Printed Pages : 4

TEE – 602

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2060 Roll No.

B. Tech.

(SEM. VI) EXAMINATION, 2008-09

CONVENTIONAL AND COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES

Time : 3 Hours] *[Total Marks : 100*

Note : (1) Attempt all questions.
(2) All questions carry equal marks.

1 Answer any **four** parts of the following: **4×5=20**

(a) Mention important specifications of transformer, d.c. machine and induction motor.

(b) Give the thermal classification of insulating materials along with atleast two examples of each.

(c) Distinguish between: Open-circuit and closed-circuit ventilation; Radial and axial ducts; Direct and indirect cooling; Splash proof and drip proof.

(d) The width of a transformer core-plate is 500 mm. The plate has a specific core-loss of 4 W kg^{-1}, a density of 7500 kg m^{-3}, and a thermal resistivity of 0.01 $m^{o}C\ W^{-1}$. Assuming the core loss to be uniformly distributed and a stacking factor of 0.9, and the heat flow is along the laminae, compute the maximum core temperature when the two surfaces are maintained at a temperature of 45°C.

(e) How are radial ducts on both stator and rotor considered in calculating the gap m.m.f.?

(f) Discuss the causes responsible for unbalanced magnetic pull in rotating machines.

2 Answer any **two** parts of the following: **2×10=20**

(a) Determine the main dimensions of the core, the number of turns and the cross-section of the conductors for a 5 kVA, 11000/400 volt, 50 Hz, single phase core type distribution transformer. The net copper area in the window is 0.6 times the net cross-section of iron in the core. Assume a square cross section for the core, a flux density 1 Wb/m^2, a current density 1.4 A/mm^2, and window space factor 0.2. The height of window is 3 times its width.

(b) Using output equation of transformer obtain the ratio of weight of iron to weight of copper.

(c) What are the sources of heat in a transformer? Desscribe briefly the various methods used for cooling of transformers.

3 Answer any **two** parts of the following:

(a) Define specific magnetic loading and specific electric loading of rotating electrical machine. Two machines A and B are identical, but A has all linear dimensions x times those of B. For partiucular specific loadings show that

(i) output of A is x^4-times that of B

(ii) total loss of A in x^3 times that of B

(iii) loss-dissipating surface of A in x^2-times that of B

(b) A 3-phase, 440 volt, 750 r.p.m. 50 Hz star connected induction motor has a stator with an internal diameter of 25 cm and an axial length of 15 cm. It has 48 slots with 24 conductors per slot. Calculate the air gap flux per pole. The area of each stator conductor is to be 0.05 cm^2. Calculate the width and the depth of the slot to accommodate the stator conductors. The maximum flux density in the teeth is to be 1.8 Wb/m^2. Conductor insulation is 0.08 mm thick and slot insulation is 0.8 mm thick. Make suitable assumptions.

(c) Discuss in detail the rotor design of a wound rotor induction motor.

4 Answer any **two** parts of the following: **2×10=20**

(a) Prove that the rotor resistance per phase referred to stator for a three phase squirrel cage induction motor is given by

$$r_{\sigma}^{1} = 4\, m_s T_s^2\, K_{ws}\, \rho \left[\frac{L_b}{S_{\sigma} a_b} + \frac{2}{\pi} \frac{D_e}{p^2 a_e} \right] ohms$$

where m_s = no. of stator phases

T_s = No. of stator turns per phase

K_{ws} = stator winding factor

ρ = resistivity of material of bars and rings

L_b = Length of each bar (m)

S_{σ} = No. of rotor bars

a_b = area of each bar (mm^2)

D_e = mean diameter of each ring (m)

p = No. of poles

a_e = area of each ring (mm^2)

(b) An 8 pole, 500 volt d.c. shunt generator with all the field coils connected in series requires an mmf of 5000 amperes per pole. The poles are of rectangular dimensions, 12 cm × 20 cm and the available winding cross-section is 12 cm × 2.5 cm. Determine

(i) the cross sectional area of wire

(ii) the number of turns

(iii) the dissipation in W/m^2 based upon the area of the outside surface and the two end surfaces of the coil.

A conductor of round cross-section is to be used. The resistivity is 0.02 Ω/m and mm^2 and the insulation on the wires increases the diameter by 0.2 mm. Allow a voltage drop of 50 V in the field regulator.

(c) Develop the step by step procedure to design the field winding for a synchronours machine.

5 Answer any **two** : **2×10=20**

(a) Develop the flow chart for determining stator turns per phase of a synchronous machine.

(b) Discuss philosophy of computer aided design. Explain hybrid method of computer aided design.

(c) Discuss concept of optimization. Give a general procedure for optimization of design of electrical machines.
