

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2024****Subject Code:2170909****Date:19-11-2024****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.
4. Simple and non-programmable scientific calculators are allowed.

		<b>MARKS</b>
<b>Q.1</b>	(a) What is segmental lamination? When it is required for rotating AC machine?	<b>03</b>
	(b) What is the role of damper winding in (i) synchronous generator (ii) synchronous motor?	<b>04</b>
	(c) Explain how a particular harmonic component in the voltage wave form of an alternator may be eliminated by chording.	<b>07</b>
<b>Q.2</b>	(a) Why a turbo alternator has smaller diameter and larger length whereas water wheel generator has larger diameter and smaller length? Give reasons.	<b>03</b>
	(b) Define SCR and its importance in designing of synchronous machine	<b>04</b>
	(c) Determine main dimensions of a 12 MVA, 50 Hz, 1500 rpm, 3-ph, star connected alternator with following data: Average flux density=0.60 tesla Amp. Cond. Per meter=42000 Peripheral speed= 80 m/sec , Kw=0.955 Find also the maximum flux, the number of stator slots if one conductor per slot is used and number of turns per phase.	<b>07</b>
<b>OR</b>		
	(c) A 500 KVA, 3.3 KV, 50 Hz, 600 rpm, 3-ph salient pole alternator has 180 turns per phase. Estimate the length of the air gap if the average flux density is 0.54 wb/m <sup>2</sup> . The ratio of pole arc to pole-pitch=0.66. The SCR=1.2 and the gap extension coefficient = 1.15. The mmf required for gap is 80% of no load field mmf. Winding factor=0.955.	<b>07</b>
<b>Q.3</b>	(a) What is the significance of L/τ ratio for design of 3-phase induction motor?	<b>03</b>
	(b) What is dispersion coefficient? What is its effect on maximum power factor?	<b>04</b>
	(c) Find the current in the bars and endrings of a cage rotor of a 6-pole 3-ph I. M. having stator slots with 15 conductors in each slot if the stator current per phase is 20A and rotor slots are 55. Hence find the suitable size of the cage bars and end rings. Take current density as 5 A/mm <sup>2</sup> for rotor bar and 7 A/mm <sup>2</sup> for end rings. Assume rotor mmf is of 85% that of stator mmf.	<b>07</b>

**OR**

- Q.3** (a) Differentiate between radial ventilating ducts and horizontal ventilating ducts for rotating AC machines. **03**
- (b) List the rules for selecting number of rotor slots for squirrel cage induction motor. **04**
- (c) Find the main dimensions, no. of stator turns of a 5 HP, 400 V, 3-ph 1500 syn. rpm, squirrel cage induction motor. Star-Delta starter is use. Assume following data: **07**  
Avg. Flux Density in air gap= 0.46 wb/m<sup>2</sup>.  
Amp. Cond. Per meter = 22000; L/ $\tau$  ratio=1.5; Kw=0.955  
Full load efficiency= 83% and full load p.f.= 0.84 lagging

- Q.4** (a) Describe in brief different shape and size of stator slots for induction machine design. **03**
- (b) What is the effect of using a large air gap on the performance of an induction motor? Explain. **04**
- (c) Illustrate the procedure to design endrings of squirrel cage I. M. **07**

**OR**

- Q.4** (a) Define specific electric loading and specific electric loading for induction machine design. State and explain the factors on which specific electric loading depends. **07**
- (b) Discuss circle diagram as obtained from the design parameters and its use to obtain the performance characteristics of a 3-ph induction motor. **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) In a single phase induction motor explain the following: **07**  
(i) Equivalent circuit from design parameter  
(ii) Magnetic circuit calculations

**OR**

- Q.5** (a) Derive an expression for rotor resistance referred to stator for a single phase capacitor start squirrel cage induction motor. **07**
- (b) Describe with sketches the various steps followed in the design of rotor of a single phase induction motor. **07**

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