Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2022

Subject Code:2170909 Date:16-01-2023

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)**	Define 'Specific electric loading' and 'Specific magnetic loading' in connection with 3-phase induction motor.	**03**
	(b)	Explain the factors affecting the choice of specific Magnetic loading in case of a Synchronous machine.	**04**
	(c)	Derive an output equation for 3-ϕ induction motor with usual notation.	**07**
Q.2	**(a)**	State the rules for the selection of rotor slots in 3-phase squirrel cage induction motor.	**03**
	(b)	State important design difference between turbo alternators and hydro generators.	**04**
	(c)	Define SCR. Discuss its effects on synchronous machine performance.	**07**
		OR	
	(c)	Find the main dimensions of a 2500 kVA, 187.5 r.p.m., 50 Hz, 3-phase, 3 kV, salient pole synchronous generator. The generator is to be a vertical, water wheel type. The specific magnetic loading is 0.6 Wb/m2, and the specific electric loading is 34000A/m. use circular poles with ratio of core length to pole pitch = 0.65. specify the type of pole construction used if the run-away speed is about 2 times the normal speed	**07**
Q.3	**(a)**	What is the role of damper winding in (i) synchronous generator and (ii) synchronous motor?	**03**
	(b)	What is dispersion coefficient? What is its effect on max. power factor	**04**
	(c)	Determine the main dimensions of a 15 kW, 3-phase, 400 V, 50 Hz, 2810 r.p.m squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9. Assume: Specific magnetic loading = 0.5 Wb/m_2, specific electric loading = 25000 A/m, winding factor = 0.955. Take the rotor peripheral speed as approximately 20 m/s at synchronous speed.	**07**
		OR	
Q.3	**(a)**	Explain the terms "critical speed" and "run away speed" with reference to synchronous machine.	**03**
	(b)	Draw and explain briefly the current distribution wave form speeded over one pole pitch in bars and end rings squirrel cage induction motor	**04**
	(c)	A 11kW,3 phase,6 pole 50 Hz,415V star connected induction motor has 48 slots each containing 9 conductors. Calculate the values of bar and end ring currents. The number of rotor bars is 64. The machine efficiency of 0.86 and a power factor of 0.85. The rotor mmf may be assumed of 85 percent of stator mmf. Find area of rotor bar and area of end ring, if current density is 5 A/mm2	**07**
Q.4	**(a)**	Explain direct axis and quadrature axis synchronous reactance in synchronous machine	**03**
	(b)	Calculate the value of capacitance for maximum starting torque in 1-phase induction motor	**04**

	(c)	The following is the design data available for a 1250 kVA, 3-phase, 50 Hz, 3300 V, star connected, 300 r.p.m. alternator of salient pole type: Stator bore D = 1.9 m, stator core length L = 0.335 m, turns per phase =150, pole arc/pole pitch = 0.66, single layer concentric winding with 5 conductors per slot, short circuit ratio=1.2. assume that the distribution of gap flux is rectangular under the pole arc with zero values in the interpolar region. Calculate: (a) Specific magnetic loading (c) armature mmf/ pole (b) Gap density over pole arc (d) air gap length. Mmf required for air gap is 0.88 of no load field mmf and the gap contraction factor is 1.15.	**07**
		OR	
Q.4	**(a)**	Compare the output equation of both 1-phase and 3-phase IM.	**03**
	(b)	List out factors affecting determining air gap length in induction motor design & Explain any one.	**04**
	(c)	Write a brief note on stator design of 1-phase induction motor	**07**
Q.5	**(a)**	State why a turbo alternator has smaller diameter and large length but hydro alternator has larger diameter and small length	**03**
	(b)	Describe the methods for reducing the effect of harmonics torque in 3-phase squirrel cage induction motor.	**04**
	(c)	Discuss application of FEM technique for design problems.	**07**
		OR	
Q.5	**(a)**	Derive the equation of MMF of damper winding.	**03**
	(b)	Explain briefly the methods for improving e.m.f. wave form of an alternator.	**04**
	(c)	Discuss the effect of variation of main dimension (D&L) on performance (Rating, losses & efficiency) of 3-ϕ induction motor.	**07**

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