | | | | | |
|----|--|----|----|-----|
| b) | Refer the Singly excited machine shown below. Is it possible to generate torque on the rotor with the current from the stator coil? If so, state the principle and derive the general expression for torque. | 15 | K2 | CO1 |
|----|--|----|----|-----|

