Total No. of Questions : 12]

SEAT No. :

P2321

[Total No. of Pages : 4

[4758]-56

T.E. (Electrical)

DESIGN OF ELECTRICAL MACHINES

(2008 Course) (Semester - II)

Time : 3 Hours] *[Max. Marks :100*

Instructions to the candidates:

1) ***Answer 3 questions from Section -I and 3 questions from Section - II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Explain the "$B_{t\frac{1}{3}}$ method" to calculate the mmf of small taper teeth of an electrical machines. **[8]**

b) Calculate the specific iron loss in a specimen of alloy steel for a maximum flux density of 3.2 Wb/m^2 and freq. of 50 Hz, using 0.5 mm thick sheets. The resistivity of alloy steel is 0.3 x 10^{-6} Ωm. The density is 7.8 x 10^3 kg/m^3. Hysteresis loss in each cycle is 400 J/m^3. **[8]**

OR

Q2) a) Explain the various types of stator leakage flux in three-phase induction motor. **[8]**

b) Explain the components of core loss in rotating machines. Also explain the factors on which the core loss depend. Why core loss is called constant loss. **[8]**

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Q3) a) Explain why the hydrogen cooling is used in modern ac generators. What are the advantages of hydrogen cooling. **[8]**

b) Explain why tappings are provided on hv winding of transformer. **[8]**

OR

Q4) a) Explain the possible connections of windings in transformer what are the advantages of star connection. **[8]**

b) The temperature rise of a transformer is 25°C after one hour and 37.5°C after two hours of starting from cold conditions. Calculate its final steady temperature rise and the heating time constant. If its temperature falls from the final steady value of 40°C in 1.5 hour when disconnected, calculate the cooling time constant. The ambient temperature is 30°C. **[8]**

Q5) a) Explain the effect of change in supply frequency on **[8]**

i) Voltage,

ii) Losses

iii) Leakage reactance and

iv) Resistance of the transformer windings.

b) Calculate the no load current of a 400V, 50Hz, 1-phase core type transformer, the particulars of which are as given below.

Length of mean magnetic path = 200 cm, Gross core area = 100 cm^2, Joints equivalent to 0.1 mm air-gap, the max. flux density = 0.7 tesla, specific core loss at given frequency and flux density = 0.5 W/kg mmf 2.2 per cm for 0.7 tesla. The Stacking factor = 0.9. Density of core material = 7.5 x 10^3 kg/m^3. **[10]**

OR

Q6) a) Derive the equation for radial mechanical force developed in transformer when fault occur at the terminals of the transformer. **[8]**

b) Design cooling tube arrangement for a 250KVA, 6600/400V, 50Hz, 3-phase, Δ / Y, core type transformer immersed in oil with following particulars. **[10]**

i) Working temp. rise not to exceed 50°C.

ii) Total losses at 90°C are 5 kW.

iii) Tank dimensions, height x length x width = 125 (mm) x 100 (mm) x 50 mm.

iv) Oil level = 115 cm length

Draw the diagram to show the arrangement. Neglect top and bottom heat dissipating surfaces of the tank.

SECTION - II

Q7) a) Explain the factors affecting the size of rotating electrical machines. **[8]**

b) Calculate the following design information for a 30 kW, 440V, 3-phase, 6-pole, 50Hz, delta connected squirrel cage induction motor. **[8]**

i) Main dimensions, D and L.

ii) Nos. of stator turns per phase.

iii) Nos. of stator slots.

Assume:

Specific magnetic loading = 0.48 tesla

Specific electric loading = 26,000 amp-cond/m

full load efficiency = 0.88

full load power factor = 0.86

winding factor = 0.955

OR

Q8) a) Explain the guidelines that help design engineer to select the number of stator slots in three phase induction motor. **[8]**

b) Derive the output equation of three-phase induction motor. **[8]**

Q9) a) Explain the factors to be considered while estimating the length of air-gap in induction motor. How the length of air - gap affect the overload capacity of motor. **[8]**

b) Explain the phenomenon of crawling and logging as applicable to squirrel cage induction motor. What steps are taken while designing motor to avoid their occurrence? **[10]**

OR

Q10)a) Explain the procedure to design the rotor of squirrel cage induction motor. What is the effect of selecting higher value of current density in rotor bars than normal value on the performance of the motor. **[8]**

b) A 11 kW, 3-phase, 6-pole, 50Hz, 220V, star connected induction motor has 54 stator slots, each containing 9 conductors. calculate the value of bar current and end ring current. The number of rotor bars is 64. The machine has efficiency of 0.86 and power factor of 0.85. The rotor mmf may be assumed as 85% of stator mmf. Also find the size of rotor bar and end ring. Assume current density $\delta_b = \delta_e = 5 A / mm^2$ **[10]**

Q11)a) Explain why the flux density at 60^o from the neutral axis is considered while estimating the magnetising current of a three-phase induction motor. **[8]**

b) Explain the effect of dispersion coefficient on overload capacity of induction motor. **[8]**

OR

Q12)a) Derive the relation for slot leakage reactance for a parallel sided semiclosed slots. Give the standard nomenclature. State clearly the assumptions used. **[8]**

b) Explain the methods of improving starting torque in induction motor. **[8]**

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