Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019

Subject Code: 2170909 **Date: 03/12/2019**

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.**

Q.1	**(a)**	Why semi-enclosed slots are usually preferred for induction motors.	**03**
	(b)	Explain design difference between low speed and high speed machine.	**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-ph induction motor.	**07**
Q.2	**(a)**	State the methods of improving starting torque of three phase induction motor.	**03**
	(b)	Discuss the rules for selection of number of rotor slots in three phase induction motor.	**04**
	(c)	Define SCR of a synchronous machine. Discuss the importance of SCR in the design of synchronous machine.	**07**
		OR	
	(c)	Design the suitable values of diameter and length of 75 MVA, 11 KV, 50 Hz, 3000 r.p.m, 3-ph, star connected alternator. Also determine the value of flux, conductors per slot, number of turns per phase and size of armature conductor. Given: (i) average gap density = 0.6 tesla (ii) ampere conductors per meter = 50,000 (iii) peripheral speed = 180 m/sec. (iv) winding factor = 0.95 and (v) current density = 6 amp/mm^2.	**07**
Q.3	**(a)**	What do you mean by dispersion co-efficient applied to induction motors.	**03**
	(b)	Explain the effect of harmonic induction torque and harmonic synchronous torque on the performance of 3-ph induction motor.	**04**
	(c)	A 15 HP, 400 volt, 1430 r.p.m, 3-ph induction motor with an efficiency of 80 % and p.f. 0.81 has inner diameter of stator 30 cm and length 12 cm. Estimate the diameter and length for a 50 h.p, 406 volt, 4 pole, 50 Hz induction motor to be designed for 84 % efficiency and 0.85 p.f. assuming same specific loadings as the previous motor. Assume, $\tau = 0.41\sqrt{L}$.	**07**
		OR	
Q.3	**(a)**	Compare single phase induction motor and three phase induction motor.	**03**
	(b)	Prove that output of single phase machine is two third of the output of three phase induction motor.	**04**
	(c)	A 370 watt, 230 volt, 50 Hz, 4-pole single phase capacitor start induction motor has the following design data: The full load efficiency and power factor should not be less than 0.65 and 0.62 respectively. The starting torque should be about 300 percent of full load torque with starting current not more than 21 amp. Take flux per pole 0.0027 Wb, current density 4 amp/mm^2 and winding factor for main winding is 0.8. Determine (i) number of turns of main winding. (ii) number of turns in each coils for sinusoidal distributions. Assume $L/\tau = 1$.	**07**
Q.4	**(a)**	Explain following terms for a design of single phase induction motor: (i) Number of turns of main winding (ii) Resistance of main winding	**03**

	(b)	Describe hunting in synchronous machine.	**04**
	(c)	Explain the factors which are to be considered while selecting the armature slots of a synchronous machine.	**07**

OR

Q.4	**(a)**	Define the terms critical speed and run away speed in synchronous machine.	**03**
	(b)	Explain how length of air gap is estimated in synchronous machine.	**04**
	(c)	A 1250 KVA, 3-ph, 6.6 KV, salient pole alternator has the following data: Air gap diameter = 1.6 meter, length of core = 0.45 meter, number of poles = 20, armature ac per meter = 28000, ratio of pole arc to pole pitch = 0.68, stator slot pitch = 28 mm, current density in damper bars = 3amp/mm^2. Design a suitable damper winding for the machine.	**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)	Discuss the design difference of a salient pole and non salient pole synchronous machines.	**04**
	(c)	Explain steps for field winding design in case of salient pole synchronous machine.	**07**

OR

Q.5	**(a)**	What are the applications of FEM technique for design problem?	**03**
	(b)	Explain the advantages of finite element method.	**04**
	(c)	Explain how you will estimate MMF required for various parts of magnetic circuit of synchronous machines.	**07**

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