Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2017

Subject Code: 2170909 Date:15/11/2017

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.**

			MARKS
Q.1	**(a)**	Write the output equation of 3-phase induction motor in usual notation with meaning of each notation.	**03**
	(b)	Define SCR and its importance in designing of synchronous machine.	**04**
	(c)	Discuss the effect of variation of main dimension (D&L) on performance (Rating, losses & efficiency) of 3-ϕ induction motor.	**07**
Q.2	**(a)**	Define 'electric loading' and 'magnetic loading' in connection with 3-phase induction motor.	**03**
	(b)	Prove that torque produce by 5TH harmonics is in backward direction & 7TH harmonics is in forward direction.	**04**
	(c)	Design a 10HP, 440V, 3-Phase, 4-pole, 50Hz squirrel cage induction motor which is to be started using a star-delta starter. Find the main dimensions, number of turns per phase & number of stator slots. Assume:-Average flux density in the gap=0.45wb/m^2, Ampere conductors per meter=23000, efficiency=0.85, Power factor=0.84, stator winding factor=0.955. Choose the main dimension to give an overall good design.	**07**
		OR	
	(c)	Determine the D and L of a 70 Hp, 415V, 3-phase, 50-Hz, star connected, 6 pole induction motor for which ac = 30000 amp.cond/m and Bav = 0.51 wb/m2. Take Efficiency = 90 % and pf = 0.91. Assume Pole pitch τ = L. Estimate the number of stator conductors required for a winding in which the conductors are connected in 2-parallel paths. Choose a suitable number of conductors/ slots, so that the slot loading does not exceed 750 amp. cond.	**07**
Q.3	**(a)**	Write a note on choice of average flux density in air gap in connection with 3-phase IM.	**03**
	(b)	What is dispersion coefficient? What is its effect on max. power factor	**04**
	(c)	Design a cage rotor for a 40 HP, 3-phase, 400V,50 Hz, 6 pole, delta connected induction motor having a full load efficiency of 87% and a full load pf of 0.85. Take D = 33 cm and L = 17 cm. Stator slots – 54, conductors/slot = 14. Assume suitable missing data if any.	**07**
		OR	
Q.3	**(a)**	Explain the difference between turbo and hydro alternator in a point of view of design.	**03**
	(b)	Explain the factors affecting the choice of specific Magnetic loading in case of a Synchronous machine.	**04**

	(c)	The output co-efficient of 1250KVA, 300 rpm, synchronous generator is 200KVA/m2-rps. (a) find the values of main dimensions (D,L) of the machine if the ratio of length to diameter is 0.2. Also calculate the value of main dimensions if (b) specific loading are decreased by 10% each with speed remaining the same as in part (a). (c) speed is decreased to 150 rpm with specific loading remaining the same as in part (a). Assume the same ratio of length to diameter. Comment upon the results.	**07**
Q.4	**(a)**	What is the role of damper winding in (i) synchronous generator and (ii) synchronous motor?	**03**
	(b)	Explain the terms "critical speed" and "run away speed" with reference to synchronous machine.	**04**
	(c)	A 600 rpm, 50 Hz, 10000 V, 3 phase, synchronous generator has the following design data. B_{av} = 0.48 Wb/m^2, Current Density = 2.7 amp/mm^2, slot space factor = 0.35, number of slots = 144, slot size = 120 x 20 mm, D = 1.92 m and L = 0.4 m. determine the KVA rating of the machine.	**07**
		OR	
Q.4	**(a)**	State why a turbo alternator has smaller diameter and large length but hydro alternator has larger diameter and small length	**03**
	(b)	Derive the equation of MMF of damper winding	**04**
	(c)	Calculate the diameter, core length, no of conductors of the stator , size of conductor, no of stator slots of 30 MVA, 11KV, 3000RPM, 50 HZ, star connected Turbo alternator. Assume Bav= 0.55 Wb/m2, ac=55000 A/m Kw=0.955, peripheral velocity= 160m/s	**07**
Q.5	**(a)**	Explain main differences between design of 1-phase and 3-phase induction motor.	**03**
	(b)	Explain significance of FEM in design problem.	**04**
	(c)	Write a brief note on overall design of 1-phase induction motor.	**07**
		OR	
Q.5	**(a)**	Compare the output equation of both 1-phase and 3-phase IM.	**03**
	(b)	Application of FEM technique for design problems.	**04**
	(c)	Calculate the value of capacitance for maximum starting torque in 1-phase induction motor.	**07**

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