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, 2007-08

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** : 4×5

(a) What are the important design and constructional elements of a transformer ?

(b) What are the fundamental requirements of a good insulating material ? Also explain what is varnish impregnation ?

(c) Explain the terms : Direct Cooling system; Totally enclosed type of ventilation, Screen-protected enclosure, Flame proof-enclosure.

(d) A 15 kW squirrel-cage induction motor having maximum efficiency of 90 percent on continuous full-load has a temperature-rise of 41.8°C after 30 minutes and 50°C after one hour under the above operating conditions :

(i) Compute its final steady-state temperature-rise on continuous load, and heating time-constant.

(ii) Compute the maximum overload that can be applied on a short-time six-minute rating so that the temperature-rise is the same as the final steady state temperature-rise on continuous load.

(e) How does the radial duct on either stator or rotor affect the gap m.m.f. ?

(f) Explain how skewing increases zigzag leakage reactance. Also mention component leakage fluxes of an armature.

2 Answer any two of the following : 2×10

(a) Determine the core and yoke dimensions for a 200 kVA, 50 Hz, 6600/400 volt, 3-phase core type transformer. The following data may be assumed :

Maximum flux density = 1.3 Wb/m^2
Current density = 2.5 A/mm^2
Window space factor = 0.3
Voltage per turn = 10 volts
Height of window = 3 times width of window
A three steeped core is used.

(b) Prove that the output of a single phase transformer in given by

$$Q = 2.22\, f\, B_m\, \delta\, K_w A_w A_i \times 10^{-3}\ KVA$$

where f = Frequency, Hz

B_m = Maximum flux density Wb/m^2

δ = Current density A/m^2

K_w = Window space factor

A_w = Window area, m^2

A_i = Net core area in m^2

(c) For a three-phase, natural oil-cooled transformer, give procedure of designing the cooling tank and tubes so that temperature rise does not exceed the permissible limit. Assume any data required.

3 Answer any **two** of the following : **2×10**

(a) Define specific magnetic loading and specific electric loading of a transformer. Also show that the specific electric loading is approximately constant provided the current-density, ratio of conductor to slot-area, ratio of tooth-width to slot-width and the slot depth in a rotating machine are constants.

(b) Determine the diameter of stator bore and core length of 70 h.p, 415 volt, 3-phase, 50 Hz star connected, 6-pole, induction motor for which the specific electric and magnetic loadings are 32000 ampere conductors per meter and 0.51 weber per m^2 respectively. Take the efficiency as 90 percent and power factor as 0.91. Assume pole pitch equal to core length. Estimate the number of stator conductors required for a winding in which the conductors are connected in two parallel paths. Choose a suitable number of conductors per slot so that the slot loading does not exceed 750 ampere conductors.

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

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

(a) Calculate the equivalent resistance of rotor per phase in terms of stator, current in each bar and end ring and total rotor copper loss from the following data :

4 pole, 3 phase, 50 Hz, 400 volt cage motor has 48 slots in stator with 35 conductors per slot. Each conductor carries a current of 10 amperes. Assume full pitch coils. The rotor has 57 slots, each lot has bar of 12 cm length and 50 mm^2 area. The mean diameter of ring is 20 cm and its area is 175 mm^2. Resistivity is 0.02 ohm per m and mm^2 and the power factor is 0.8.

(b) Discuss the estimation of full load field mmf using magnetisation curve of a DC machine.

(c) Develop the step by step procedure to calculate the dimensions of the pole for a synchronous machine.

5 Answer any **two** of the following : **2×10**

(a) What is optimization ? Develop the algorithm for optimizing the performance of a DC machine.

(b) Discuss the synthesis method of CAD for design of a single phase transformer.

(c) Develop a 'C' program to estimate the performance of a squirrel cage inductions motor from the given design data.
