

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VIII • EXAMINATION – SUMMER 2013

Subject Code: 180904**Date: 10/05/2013****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** (a) State and discuss the factors to be considered while determining the air gap in case of 3-phase induction motors. **07**
- (b) What do you mean by 'dispersion co-efficient' applied to induction motors. Discuss its effect on maximum power factor and overload capacity of I.M. **07**

- Q.2** (a) Draw and explain briefly the current distribution wave form spreaded over one pole pitch in bars and end rings squirrel cage induction motor. **04**
- (b) Determine the main dimensions, turn per phase, number of slots, conductor section and slot area of a 3-phase, 5 H.P., 400 volts, 50 Hz, 1500 rpm squirrel cage induction motor. The machine is to be started by a star-delta starter. **10**

Assume:

Average flux density in the air gap = 0.5 Wb/m^2 , ampere conductors per meter = 27000, efficiency = 0.8, power factor = 0.8 lagging at full load, winding factor = 0.955, current density = 3.5 A/mm^2 . Choose main dimensions to give Good overall design.

OR

- (b) A 15 kW, 400 V, 3 phase, 50 Hz, 6 pole induction motor has a diameter of 0.3 m and the length of core 0.12 m. The number of stator slot is 72 with 20 conductors per slot. The stator is delta connected. Calculate the value of magnetizing current per phase if the length of air gap is 0.55 m. The gap contraction factor is 1.2. Assume the mmf required for the iron parts to be 35 percent of the air gap mmf. Coil span = 11 slots. **10**
- Q.3** (a) Define and explain the term 'short circuit ratio' of a synchronous generator and discuss its influences on the machine performance. **07**
- (b) The field coil of a salient pole alternator are wound with a single layer winding of bare copper strip 30 mm deep, with separating insulation 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of conductor to develop an mmf of 12000 A with a potential difference of 5 V per coil and with a loss of 1200 W/m^2 of total coil surface. The mean length of turn is 1.2 m. the resistivity is $0.021 \text{ } \Omega \cdot \text{m}$ and mm^2 . **07**

OR

- Q.3** (a) What is the role of damper winding in (i) synchronous generator and (ii) synchronous motor? Derive the equation of MMF of damper winding. **06**
- (b) The field coils of a salient pole alternator are wound with a single layer winding of bare copper strip 30 mm deep, with separating insulation 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of conductor to develop an mmf of 12000 A with a potential difference of 5 V per coil and with a loss of 1200 W/m^2 of total coil surface. The mean length of turn is 1.2 m. The resistivity of copper is $0.021 \text{ } \Omega \cdot \text{m}$ and mm^2 . **08**

Q.4 (a) Explain how you will estimate MMF required for various parts of magnetic circuit of Synchronous Machines. **07**

(b) Explain the effect of skewing the rotor slots in a squirrel cage induction motor. **07**

OR

Q.4 (a) 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 60° phase spread. **10**

Assume $a_c = 36000$ A/m, current density 5 A/mm², $B_{av} = 0.55$ Wb/m², peripheral speed = 160 m/s.

The winding should be arranged to eliminate 5th harmonics.

Q.4 (b) Give the rules for selecting number of rotor slots in induction motor. **04**

Q.5 (a) For the same h.p. output compare the relative sizes of a 3-phase induction motor to 1-phase induction motor (split phase capacitor start). Assume same loadings, same number of poles, same power factor and efficiency. **06**

(b) A 370 W, 230 V, 50 Hz, 4 pole single phase capacitor start induction motor has the following design data: **08**

The full load efficiency and power factor should not be less than 0.65 and 0.62 respectively. The starting torque should be about 300 percent of full load torque with starting current not more than 21 A. Take flux per pole 2.70×10^{-3} Wb., current density 4 A/mm² and winding factor for main winding (K_{wm}) = 0.8.

Determine (a) number of turns of main winding (b) number of turns in each coil for sinusoidal distribution.

OR

Q.5 (a) Derive the equation of capacitance to give maximum starting torque of capacitor start single phase induction motor. **07**

(b) State the formulae used for calculation of Leakage reactance in single phase induction motor. **07**
