

BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)  
B.Tech.Sem - V ELECTRICAL : WINTER- 2022  
SUBJECT : ELECTRICAL MACHINE DESIGN & ANALYSIS

Day : Thursday

Time : 02:30 PM-05:30 PM

Date : 8/12/2022

W-24557-2022

Max. Marks : 60

**N.B.**

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Use of non programmable **CALCULATOR** is allowed.
- 4) Draw neat and labeled diagrams **WHEREVER** necessary.
- 5) Assume suitable data **WHEREVER** necessary.

Q.1 a) State the types of duties and explain any two with neat load diagrams. [05]

b) A field coil has a heat dissipating surface of  $0.15 \text{ m}^2$  and a length of mean turn of 1 m. It dissipates loss of 150 W, the emissivity being  $34 \text{ W/m}^2\text{-}^\circ\text{C}$ . Estimate the final steady temperature rise of the coil and its time constant if the cross-section of the coil is  $100 \times 50 \text{ mm}^2$  specific heat of copper is  $390 \text{ J/kg-}^\circ\text{C}$ . The space factor is 0.56, copper weighs  $8900 \text{ kg/m}^3$ . [05]

OR

Q.1 a) Discuss main dimensions and total loadings of rotating machines. [05]

b) Describe the factors affecting the choice of specific electric loading. [05]

Q.2 Derive the output equation for a single phase and three phase transformer. [10]

OR

Q.2 Estimate the main dimensions (no. of turns of primary and secondary winding, window and core area) including winding conductor areas of a 3-phase delta/star core type transformer rated at 300 kVA, 6600 / 440 V, 50 Hz. A suitable core with three steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4 m is available. The emf per turn is 8.5 V. Assume a current density of  $2.5 \text{ A/mm}^2$ , a window space factor of 0.28 and a stacking factor of 0.9. [10]

Q.3 Discuss the estimation of resistance of primary and secondary windings and estimation of no-load current in transformer. [10]

OR

Q.3 Prove that the magnitude of force acting on a conductor is proportional to the square of current in it. [10]

Q.4 a) Write down the steps of designing stator of slip ring induction motor. [04]

b) Find the main dimensions of a 15 kw, 3 phase, 400 V, 50 Hz, 2810 r.p.m. squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9. Assume: specific magnetic loading =  $0.5 \text{ Wb/m}^2$ ; specific electric loading =  $25000 \text{ A/m}$ . Take the rotor peripheral speed as 20 m/s at synchronous speed. [06]

OR

P.T.O.

- Q.4 a) Discuss the factors to be considered while selecting the choice of ampere conductors per meter for induction motor. [04]
- 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,  $B_{av} = 0.4$  Wb/m<sup>2</sup>, specific electric loading = 20000 A/m, winding factor = 0.955. take the rotor peripheral speed as 20 m/sec. [06]

- Q.5 a) Discuss the factors to be considered when estimating the length of the air gap of induction motor. [06]
- b) Elaborate the steps to design rotor slots and bars of squirrel cage induction motor. [04]

OR

- Q.5 a) Write down the steps of designing rotor of slip ring induction motor. [04]
- b) A 11 kW, 220 V, 3 phase, 6 pole, star connected squirrel cage induction motor has the following data: number of stator slots = 54, number of conductor in each stator slot = 9, number of rotor bars = 64, efficiency = 0.86, power factor = 0.85, current density = 5 A/mm<sup>2</sup>. Find bar current, end ring current, area of bar, area of end ring. Assume Rotor mmf as 85% of Stator mmf. [06]

- Q.6 a) Describe Unbalanced Magnetic Pull. State the practical aspects of it. [05]
- b) What is dispersion coefficient? State its significance in designing induction motor. [05]

OR

- Q.6 a) Elaborate the effect of dispersion coefficient on maximum power factor of three phase induction motor. [04]
- b) A 75 KW, 3300 V, 50 Hz, 8 pole, 3 phase and star connected induction motor has a magnetizing current which is 40% of full load current. Calculate the value of stator turns per phase if the mmf required for flux density at 60° from the pole axis is 500 A, winding factor 0.95, efficiency = 0.94 and power factor = 0.86. [06]

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