Reg. No.																

Question Paper Code	14195

M.E. / M.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

First Semester

M.E. - Power Electronics and Drives

24PPEPC102 - ANALYSIS OF ELECTRICAL MACHINES

Regulations - 2024

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

	Question	Marks	K – Level	CO
1.	The main purpose of a doubly-excited system is to: (a) Increase the magnetic saturation (b) Provide two separate magnetic paths (c) Produce continuous torque or force through the interaction of two fields (d) Reduce the core losses	1	K1	CO1
2.	The MMF (magneto-motive force) produced by a concentrated coil with N turns carrying current i is: (a) Ni (b) Ni/2 (c) Ni^2 (d) N/i	1	K1	CO1
3.	The steady-state speed of a shunt DC motor can be increased by: (a) Increasing the armature resistance (b) Decreasing the field flux (c) Decreasing the supply voltage (d) Increasing the load torque	1	K1	CO2
4.	The dynamic equation for the armature circuit of a DC motor is: (a) V = Eb + IaRa (b) V = L di/dt + iR + Eb (c) V = Eb – IaRa (d) T = J dω/dt + Bω + TL	1	K1	CO2
5.	The back EMF of a Permanent Magnet Synchronous Motor (PMSM) appears as a constant voltage along which axis in a rotor reference frame? (a) d-axis (b) q-axis (c) Both d and q axes (d) Zero-sequence axis	1	K1	CO3
6.	For a three-phase balanced fault analysis of a synchronous generator, the most appropriate reference frame to use is the: (a) Stator (stationary) reference frame (b) Rotor reference frame (c) Network synchronous reference frame (d) Arbitrary reference frame with ω = 0	1	K1	CO3
7.	When an induction motor is operating at its maximum torque point, the power factor is: (a) Unity (b) Leading (c) Lagging and relatively high (d) Lagging and relatively low	1	K1	CO4
8.	The starting current of an induction motor is typically: (a) Equal to the full-load current (b) Slightly less than the full-load current (c) 5 to 8 times the full-load current (d) Independent of the applied voltage	1	K1	CO4
9.	In the dynamic model of a synchronous machine, the damper windings are represented in the equivalent circuits of: (a) Only the d-axis (b) Only the q-axis (c) Both the d-axis and q-axis (d) The field circuit only	1	K1	CO5
10.	The damper windings in a synchronous machine provide: (a) The main field excitation. (b) A path for DC current. (c) A damping torque during rotor oscillations (d) A means to change the number of poles.	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

	Question	Marks	K – Level	CO
11.	Compare between field energy and co-energy.	2	K2	CO1
12.	Outline the principle of Electromechanical energy conversion.	2	K2	CO1
13.	Summarize the use of static reference frame in D.C motor analysis.	2	K2	CO2

14. Write the transfer function of the separately excited D.C. motor. *2 K1 CO2*
15. Explain the use of transformations of balanced set. *2 K2 CO3*
16. State the reference frames theory. *2 K1 CO3*
17. What are the specific variables observed from several frames of reference of an induction motor? *2 K1 CO4*
18. Write the equations for flux linkages in the two axis model in induction machine. *2 K1 CO4*
19. Write the voltage equations of a three phase synchronous machine in phase variable form. *2 K1 CO5*
20. Write transformation relationship between static and rotating reference frames for R, R-L and R-L-C circuits in synchronous machine. *2 K1 CO5*
21. Draw the time domain block diagram for shunt connected D.C. machine. *2 K1 CO2*
22. A 4-pole, 60 Hz, three-phase induction motor runs at a full-load speed of 1740 RPM. Calculate the percent slip at full load. *2 K2 CO3*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23\. a) The lifting magnetic system shown in Figure.1 has a square cross section of 6 X 6 cm^2. The coil has 300 turns and a resistance of 6 ohms. Neglect reluctance of the magnetic core and field fringing in the air gap. The air gap is initially held at 5 mm and a DC source of 120 V is connected to the coil. Determine the stored energy and the lifting force. *11 K2 CO1*

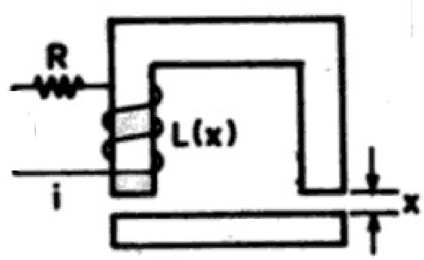

Figure.1

OR

b) Explain in detail about the calculation of air gap MMF and per phase machine inductance using physical machine data. *11 K2 CO1*

24\. a) The parameters of a 5 HP dc machine are r_a=0.6ohms,L_{AA}=0.012 H, R_f=120 Ohms, L_{FF}=120 H,L_{AF}=1.8H, V_a=V_f=240V. Calculate the steady state rotor speed, Assume B_m=0. *11 K2 CO2*

OR

b) A 220V, 5KW, 1480 r.p.m. separately excited D.C. motor has the following data: r_a = 1.2Ω no load speed = 1500 r.p.m, J = 1.6 Kg.m^2 no load current = 3A. Assume constant field current and neglect armature inductance. Find the parameters of equivalent electrical circuit. *11 K2 CO2*

25\. a) Model transformations equations to convert three-phase (a-b-c) or two-phase (α-β) stationary frame variables into the rotating d-q synchronous reference frame. *11 K3 CO3*

OR

b) Utilize reference-frame theory and derive the transformations for currents between a rotating balanced two phase (a,b) winding and a pseudo-stationary two phase (d, q) winding. Assume equal turns on all coils. Show that the transpose of current transformation matrix is equal to its inverse. *11 K3 CO3*

26.	a)	Make use of reference-frame theory, Derive the expressions for a three phase induction motor (voltage and current) in state variable form in stator reference frame and synchronously rotating frame.	*11*	*K3*	*CO4*
		OR			
	b)	Apply reference-frame theory and derive the expressions for flux linkages in the two axis model for a three phase induction motor from ψ_a,ψ_b,ψ_c values.	*11*	*K3*	*CO4*
27.	a)	Construct dynamic performance of synchronous machine for load torque variations with necessary waveforms.	*11*	*K3*	*CO5*
		OR			
	b)	Make use of reference frame theory in a step-by step basis that how a three phase symmetrical induction machine model transformed into two phase machine model. Draw also the equivalent circuit model of transformed two phase machine model with respect to synchronous reference frame.	*11*	*K3*	*CO5*
28.	a) (i)	Utilize the free acceleration characteristics to analyze the performance of an induction motor.	*6*	*K3*	*CO4*
	(ii)	Apply load torque variations to explain about the analysis of dynamic performance of an synchronous machine.	*5*	*K3*	*CO5*
		OR			
	b) (i)	Model symmetrical induction machine equations using steady state operation and draw the equivalent circuit.	*6*	*K3*	*CO4*
	(ii)	Make use of Park's equations, derive the torque equations for synchronous machine.	*5*	*K3*	*CO5*