Total No. of Questions : 12]

SEAT No. :

P2933

[Total No. of Pages : 3

[4958]-168
T.E.(Electrical)
DESIGN OF ELECTRICAL MACHINES
(2008 Course) (303148)(Semester-II)

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

Instructions to the candidates:

1) ***AnswerQ.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 questions from section I and Q.7 or Q.8,Q.9 or Q.10,Q.11 or Q.12 questions from section II.***
2) ***Answers to the two sections should be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logrithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***

SECTION-I

Q1) a) Explain Carter's fringe curve and gap distribution factor in detail. **[8]**

b) Explain principal components of leakage flux for poly-phase machines. **[8]**

OR

Q2) a) Write note on magnetic leakage and state effects of magnetic leakage. **[8]**

b) Calculate the specific iron loss in a specimen of alloy steel for a maximum flux density on 3.2 Wb/m^2 and frequency of 50Hz, using 0.5 mm thick sheets. The resistivity of alloy steel is $0.3\times10^{-6}\Omega$ m. The density is $7.8\times10^3 kg/m^3$. Hysteresis loss in each cycle is $400J/m^3$. **[8]**

Q3) a) Determine the main dimensions of 500 KVA, 6600/400V, 3phase, 50 Hz core type oil immersed self-cooled distribution transformer. Voltage per turn is 20V, area factor for stepped core is 0.56, window space factor=0.3, current density is $3A/mm^2$, $B_m=1.2Wb/m^2$, width of largest stamping=0.85d, D=1.85a. Assume $A_y = A_i$ **[8]**

b) Derive output equation of single phase core type transformer. **[8]**

OR

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Q4) a) Enlist specifications of transformer as per IS 2026. **[8]**

b) Draw heating curve and cooling curve and explain the following: **[8]**

i) Heating time constant

ii) Cooling time constant

iii) Final steady temperature rise

iv) Hot spot temperature

Q5) a) Discuss mechanical forces in transformer and explain how they are taken into consideration while fabricating and how the mechanical bracing is provided? **[8]**

b) Determine the main dimension of core and yoke for a 200KVA, 50 Hz, 1phase, core type transformer. A cruciform core is used with distance between adjacent limbs is 1.5 times the width of core laminations. Assume voltage per turn=14V, B_m = 1.2T, K_w = 0.30, current density= 2.5A/mm^2, K_s=0.9, A_i=0.56d^2. Width of largest stamping is 0.85d. **[10]**

OR

Q6) a) Derive the formula for axial forces developed in transformers. **[8]**

b) A 500 KVA 11000/400 delta/star transformer has following details: HV turns = 1660, length of mean turn=93cm, length of coil=52cm, short circuit current=20 × rated current. Find radial force in tonnes on HV winding under short circuit conditions. **[10]**

SECTION-II

Q7) a) Derive the Output equation of 3ph. IM. State the units with meanings of each symbol used. **[8]**

b) Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250hp, 3-phase 50Hz, 400V, 1410 rpm slip ring induction motor. Assume Bav=0.5 Wb/m^2, ac=30,000 A/m, efficiency =0.9 and power factor=0.9, winding factor=0.955, current density =3.5 A/mm^2. Slot space factor=0.4 and ratio L/τ= 1.2. The machine is delta connected. Assume 5 slots per pole per phase. **[10]**

OR

Q8) a) With reference to ac windings compare: **[8]**

i) Single layer and double layer winding

ii) Fractional slot and integral slot winding

b) Discuss factors governing choice of specific electrical loading and specific

magnetic loading for 3ph. IM. **[10]**

Q9) a) Explain various methods to eliminate harmonic torques. **[8]**

b) A 90kW, 500V, 50Hz, 3-phase, 8-pole induction motor has a star connected stator winding accommodated in 63 slots with 6conductors per slot. If the slip-ring voltages on open circuit is to be about 400V, find a suitable rotor winding, stating: **[8]**

i) Number of slots

ii) Number of conductors per slot

iii) Coil span

iv) Slip ring voltage on open circuit

v) Approximate full load current per phase in rotor.

Assume efficiency=0.9, power factor=0.86, slots per pole per phase=3, rotor mmf is 86% of stator mmf.

OR

Q10) a) Discuss factors that affect the choice of length air gap in IM. Why should air gap be as small as possible? **[8]**

b) Derive the equation for end ring current for the rotor of squirrel cage induction motor. **[8]**

Q11)a) Discuss various losses in case of three phase induction motor. **[8]**

b) A15 kW, 400 V, 50Hz, 6 pole, 3 phase star connected induction motor has a magnetizing current which is 35% of full load current. Calculate the value of stator turns per phase if mmf required for flux density at 30°C from pole axis 4005A. Assume winding factor = 0.95.Full load efficiency = 0.95 and full load power factor=0.86. **[8]**

OR

Q12)a) Write short notes on **[8]**

i) MMF calculations for air gap of three phase Induction motor

ii) Effect of saturation on calculation of mmf of 3 phase Induction motor

iii) Performance calculations of 3 ph. IM from circle diagram

b) Explain the procedure to calculate no load current of three phase induction motor. **[8]**