Total No. of Questions : 8]

SEAT No. :

P2446

[Total No. of Pages : 4

[5253]-169

T.E. (Electrical)

DESIGN OF ELECTRICAL MACHINES

(2012 Pattern)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer 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 logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume suitable data, if necessary.***

Q1) a) Write short note on Cross over winding and Disc winding. **[8]**

b) Explain use of tap changer, breather and conservator. **[6]**

c) A three phase slipring induction motor has a final steady temperature rise of 40°C when running at its rated output. Calculate its half hour rating for the same temperature rise if the copper loss at rated output is 1.25 times its constant loss. The heating time constant is 90 minutes. **[6]**

OR

Q2) a) Explain the procedure to determine the total resistance of a designed transformer. **[4]**

b) What are the various specifications of distribution transformer as per IS 2026. **[4]**

c) Determine the main dimensions of the core, the number of turns and the area of conductors for a 5 kVA, 50 Hz, 1100/400 V, single phase core type transformer. The net conductor area in window is 60% of the net square cross section of the iron core. Assume maximum flux density of 1 Wb/m^2, current density of 1.4 A/mm^2, window space factor of 0.2 and stacking factor of 0.9. The window height is 3 times its width. **[12]**

P.T.O.

Q3) a) Explain briefly how the number of slots in a cage rotor is decided to avoid crawling and cogging. **[6]**

b) Design the stator of 10 H.P., 415V, 50Hz, delta connected three phase, 4 Pole, squirrel cage induction motor. The motor has an efficiency of 0.88, power factor of 0.865 lag and winding factor of 0.955. Assume specific magnetic and electrical loading of 0.45 Wb/m^2 and 23000 A/m. Frame size of 160M is to be used for stator core. Assume slot/pole/phase of 3 and current density of 4.1 A/mm^2. **[10]**

OR

Q4) a) Derive output equation of three phase induction motor. **[6]**

b) Determine the stator core dimensions, number of stator slots and number of stator conductors per slot for a 125kW, 3300 V, 50Hz, 12 pole star connected induction motor while following data : **[10]**

i) Average flux density = 0.4 Wb/m^2

ii) Conductor/meter = 27000 A/m

iii) Full load efficiency = 0.9

iv) Power factor = 0.9

v) Winding factor = 0.955

vi) Slot/pole/phase = 3

Choose main dimension to give best power factor.

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. **[6]**

b) A 20kW, three phase, 6 pole, 50 Hz squirrel cage induction motor has following data : **[12]**

i) Stator bore diameter = 0.32m

ii) Axial length of stator core = 0.125m

iii) Number of stator slots = 54

iv) Number of conductors/slot = 24

v) Current in each stator conductor = 17.5 A

vi) Full load power factor = 0.862

Calculate :

1) Number of rotor slots

2) Rotor bar current

3) Area of copper rotor Bar

4) Length of rotor bar

5) Current in each end ring

6) Area of copper end ring

7) Full load slip.

Assume current density of 7A/mm^2 for rotor bar and end ring and resistivity of copper as 0.02 Ohm-m.

OR

Q6) a) What is unbalanced magnetic pull (UMP)? Explain the procedure to calculate UMP. **[8]**

b) A 15kW three phase, 6 pole, 50 Hz, 415v, star connected squirrel cage induction motor has 54 stator slots each containing 18 conductors. Calculate the value of bar and end ring currents. The numbers of rotor bars are 64. The motor has an efficiency of 0.9 and a power factor of 0.85. The rotor mmf may be assumed as 90% of stator mmf. Also find the bar and end ring section if current density is 6A/mm^2. **[10]**

Q7) a) Explain the procedure to calculate the magnetizing current of an induction motor. **[8]**

b) Explain the procedure to calculate the Zig-zag leakage reactance and tooth top leakage reactance of three phase induction motor. **[8]**

OR

Q8) a) Sketch the paths of the following leakage fluxes of three phase induction motor. **[8]**

i) Slot leakage flux

ii) Zig-zag leakage flux

iii) Tooth top leakage flux

iv) Overhang leakage flux

b) Calculate overhang and slot leakage reactance for a 75 kW, 3000V, 8 pole 50Hz three phase star connected slip ring induction motor having following data: stator bore = 0.66m, stator core length = 0.5m, number of stator turns/phase = 286, total specific permanence due to stator slot = 4.9μ. The stator has full pitch winding. **[8]**