Total No. of Questions : 8]

SEAT No. :

P3374

[Total No. of Pages : 3

[5353] - 569

T.E. (Electrical)

DESIGN OF ELECTRICAL MACHINES

(2015 Pattern) (Semester - VI)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to candidates:

1) ***Attempt Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.***
2) ***Assume suitable data, if wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of non-programmable scientific calculator is permitted.***
5) ***Neat figures must be drawn wherever necessary.***

Q1) a) Write down in detail the steps to calculate the number of tubes for cooling in an oil immersed transformer. **[6]**

b) Discuss with neat sketches various types of oil cooled transformers. **[6]**

c) Write short notes on cross over and disc windings used in transformer. **[8]**

OR

Q2) a) Derive expression for the condition of transformer design for minimum cost in terms of total cost of iron and total cost of copper for a three phase transformer. **[6]**

b) What types of forces developed in transformer winding under short circuit condition? With a neat diagram explain any one in detail. **[6]**

c) A 125kVA, 2000/415V, 50Hz, single phase shell type transformer has sandwiched coils. There are two full HV coils, one full LV coil and two half LV coils. Calculate the leakage reactance referred to HV side. Also calculate per unit leakage reactance from the following data: **[8]**

i) Depth of HV coil = 0.038m
ii) Depth of LV coil = 0.036m
iii) Number of primary turns = 200
iv) Width of winding = 0.12m
v) Depth of duct = 16mm
vi) Length of mean turn = 1.5m

P.T.O.

Q3) a) Discuss various factors considered for choice of specific electrical and specific magnetic loading of three phase induction motor? **[8]**

b) Design a full pitch, lap winding for the stator of three phase induction motor having 4 poles and 24 slots. There are two coils sides per slot. Draw the layout of phase R only. **[10]**

OR

Q4) a) Derive output equation of three phase induction motor. **[8]**

b) Estimate the main dimensions, number of stator slots, stator turns per phase and cross sectional area of stator conductor, conductors per slot, for a three phase, 20 h.p., 400 V, 6 pole, 50Hz, 970 rpm induction motor suitable for star-delta starting. The specific electric and magnetic loadings are 23000 A/m and 0.45 Wb/m^2 respectively, the ratio of core length to pole pitch is 0.85. Full load efficiency and power factor is 0.88 and 0.89 respectively, assume winding factor of 0.955m and slots/pole/phase of 3. **[10]**

Q5) a) What are the factors considered when estimating the length of the air gap of Induction motor? Why the length of the air gap should be as small as possible. **[8]**

b) A 12 kW, three phase, 6 pole, 50Hz, 220V and star connected induction motor with 72 slots having 9 conductors per slot. Calculate the value of bar and end ring currents. The number of rotor bars is 64. The machine has an efficiency of 0.86 and a power factor of 0.9. The rotor mmf may be assumed as 85 percent of stator mmf. Also find the area of each bar and area of each end ring if the current density is $6A/mm^2$. **[8]**

OR

Q6) a) State any four rules for selecting the number of rotor slots of three phase squirrel cage induction motor. **[4]**

b) During the stator design of a 3 phase, 30 kW, 400volts, 6 pole, 50Hz, delta connected squirrel cage induction motor following data has been obtained. Gross length of the stator = 0.17 m, Internal diameter of stator = 0.33 m, Number of stator slots = 45, Number of conductors per slot = 12. Based on the above design data design a suitable rotor with following assumptions: length of air gap= 0.67mm, rotor slots = 42, $K_W = 0.955$, current density = $6A/mm^2$, full load efficiency and power factor 0.88 & 0.86 respectively. **[12]**

Q7) a) Define and explain short time rating. **[6]**

b) How stator and rotor resistances are calculated in three phase squirrel cage induction motor. **[6]**

c) What is the effect of ducts on the calculation of magnetizing current? **[4]**

OR

Q8) a) Step by step write down the procedure to calculate the magnetizing component of no load current of three phase induction motor. **[8]**

b) A 20 kW, three phase, 50Hz, 6 pole, 400V, star connected induction motor has magnetizing current of 20% of full load current. Calculate the value of stator turns per phase, if the mmf required for the flux density at 60° from pole axis is 750A. Assume full load efficiency and full load power factor of 0.9 each. Assume winding factor of 0.96. **[8]**