Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2025

Subject Code:3170909 Date:23-05-2025

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.**

			MARKS
Q.1	**(a)**	Enlist the factors for choice of specific magnetic loading and specific electric loading in synchronous machine.	**03**
	(b)	Explain the factors to be considered while selecting number of stator slots in the design of a synchronous machine.	**04**
	(c)	Discuss the factors affecting the choice of specific Magnetic loading and specific electrical loading in case of a induction motor.	**07**
Q.2	**(a)**	Enlist different methods for computer aided machine design. Discuss any one.	**03**
	(b)	Explain significance of FEM in design problem.	**04**
	(c)	What is design optimization? Derive necessary condition for designing a transformer with minimum cost.	**07**
		OR	
	(c)	What are the applications of FEM technique for design problem? Explain the advantages of finite element method.	**07**
Q.3	**(a)**	Why stepped core is used in transformers?	**03**
	(b)	How will the output and losses in a transformer vary with the linear dimensions?	**04**
	(c)	Estimate the main dimensions for a 200 kVA, 3 phase, 50 Hz, 6600/500 Volts, star delta core type transformer.use the following data: Window space factor = 0.27, current density = 2.8 A/mm^2 ,volts per turn = 8.5 ,maximum flux density = 1.25 Wb/m^2 .Assume 4 stepped core, width of largest stamping is 0.92d and net iron area=$0.62d^2$, where d is diameter of circumscribing circle.The height of window is 2 times its width.	**07**
		OR	
Q.3	**(a)**	Explain effect of change in frequency on losses of transformer.	**03**
	(b)	Give reason: the area of yoke in a transformer is kept 15-20 % more than that of core.	**04**
	(c)	Derive the expression of leakage reactance of a 3 phase core type distribution transformer.	**07**
Q.4	**(a)**	What is Dispersion coefficient? Explain the effect of Dispersion coefficient on maximum power factor.	**03**
	(b)	Explain the effect of air gap length on the performance of a 3-phase induction motor.	**04**

	(c)	Estimate the stator core dimensions, number of stator slots and number of stator conductor per slot for 100 kW ,3300 V, 50 Hz, 12pole star connected slip ring induction motor. Assume: average gap density = 0.4 Wb/m^2 ,conductor per metre = 25,000 A/m, efficiency = 0.9, power factor = 0.9 and window space factor = 0.96. choose main dimensions to give best power factor.the slot loading should not exceed 500 ampere conductor.	**07**

OR

Q.4	**(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)	Derive an output equation for 3-ϕ induction motor with usual notation.	**07**
Q.5	**(a)**	Explain design considerations to eliminate harmonics in synchronous machines.	**03**
	(b)	Discuss steps for field winding design of salient pole synchronous machine.	**04**
	(c)	A 1250 kVA, 3 phase, 50 Hz, 3300 V, 300 r.p.m. synchronous generator with a concentric winding has the following data: specific magnetic loading B_{av} = 0.58 Wb/m^2 ,specific electrical loading ac = 33,000 A/m, gap length = 5.5 mm, field turns per pole = 60, short circuit ratio = 1.2 The effective gap area is 0.6 times the actual area.Peripheral speed is 30 m/s.Find stator core length,stator bore,turns per phase, mmf for air gap,armature mmf per pole and field current for no laod and rated voltage.	**07**

OR

Q.5	**(a)**	Why a turbo alternator has smaller diameter and large length but hydro alternator has larger diameter and small length?	**03**
	(b)	What is SCR? Discuss its effect on synchronous machine performance.	**04**
	(c)	The following is the design data available for a 1250 kVA, 3 phase ,50 Hz, 3300 V, star connected, 300 r.p.m. alternator of salient pole type: Stator bore D = 19 m, stator core length, L =0.335 m , pole arc/pole pitch = 0.66, turns per phase = 150, single layer concentric winding with 5 conductor per slot, short circuit ratio = 1.2 , Assume that the distribution of gap flux is rectangular under the pole arc with zero values in the interpolar region. Mmf required for air gap is 0.88 of no load field mmf and the gap contraction factor is 1.15 Calculate: (a) spaecific mamgnetic loading (b) armature mmf pole pole (c) gap density over pole arc (d) air gap length.	**07**

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