Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – SUMMER 2014

Subject Code: 180904 Date: 29-05-0214

Subject Name: Electrical Machine Design-II

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.**

Q.1 The following data refer to a 75 kW , 50 Hz, 8 pole 500 V , slip ring induction motor with 3 phase star connected stator winding: **14**
Turns per phase: Stator 64; Rotor 35.
Resistance per phase: Stator 0.062 Ω; Rotor 0.019 Ω.
Reactance per phase: Stator 0.21Ω; Rotor 0.019Ω.
Magnetizing current 36 A/phase.
Iron loss 1500W.
Friction and Windage loss 750 W.
Draw circle diagram and determine The line current, efficiency, power factor and slip at full load and half load conditions. Also find Maximum output and pull out torque.

Q.2 **(a)** Derive the equation for relationship between rating and size of the machine in case of three phase induction motor. **07**

(b) The main dimensions of a 15 kW, 400V, 6 pole, three phase,50 Hz, delta connected three phase induction motor are D = 30 cm and L = 12cm. There are 72 slots in stator each containing 20 conductors. The air gap length is 0.55 mm. The gap contraction factor is 1.2. Assume mmf required for iron parts is 35% of the air gap mmf. Take coil span of 11 slots. Determine magnetizing current per phase. **07**

OR

(b) Determine the main dimensions of 30 kW, 3 phases, 400 V 50 Hz, 1440 rpm squirrel cage induction motor. Assume following: **07**
Full load efficiency: 87%.
Full load power factor: 0.9 lag.
Winding factor: 0.955.
Specific magnetic loading: 0.5 wb/m^2.
Specific electrical loading 30000 A/m.
Rotor peripheral speed 20 m/sec at synchronous speed.

Q.3 **(a)** Discuss some methods to mitigate harmonic torques in three phase induction motor. **07**

(b) Discuss the steps for rotor design of a single phase induction motor. **07**

OR

Q.3 **(a)** Explain the calculations for leakage reactance of single phase motors. **07**

(b) Explain the importance of circle diagram in designing auxiliary winding of a single phase motor. **07**

Q.4 **(a)** Discuss effect of air gap length on performance of synchronous machine. **07**

(b) Determine main dimensions and turns per phase of a 3 MVA, 11 kV 50 Hz 32 pole three phase star connected alternator. Assume average gap density of 0.55 wb/m^2, ac = 30000, winding factor 0.955. Use L/τ ratio of 1.2. **07**

OR

Q.4 **(a)** Explain steps for field winding design in case of a synchronous machine. **07**

(b) A 2500 kVA 32 pole three phase , 60 Hz, 2400 V, star connected salient pole alternator has the following design data: **07**

Stator bore = 2.5 m; core length = 0.44m; turns/phase = 224; winding factor =0.95; length of air gap 10 mm; air gap contraction factor = 1.11; ratio of pole arc to pole pitch = 0.69; ratio of amplitude of fundamental of gap flux density to maximum gap density = 1.068; per unit leakage reactance = 0.14.

Determine direct and quadrature axis synchronous reactance.

Q.5 **(a)** Discuss algorithm and develop flow chart for main dimension design of a low speed alternator. **08**

(b) Explain the terms in details: **06**

(1) Short circuit ratio.

(2) Run away speed.

OR

Q.5 **(a)** Discuss design considerations of high voltage induction motors. **06**

(b) Briefly answer following: **08**

(1) Why are conductors in the overhang are braced?

(2) Why the stator winding of all synchronous generators is usually star connected with neutral earthed?

(3) What are the advantages of circular poles?

(4) Why does the rotors of turboalternators are slotted for only two third of its periphery?

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