SATHYABAMA UNIVERSITY

(Established under section 3 of UGC Act, 1956)

Course & Branch: B.E - EEE
Title of the paper: Electrical Machine Design
Semester: V | Max. Marks: 80
Sub.Code: 214505 | Time: 3 Hours
Date: 30-04-2008 | Session: AN

PART – A (10 x 2 = 20)

Answer All the Questions

1. What is the temperature of class F insulation? Also give example.

2. Give the gap contraction factor for ducts.

3. What are the disadvantages of larger number of poles in d.c. machines.

4. Give the criterion of square pole face in d.c. machines.

5. Give the output equation of three phase transformers.

6. Write the relation between the net iron area and the diameter of circumscribing circle for a cruciform core.

7. Give the relation between D and L for best power factor in 3 phase induction motors.

8. What is the effect of dispersion coefficient on overload capacity?

9. Define run-away speed of synchronous machines.

10. What is the typical value of current density in the damper bars?

PART – B (5 x 12 = 60)

Answer All the Questions

11. (a) A motor with a heating time constant of 120 minutes is rated at 40 HP continuously. What would be its half-tour rating for the same temperature rise if it starts from room temperature 30°C everytime. The maximum efficiency occurs at full load.

(b) Give the applications of the following duties.

(i) Intermittent periodic duty with starting.

(ii) Continuous duty with intermittent periodic loading.

(iii) Short time duty.

(or)

12. (a) Determine the airgap length of a d.c. machine form the following particulars: gross length of core = 0.12m; no. of ducts = 1 and is 10 mm wide; slot pitch = 25 mm; slot width = 10 mm; Carter's coefficient for slots and ducts = 0.32; gap density at pole centre is 0.7 wb/m^2. Field mmf/pole = 3900 A and mmf required for iron parts of magnetic circuit = 800 A.

(b) Comment on the choice of specific loadings.

13. Discuss the choice of specific loadings.

(or)

14. Obtain suitable dimensions for the commutator and brushes of a 1000 kW, 500 V, 250 rpm, d.c. generator having the following data: Outside diameter of armature = 170 cm.

No of poles = 12

No. of armature coils = 540

Co-efficient of friction = 0.2

Brush pressure = 1200 kg/m^2

Brush drop = 2v

Also find the temperature rise for the given parameters.

15. (a) Determine the dimensions for core and yoke for a 5 kVA, 50 Hz, single phase core type transformer. A rectangular core is used with long side twice as long as short side. The window height is 3 times the width. Voltage per turn is 1.8 V; space factor is 0.2. Current density is 1.8 A/mm^2; flux density is 1 wb/m^2.

(b) Briefly discuss about the thermal rating of transformers.

(or)

16. A 1000 kVA, 6600/440V, 50 Hz, 3 phase delta/star, core types oil immersed natural cooled transformer. The design data of the transformer is Distance between centres of adjacent limb =0.47 m
Outer dia of hV winding = 0.44m
Height of frame = 1.24m
Core loss = 3.7kW
I^2R loss = 10.5 kW
Design a suitable tank for the transformer. The average temperature rise of oil should not exceed 35°C. The specific heat dissipation from the tank walls is 6 W/m^2 - C° and 6.5 W/m^2 - °C due to radiation and convection is improved by 40% due to convection with the provision of tubes.

17. How is the performance of 3 phase induction motor determined using circle diagram?

(or)

18. Calculate
i) Rotorbar current and cross sectional area of bar.
ii) Conductor losses in bar
iii) End ring current and its area
iv) Full load slip and speed of 3 phase, 15 kW, 50 Hz, 440 V squirrel cage induction motor.
Given:
Stator bore diameter = 30 cm

Axial length of stator core = 12 cm.
No. of poles = 8
No. of stator slots = 48
No. of rotor slots = stator slots + (no. of poles/2)
No. of conductors/stator slots = 24
Current in each rotor conductor at full load = 18.5A
Full load power factor = 0.88 lagging
Resistivity of conductors in rotor bars and rings = 2×10^{-6} ohm-cm.
Assume 4 cm for projection of bar beyond core. The rotor mmf may be taken 85% of stator mmf. Current density of bar conductors and end rings = 7 A/mm^2. end ring diameter may be taken as 2 cm less than stator bore diameter.

19. Calculate the diameter, core length, no. of conductors of the stator, size of the conductor, no. of stator slots of a 30 MVA, 11 KV, 3000 rpm, 50 Hz star connected turbo alternator. Assume the following data: B_{avg} = 0.55 wb/m^2, ac = 55000 A/m, K_w = 0.955 and peripheral velocity = 160 m/sec.

(or)

20. A 1250 kVA, 3 phase, 6600 V, salient pole alternator ahs the following data:
Airgap diameter = 1.6m; length of core = 0.45m; no. of poles = 20: armature conductors per meter = 28000; ratio of pole arc to pole pitch = 0.68; stator slot pitch = 28mm; current density in damper bars = 3 A/mm^2. Design a suitable damper winding for the machine.