Ref. No.: Ex/ME(M2)/PC/B/EE/T/122/2024

B.E. MECHANICAL ENGINEERING FIRST YEAR SECOND SEMESTER – 2024

ELECTRICAL MACHINES

Time : 3 hours Full Marks : 100

Part - I (60 marks for this part)
Use Separate Answer scripts for each part.

Answer any three (03) taking at least one from Group A and Group B. Answer questions of this part in the same answer-script.

Group-A

1.	(a)	For an ideal two winding transformer, show that (primary VA) = (Secondary VA)	7
	(b)	Explain how impedances can be referred from secondary to the primary of a transformer.	6
	(c)	Discuss the constructional differences between core and shell type transformers	7
2.	(a)	Explain the experimental procedure to find the equivalent circuit parameters of a single phase transformer.	8
	(b)	A transformer is rated 10 kVA, 50 Hz 2300/230 V with $R_1 = 4\Omega$, $R_2 = 0.04\ \Omega$, $X_{11} = 5\ \Omega$, $X_{12} = 0.05\ \Omega$. It has a core loss of 120 W at 2300 V. Find the efficiency of the transformer at 80% load at 0.8 lagging pf. Find the maximum efficiency of the transformer at 0.9 lagging pf.	12

Group-B

3.	(a)	Classify DC generators based on the process of excitation. Draw the circuit models for each case.	7
	(b)	A shunt generator is not generating significant voltage. What may be the reasons? How to correct them?	7
	(c)	Derive, draw and explain the load characteristics of a shunt excited DC generator.	6
4.	(a)	Derive the torque equation of a DC motor.	5
	(b)	Derive and draw the torque-speed characteristics of a DC series motor.	7
	(c)	The armature and field resistances of a 15 kW, 250 V series motor are 0.25 Ω and 0.2 Ω respectively. The motor takes 40 A at a speed of 600 rpm. Find the motor speed when the motor takes 70 A. Assume linear magnetisation characteristics.	8
5	(a)	Explain the commutation process of a DC machine.	6
	(b)	How can we control the speed of a shunt motor **above the rated speed**?	7
	(c)	With suitable circuit diagram explain how a starter is used to start a shunt motor.	7

[Turn over

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B.E. MECHANICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION - 2024

Subject: **ELECTRICAL MACHINES**

Time: Three hours | Full Marks: 100

Part-II | (40 Marks for part-II)

Use separate answer-Script for each part

Questions No.		*Answer ANY THREE of the questions below(Question No. 1 carries 14 marks)*	Marks
1.	a)	With the help of connection and phasor diagrams, show that the power factor of a balanced three phase load can be determined using two wattmeters.	7
	b)	A balanced three-phase star connected load of impedance $Z_Y = 8 + j6\ \Omega$ per phase is connected to a three phase 230V supply. Calculate the active and recative power of the load. What will be the readings of the wattmeters if the power is measured with two wattmeter method?	7
2.	a)	Explain, how the rotating magnetic field is produced by the stator of a three phase induction motor.	7
	b)	A three phase induction motor has a rotor for which the resistance per phase is 0.1 Ω and reactance per phase when stationery is 0.4 Ω . The rotor induce e.m.f per phase is 100 V when stationery. Calculate the rotor current and rotor power factor (i) when stationery (ii) when running with a slip of 5%.	6
3.	a)	Derive and plot the torque-speed characteristics of a three phase induction motor.	7
	b)	Draw the phasor diagram of a three phase induction motor.	6
4.	a)	Describe the no-load test and blocked rotor test on a three phase induction motor,	10
	b)	Why no-load current of an induction machine is higher compared to transformer of equivalent rating?	3
5.	a)	Discuss how starting torque is developed in a single phase induction motor.	6
	b)	Explain the operation of start-delta starter of a three phase induction motor with necessary circuit diagram.	7