Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 2170909 Date: 21/06/2023

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.**

Q.1	**(a)**	Why closed types slots are often used for small induction motors?	**03**
	(b)	State important design difference between turbo alternators and hydro generators.	**04**
	(c)	What do you mean by specific electric loading and specific magnetic loading? discuss the factors which govern the choice of specific loadings for a 3-phase induction motor.	**07**
Q.2	**(a)**	Why the length of air gap in induction motor is kept minimum possible where as in a DC machine it is larger?	**03**
	(b)	Differentiate between harmonic induction torque and harmonic synchronous torque developed in an induction motor.	**04**
	(c)	Explain the factors affecting the selection of air gap length for 3-phase induction motor.	**07**
		OR	
	(c)	What is dispersion coefficient? Show its effect on maximum power factor and overload capacity of 3-phase induction motor.	**07**
Q.3	**(a)**	What are the design criteria that should be taken care while design of submersible motors?	**03**
	(b)	Show that the output for a single phase induction motor is $2/3^{rd}$ of that for a three phase equivalent induction motor for the same D^2L values.	**04**
	(c)	In the design of a 30 h.p., 440 volt, 960 r.p.m, 50 Hz, 3-phase delta connected induction motor, assume the specific electric loading of 25000 ac/m, specific magnetic loading of 0.46 wb/m^2, winding factor of 0.955. Full load efficiency 86 %, p.f. 0.87 and estimate the following: (i) Stator core dimensions (ii) Number of stator slots and winding turns. Assume $L/\tau = 1$.	**07**
		OR	
Q.3	**(a)**	Why in an induction motor the number of stator slots should never be equal to the number of rotor slots?	**03**
	(b)	Derive the equation for the value of capacitance for maximum starting torque in 1-phase induction motor.	**04**
	(c)	Calculate the length of air gap of a 15 kW, 400 volt, 50 Hz, delta connected 1440 r.p.m. induction motor having both full load efficiency and power factor as 0.88 each. Assume the specific electric loading of 23000 ac/m, specific magnetic loading of 0.45 tesla, ratio of core length to pole pitch = 0.85, winding factor = 0.955.	**07**

Q.4	**(a)**	What is the role of damper winding in (i) synchronous generator and (ii) synchronous motor.	**03**
	(b)	Explain the term SCR and its effect on the synchronous machine performance.	**04**
	(c)	Write the steps and necessary equations for rotor design of an synchronous machine.	**07**

OR

Q.4	**(a)**	Define the terms critical speed and run away speed in synchronous machine.	**03**
	(b)	Explain the factors which are to be considered while selecting the armature slots of a synchronous machine.	**04**
	(c)	A 1250 kVA, 3-phase, 6600 volt, salient pole alternator has the following data: Air gap diameter = 1.6 meter, length of core = 0.45 meter, number of poles = 20, armature ampere conductors per meter = 28000, ratio of pole arc to pole pitch = 0.68, stator slot pitch = 28 mm, current density in damper bars = 3 amp/mm^2. Design a suitable damper winding for the machine.	**07**

Q.5	**(a)**	Briefly answer following: (i) Why the stator winding of all synchronous generators is usually star connected with neutral earthed? (ii) Why does the rotors of turbo alternators are slotted for only two third of its periphery?	**03**
	(b)	Explain how mmf is calculated for magnetic circuit in synchronous machine.	**04**
	(c)	Discuss algorithm and prepare a flow chart for design of main dimensions of a low speed alternator.	**07**

OR

Q.5	**(a)**	What are the applications of FEM technique for design problem?	**03**
	(b)	Explain significance of FEM in design problem.	**04**
	(c)	Draw the flow chart for computer design of three phase induction motor and also write its advantages.	**07**

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