Reg. No.															

Question Paper Code	12737

M.E. / M.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

First Semester

M.E - Power Electronics and Drives

20PPEPC102 - ANALYSIS OF ELECTRICAL MACHINES

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Define energy and co-energy.	2	K1	CO1
2.	Write the force/torque equation of an electrical machine.	2	K1	CO1
3.	A separately excited D.C. motor requires 100 W at full load. The full load speed is 1000 RPM, and the armature voltage is 80 V. Armature coil resistance is 2.1 ohms and the field coil resistance is 220 ohms. Calculate the no-load speed of the motor.	2	K2	CO2
4.	What are the conditions to be fulfilled by for a dc shunt generator to build back emf?	2	K1	CO2
5.	What is meant by synchronous reference frame?	2	K1	CO3
6.	Why it is necessary to transform variable from one frame to another frame?	2	K2	CO3
7.	Write the electromagnetic torque equation in terms of flux linkages of an induction motor.	2	K1	CO4
8.	List few advantages of skewing.	2	K1	CO4
9.	Where are the damper windings located? What are their functions?	2	K1	CO5
10.	Why are Alternators rated in kVA and not in kW?	2	K2	CO5

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Derive the general expression of stored magnetic energy, co-energy and force for doubly excited system.	13	K4	CO1
		OR			
	b)	Derive how the air gap mmf and per phase machine inductance is calculated using physical machine data.	13	K4	CO1
12.	a)	Describe in detail the digital computer simulation of permanent magnet D.C machine**.**	13	K2	CO2
		OR			
	b)	Derive the torque and EMF equation of a D.C. motor along with its dynamic characteristics.	13	K2	CO2

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

13. a) Explain the transformation of stationary circuit variables to the arbitrary reference frame for the three-phase inductive circuit. *13 K2 CO3*

OR

b) Explain the difference between phase transformation and commutator transformation with an example. *13 K2 CO3*

14. a) Write down the nonlinear dynamic equations describing the induction machine. Draw the typical stator current, rotor current, developed torque and rotor speed waveforms during free acceleration and sudden short circuit conditions stator terminals. *13 K3 CO4*

OR

b) Derive the torque equation of a three-phase induction motor in machine variables. *13 K3 CO4*

15. a) Apply park's transformation on a three-phase synchronous machine and obtain its voltage and torque equations. *13 K3 CO5*

OR

b) Derive the stator voltage equations of a synchronous machine in arbitrary reference-frame variables. *13 K3 CO5*

PART - C (1 × 15 = 15 Marks)

16. a) The armature of a D.C motor carries 30 A. The armature is lap wound with 310 conductors. The number of poles is 4. The length of the pole is 16 cm. Pole shoe subtends an angle of 60 degree at the center, bore radius =16 cm, flux density in the air gap is 7 Tesla. Estimate the torque developed by the motor. *15 K6 CO2*

OR

b) A series excited DC machine designed for a variable speed application has the following name plate details and parameters. 3HP, 230V, 2000 rpm, R_a =1.5 Ω, R_{se}= 0.7 Ω , L_a =0.12 H, L_{se} = 0.03 H, M = 0.0675 H, B_1 = 0.0025 N-m (rad/sec). Estimate (i) The input voltage required in steady state to deliver rated torque at rated speed and (ii) The efficiency at this operating point. Assume that a variable voltage source is available for this machine. *15 K6 CO2*