Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering - SEMESTER - VII EXAMINATION - WINTER 2025

Subject Code: 2170909 **Date: 13-11-2025**

Subject Name: Design of AC Machines

Time: 10:30 AM TO 01:30 PM **Total Marks: 70**

Instructions

1. Attempt all questions.

2. Make suitable assumptions wherever necessary.

3. Figures to the right indicate full marks.

4. Simple and non-programmable scientific calculators are allowed.

			Marks
Q.1	**(a)**	Why semi-enclosed slots are usually preferred for induction motors.	**03**
	(b)	Discuss the rules for selection of number of rotor slots in three phase induction motor.	**04**
	(c)	What do you mean by specific electric loading and specific magnetic loading applied to electric machines? State the factors on which the choice of these loadings depends.	**07**
Q.2	**(a)**	Important of circle diagram in design of induction motor.	**03**
	(b)	Derive D^2L in single phase induction motor is 1.5 times of three phase induction motor for same output and speed.	**04**
	(c)	Define SCR of a synchronous machine. Discuss the importance of SCR in the design of synchronous machine.	**07**
		OR	
	(c)	Machines rated at 3.7 kW, 4 pole are sold at a competitive price and therefore choose the main dimensions to give cheap design. determine the main dimensions, number of radial ventilating ducts, number of stator slots and the number of turns per phase of a 3.7 kW, 400 V, 3-phase, 4 pole, 50 Hz squirrel cage induction motor to be started by a star-delta starter. Work out the winding details. Assume average flux density in the gap = 0.45 Wb/m^2, ampere conductor per meter = 23000, efficiency = 0.85, power factor = 0.84, winding factor = 0.955 and staking factor = 0.9.	**07**
Q.3	**(a)**	An alternator rated for 490 kVA, 3.3 kV, 10 poles, 3 phase, 50 Hz, Delta connected has 182 turns per phase, Determine length of airgap. Given: B_{av} = 0.54 wb/m^2, Pole arc to pole pitch ratio = 0.66, SCR = 1.2, Gap contraction factor = 1.15, Winding factor = 0.95, Mmf for airgap is 80% of number load field mmf, Field form factor = 0.68.	**03**
	(b)	Prove that torque produce by 5^{th} harmonics is in backward direction & 7^{th} harmonics is in forward direction.	**04**
	(c)	Calculate the diameter, core length, no of conductors of the stator , size of conductor, no of stator slots of 75 MVA, 96 pole, 50 HZ, low speed star connected hydro generator having voltage per phase is 8000 V. Assume B_{av}= 0.64 Wb/m^2, ac=40625 Amp-cond/m, Kw=0.955, peripheral velocity= 39.5m/s	**07**

OR

	(a)	Derive the equation of MMF of damper winding.	**03**
	(b)	What is dispersion coefficient? What is its effect on max. power factor.	**04**
	(c)	Write the steps and necessary equations for rotor design of an synchronous machine.	**07**
Q.4	**(a)**	List out the factors to be considered while selecting number of armature slots in the design of a synchronous machine & explain any one.	**03**
	(b)	Calculate the value of capacitance for maximum starting torque in 1-phase induction motor.	**04**
	(c)	Write a brief note on rotor design of 1-phase induction motor.	**07**

OR

	(a)	List out factors affecting determining air gap length in induction motor design & Explain any one.	**03**
	(b)	Explain main differences between design of 1-phase and 3-phase induction motor.	**04**
	(c)	Write a brief note on stator design of 1-phase induction motor	**07**
Q.5	**(a)**	Why a turbo alternator has smaller diameter and larger length where as a hydro alternator has large diameter and small length?	**03**
	(b)	What is dispersion coefficient? What is its effect on maximum power factor?	**04**
	(c)	Write the steps and necessary equations for armature design of a synchronous machine.	**07**

OR

	(a)	Explain direct axis and quadrature axis synchronous reactance in synchronous machine.	**03**
	(b)	Discuss the advantages of using open-source FEM software for 2D design in electrical machine design.	**04**
	(c)	Discuss application of FEM technique for design problems.	**07**

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