

**[5460] - 568**  
**T.E. (Electrical)**  
**DESIGN OF ELECTRICAL MACHINES**  
**(2015 Pattern)**

*Time : 2½ Hours]*

*[Max. Marks :70*

*Instructions to the candidates:*

- 1) *Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of calculator is allowed.*
- 5) *Assume suitable data if necessary.*

- Q1)** a) Explain the mechanical forces developed under short circuit condition in a transformer and the measures to overcome them. **[6]**
- b) Explain Specifications of three phase transformers as per IS 2026. **[4]**
- c) Determine the dimensions of core and yoke for a 200 KVA, 50 Hz, single phase core type transformer. A cruciform core is used with distance between the adjacent limbs equal to 1.6 times the width of the core laminations. Assume voltage per turn 14V, flux density = 1.1 wb/m<sup>2</sup>, window space factor = 0.32, current density = 3 A/mm<sup>2</sup>. The net iron area is 0.56d<sup>2</sup>, width of largest stamping = 0.85d. Also calculate the overall width and height of the frame. **[10]**

OR

- Q2)** a) Derive the condition for optimum design of transformer for minimum loss or maximum efficiency. **[6]**
- b) Explain the different Modes of heat dissipation. **[4]**
- c) A 6600 V, 60 Hz, single phase transformer has a core of sheet steel. The net iron cross sectional area =  $22.6 \times 10^{-3} \text{ m}^2$ . The mean length is 2.23m. There are four lap joints and each joint takes  $\frac{1}{4}$ <sup>th</sup> time as much reactive mmf as it is required per metre of the core. The flux density is 1.1 Wb/m<sup>2</sup>. Find the number of turns on the 6600 V winding and no load current. Assume the peak factor as = 2.149, mmf/m = 232 A/m, specific loss = 1.76 W/Kg and density of plates =  $7.5 \times 10^3 \text{ kg/m}^3$  **[10]**

**P.T.O.**

- Q3)** a) Define specific electrical and magnetic loadings. Explain the factors to be considered for the choice of specific electrical and magnetic loading. [8]
- b) Derive the Output equation for three phase induction motor with usual notations. [8]

OR

- Q4)** a) Explain any two types of AC windings. [8]
- b) Explain the various factors in detail which play a major role while deciding the number of stator slots. [8]

- Q5)** a) Explain the various factors that are to be considered while deciding the length of air gap. [8]
- b) Find the main dimensions of a three phase 10 Kw, 400 V, 50 Hz, 4 pole squirrel cage induction motor having efficiency = 0.85, power factor = 0.86,  $B_{av} = 0.4 \text{ Wb/m}^2$ , Specific electric loading = 20000 A/m, winding factor = 0.955. Take the rotor peripheral speed as 20 m/sec. [8]

OR

- Q6)** a) What is Unbalanced Magnetic Pull (UMP) and what are the practical aspects of it? [8]
- b) A 11 KW, three phase, 50 Hz, 6 pole, 220 V, Star connected Induction motor has 54 stator slots each containing 9 conductors. The number of rotor bars is 64. Find the bar current, end ring current, area of bar section, area of end ring section. Assume that efficiency = 0.86, power factor = 0.85, rotor mmf is 85% of stator mmf and current density in the bar and end ring is  $5 \text{ A/mm}^2$ . [8]

- Q7)** a) Explain the different types of leakage flux in an induction motor. [6]
- b) Explain the calculation of MMF in case of an induction motor. [6]
- c) A 25 KW, 1500 rpm, three phase, 50 Hz, 4 pole, 415 V, delta connected induction motor has flux equal to 20 mwb and area is  $500 \text{ cm}^2$ . The length of air gap is 0.6 mm. The gap contraction factor is 1.533 and mmf for iron parts is 25% of mmf for air gap. Find the magnetizing current. Assume the stator winding factor as 0.955. [6]

OR

- Q8)** a) Explain the short time and continuous rating of electrical machine. [6]
- b) Explain the effect of ducts on the calculation of magnetizing current. [6]
- c) A 75 KW, 3300 V, 50 Hz, 8 pole, three phase, star connected Induction motor has magnetizing current equal to 35% of full load current. Find the stator turns per phase if the mmf required for flux density at  $60^\circ$  from the interpolar axis is 500 A. Assume the stator winding factor as 0.955. efficiency = 0.94, power factor = 0.86. [6]

