Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 3170909 Date:27/12/2021

Subject Name: AC Machine Design

Time: 10:30 AM TO 01:00 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 the following words related to transformer design: (I) Window space factor (II) Staking factor (III) Circumscribing Circle	03
	(b)	Define 'Specific electric loading' and 'Specific magnetic loading' in connection with 3-phase induction motor.	04
	(c)	Derive equation: Et = k√Q, where Q = kVA rating of a transformer. Also explain how service condition of transformer affects the value of K.	07
Q.2	(a)	State the rules for the selection of rotor slots in 3-phase squirrel cage induction motor.	03
	(b)	Give reasons for following: 1) Why tapping are provided on HV winding? 2) Why stepped core is used in transformers?	04
	(c)	A 200 kVA, 6600/440volts, 50Hz, three phase core type transformer has the following design data: Max. flux density : 1.3 wb/m2, EMF/Turn : 10 volts, Stacking factor : 0.9, Window space factor : 0.3 , Current density: 2.5 A/mm2, width of largest stamping=0.9d. Overall width and overall height are the same. If three stepped core is used to determine overall dimensions.	07
		OR	
	(c)	Derive an output equation for 3-ϕ induction motor with usual notation.	07
Q.3	(a)	Define SCR and its importance in designing of synchronous machine.	03
	(b)	What is the role of damper winding in (i) synchronous generator and (ii) synchronous motor?	04
	(c)	Discuss in steps the design of field winding of a salient pole synchronous machine.	07
		OR	
Q.3	(a)	List out the factors to be considered while selecting number of armature slots in the design of a synchronous machine & explain any one.	03
	(b)	Explain the terms "critical speed" and "run away speed" with reference to 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/mm2. Design a suitable damper winding for the machine.	07
Q.4	(a)	How design of 1-phase and 3-phase induction differ from each other.	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.4	(a)	What do you mean by dispersion co-efficient applied to induction motors.	03
	(b)	Prove that output of single phase machine is two third of the output of three phase induction motor.	04
	(c)	Explain the importance of circle diagram in designing auxiliary winding for 1-ϕ induction motor.	07
Q.5	(a)	Explain the advantages of finite element method.	03
	(b)	Write a note on computer aided design of Induction motor.	04
	(c)	Explain different methods of cooling of transformer.	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)	Discuss the design difference of a salient pole and non salient pole synchronous machines.	04
	(c)	Explain significance of FEM in design problem.	07

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3170909 Date:06/06/2022

Subject Name:AC Machine Design

Time:02:30 PM TO 05:00 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)**	Explain heat dissipation in Electrical Machines.	**03**
	(b)	Explain the factors for choice of specific magnetic loading & specific electric loading.	**04**
	(c)	Discuss magnetic material and insulating material in detail.	**07**
Q.2	**(a)**	Define window space factor and stacking factor. Which factor affecting window space factor?	**03**
	(b)	Describe design of LV winding of transformer.	**04**
	(c)	Explain design of cooling tank with cooling tubes in transformer.	**07**
		OR	
	(c)	What is Dispersion coefficient? Explain the effect of Dispersion coefficient on maximum power factor.	**07**
Q.3	**(a)**	Which points are to be considered for selecting number of stator slots in IM?	**03**
	(b)	Discuss factors affecting air gap length in induction motor design.	**04**
	(c)	Determine the main dimensions and number of stator turns per phase of a 3.7 kW, 400 V, 3-phase, 50 Hz, 4 pole squirrel cage induction motor having an efficiency of 0.85 and full load power factor of 0.84. Assume: Specific magnetic loading = 0.45 Wb/m^2, specific electric loading = 23000 A/m, winding factor = 0.955, stacking factor=0.9. Induction motor to be started by star delta starter and design for minimum cost.	**07**
		OR	
Q.3	**(a)**	State the rules for the selection of rotor slots in 3-phase squirrel cage induction motor.	**03**
	(b)	What is effect of harmonic induction torque and harmonic synchronous torque on the performance of 3-ph induction motor.	**04**
	(c)	Determine overall dimensions for a 200 kVA , 6600/440 V, 50 Hz, 3-phase core type transformer. Emf per turn is 10V, maximum flux density 1.3 Wb/m^2, current density 2.5 A/mm^2 , window space factor 0.3. overall height =overall width, stacking factor=0.9. For three stepped core : width of largest stamping is 0.9d and net iron area=$0.6d^2$, where d is diameter of circumscribing circle.	**07**
Q.4	**(a)**	Enlist the factors for choice of specific magnetic loading and specific electric loading in synchronous machine.	**03**
	(b)	Discuss steps for field winding design of salient pole synchronous machine.	**04**
	(c)	Find main dimensions and peripheral speed of a 2500 kVA, 3 phase, 50 Hz, 3000 V, 187.5 rpm salient pole synchronous generator. The specific magnetic loading is 0.6 Wb/m^2. specific electrical loading is 34000 A/m, winding factor is 0.955. Use circular poles with ratio of core length to pole pitch=0.65.	**07**

OR

Q.4	**(a)**	How MMF is calculated for magnetic circuit in synchronous machine?	**03**
	(b)	Explain design of damper winding in Synchronous machine.	**04**
	(c)	What is SCR? Discuss its effect on synchronous machine performance.	**07**
Q.5	**(a)**	Derive an output equation for 3-ϕ transformer.	**03**
	(b)	Derive an output equation for 3-ϕ induction motor with usual notation.	**04**
	(c)	What are the applications of FEM technique for design problem? Explain the advantages of finite element method.	**07**

OR

Q.5	**(a)**	Distinguish between Distribution transformer and Power transformer.	**03**
	(b)	Explain FEM software for design of machines.	**04**
	(c)	A 11 kW, 3-phase, 220V, 50 Hz, 6-pole star connected induction motor has 54 stator slots, each containing 9 conductors. Number of rotor bars is 64. The machine has efficiency of 0.86 and a power factor of 0.85. The rotor mmf is 85 percent of stator mmf. Determine bar current and end ring current. If current density is 5 A/mm^2, find area of bar and end ring.	**07**

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