Total No. of Questions : 10]

SEAT No. :

P1330

[Total No. of Pages : 3

[4858] - 1068

T.E. (Electrical) (Semester - II)

Design of Electrical Machines

(2012 Pattern) (End Sem.)

Time : 3 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, Q.9 or Q.10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table, slide rule, Mollier chart, electronic pocket calculator and steam table is allowed.***
5) ***Assume suitable data if necessary.***

Q1) a) From the design point of view compare distribution and power transformer. **[4]**

b) Prove that **[6]**

$$\theta = \theta_m \left(1 - e^{-t/T_h}\right)$$

where, θ = temperature rise at any time t, ºC;

θ_m = final steady temperature rise while heating, ºC;

T_h = heating time constant, second;

t = time, second.

OR

Q2) a) A copper bar 12 mm in diameter is insulated with micanite tube which fits tightly around the bar and into the rotor slot of an induction motor. The micanite tube is 1.5 mm thick and its thermal resistivity is $8\Omega - m$. Calculate the loss that will pass from copper bar to iron if a temperature difference of 25ºC is maintained between them. The length of bar is 0.2m. **[4]**

b) Derive the output equation of single phase core type transformer. **[6]**

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Q3) a) Derive the expression for finding the leakage reactance of three phase core transformer. **[6]**

b) A 300 kVA, 6600/440 V, three phase, delta/star core type transformer has a maximum flux density of 1.35 wb/m^2 and the total weight of core is 650 kg. The magnetizing VA/kg and the iron loss/kg corresponding to 1.35 wb/m^2 are 30 and 2.5 W respectively. Calculate the no load current if the mmf required for joints is 2.5 percent of that for iron. **[4]**

OR

Q4) a) Explain the process of design of cooling tubes of a transformer. **[6]**

b) A 500 KVA, 11000/440 Volts, Delta/Star transformer has the following data:

i)	HV Turns	=	1660
ii)	Length of mean turn	=	93 cm
iii)	Length of coil	=	52 cm
iv)	Short circuit current	=	20 x rated current

Find radial force in tones on the HV winding under short circuit conditions. **[4]**

Q5) a) Derive the output equation of 3-phase induction motor. **[8]**

b) Determine the main dimensions, turns per phase, number of slots of a 250 HP, 3 phase, 50Hz, 415V, 1450 RPM slip ring induction motor. Assume B_{av} = 0.5 wb/m^2, ac = 30000 A/m, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5 A/mm^2. The ratio of core length to pole pitch is 1. The machine is delta connected. **[10]**

OR

Q6) a) Explain various types of ac windings used for 3-phase induction motor. **[8]**

b) Explain different factors affecting selection of **[10]**

i) Specific electrical loading.

ii) Specific magnetic loading of 3-phase induction motor.

Q7) a) Explain the concept of 'Unbalanced Magnetic Pull'. Why is the Unbalanced Magnetic Pull high when the 3-phase induction motor is designed with a small air gap? **[8]**

b) A 15 kW, 3-phase, 6 pole, 50 Hz squirrel cage induction motor has the following data. **[8]**

Stator bore diameter = 0.32 m

Axial length of stator core = 0.125 m

Number of stator slots = 54

Number of conductors per stator slots = 24

Current in each stator conductor = 17.5 A

Full load power factor = 0.85 lagging

Design a suitable cage rotor giving number of rotor slots, section of each bar and section of each ring. The full load speed is about 850 rpm approximately. Use copper for the rotor bars and end rings. Resistivity of copper is $0.021\Omega / m$ and mm^2.

OR

Q8) a) Discuss various factors affecting choice of length of air gap for 3-phase induction motor. **[8]**

b) Derive the expression for end ring current in induction motor. **[8]**

Q9) a) Explain the procedure to find out mmf required for air gap, stator teeth, stator core, rotor teeth and rotor core of 3 phase induction motor. **[8]**

b) A 100 kW, 3300V, 50Hz, 8 pole, 3-phase, star connected induction motor has a magnetizing current which is 25 percent of the full load current. Calculate the stator turns per phase if the mmf required for flux density at 30° from pole axis is 450 A. Assume winding factor = 0.955, Efficiency = 0.88, Power factor = 0.85. **[8]**

OR

Q10) a) What is the significance of B_{60} from inter-polar axis. **[8]**

b) State the different leakage fluxes that exit in the 3-phase induction motor. Show their location by simple sketches. **[8]**