Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2021

Subject Code:2170909 Date:07/08/2021

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)**	Derive an output equation for 3-ϕ induction motor with usual notation.	**03**
	(b)	Define and explain the term "short circuit ratio" of a synchronous generator and discuss its influences on the machine performance.	**04**
	(c)	Explain the factors that effects the choice of specific magnetic & electric loading in case of a induction machine.	**07**
Q.2	**(a)**	Explain the effect of skewing the rotor slots in a squirrel cage induction motor.	**03**
	(b)	Explain briefly the methods for improving e.m.f. wave form of an alternator.	**04**
	(c)	Determine the main dimensions of 20 kW, 3 phases, 400 V 50 Hz, 1450 rpm squirrel cage induction motor. Assume following: Full load efficiency: 85%. Full load power factor: 0.89 lag. Winding factor: 0.955.Specific magnetic loading: 0.45 wb/m2. Specific electrical loading 28000 A/m. Rotor peripheral speed 20 m/sec at synchronous speed.	**07**
		OR	
	(c)	The output coefficient of 968KW, 11KV, 0.9 power factor, 20pole, 50Hz,Delta connected induction motor is 200kva/m3-rps. Find the value of main dimension of the machine if the ratio of length to diameter is 0.2. Also calculate the value of main dimension if the specific loadings are increase by 10% each. Assume that, Efficiency=86%.	**07**
Q.3	**(a)**	Explain the factors that affect the choice of specific magnetic loading in case of a synchronous machine.	**03**
	(b)	Explain harmonics elimination techniques in alternator	**04**
	(c)	Estimate the diameter, core length, size and number of conductors, number of slots for stator of a 15000 KVA, 11 kV, 50 Hz, 2 pole star connected cylindrical rotor alternator with the armature winding having a 600 phase spread. Assume ac = 36000 A/m, current density 5 A/mm2, Bav = 0.55 Wb/m2, peripheral speed = 160 m/s. The winding should be arranged to eliminate 5th harmonics.	**07**
		OR	
Q.3	**(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)	The following is design data available for a 1250 KVA, 3-phase, 50Hz, 3300V, star connected, 300 rpm alternator of salient pole type :Stator bore D=1.9m, stator core length L=0.335m, ratio of pole arc to pole pitch=0.66, turns per phase=150, single layer concentric winding with 5 conductors per slot, short circuit ratio=1.2. Assume that distribution of gap flux is rectangular under the pole arc with zero values in the interpolar region. Calculate (i) specific magnetic loading (ii) air gap length. Mmf required for air gap is 0.88 of no load field mmf and gap contraction factor is 1.15.	**07**
Q.4	**(a)**	Why closed types slots are often used for small induction motors?	**03**
	(b)	Prove that, for same capacity, the size of 1-Φ induction motor is 1.5 times 3-Φ induction motor	**04**
	(c)	Derive an output equation for 1-ϕ induction motor with usual notation	**07**
		OR	
Q.4	**(a)**	Compare the output equation of both 1-phase and 3-phase IM.	**03**
	(b)	How design of 1-phase and 3-phase induction differ from each other.	**04**
	(c)	Explain the importance of circle diagram in designing auxiliary winding for 1-ϕ induction motor.	**07**
Q.5	**(a)**	Compare length of air gap in different rotating machines.	**03**
	(b)	Explain application of FEM technique for design problems.	**04**
	(c)	What is Dispersion coefficient? Explain the effect of Dispersion coefficient on maximum output power factor.	**07**
		OR	
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)	Explain significance of FEM in design problem.	**04**
	(c)	Write a brief note on rotor design of 1-phase induction motor.	**07**

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