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: 414505/614502 Time: 3 Hours
Date: 06-11-2008 Session: FN

PART – A (10 x 2 = 20)
Answer All the Questions

1. What are the ideal properties of insulating materials?

2. Define apparent flux density and real flux density?

3. Define specific magnetic and electric loading.

4. What are the advantages of large number of poles?

5. Mention the relationship between core area and weight of iron and copper.

6. What are the types of high voltage windings suitable for the transformer?

7. How the number of rotor turns is decided?

8. What is the relationship between D and L for best power factor?

9. How to design number of damper windings?

10. What is the role of OCC in designing the synchronous machine?

PART – B (5 x 12 = 60)

Answer All the Questions

11. Derive the expression for MMF required for air gap.

(or)

12. Calculate the MMF required for the air gap of a machine having core length = 0.32m including 4 ducts of 10mm each, pole arc = 0.19m; slot pitch = 65.4mm; slot opening = 5mm; air gap length = 5mm; flux per pole = 52m Wb. Given Carter's co-efficient is 0.18 for opening/gap = 1, and is 0.28 opening/gap = 2.

13. (a) Derive the output equation of a dc machine.

(b) A 5KW, 250V, 4 pole, 1500 r.p.m shunt generator is designed to have a square pole face. The loadings are:

Average flux density in the gap \= 0.42 Wb/m^2 and ampere conductors per metre = 15,000. Find the main dimension of the machine. Assume full load efficiency = 0.87 and ratio of pole are to pole pitch = 0.66.

(or)

14. Prove that the kw output of a dc machine with single turn coil is given by:

$$p = \frac{1}{2} E_c ac \frac{V_a a}{n p} 10^{-3}$$

Where a= number of parallel paths

P = number of poles

Ec = average voltage between adjacent segments

Ac = ampere conductors per metre

V_a = Peripheral sped of armature, m/s

N = speed of machine in rps.

15. (a) Derive the output equation of a transformer. (4)

(b) 1000 KVA, 6600/440V, 50Hz, 3 phase delta/star, core type, oil immersed natural.

Cooled (ON) transformer. The design data of the transformer is:

Distance between centers of adjacent limbs = 0.47m, outer diameter of high voltage winding = 0.44m, height of frame = 1.24m. core loss = 3.7kW and I^2 R loss = 10.5kW. 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 wall is $6 W/m^2$ - °C and $6.5 W/m^2$ - °C due to radiation and convection respectively. Assume that the convection is improved by 35% due to convection. (8)

(or)

16. Calculate the main dimensions and winding details of a 100 kVA 2000/400V, 50 Hz, single phase shell type, oil immersed, self cooled transformer. Assume:
Voltage/turn 10V flux density in core, 1.1 Wb/m^2; current density, A/mm2 window space factor, 0.33. The ratio of window height to window width and ratio of core depth to width of central limb = 2.5. The stacking factor is 0.9.

17. (a) Derive the output equation of 3 phase Induction motor. (8)
(b) Give some guidelines for selecting number of stator slots. (4)

(or)

18. Determine the main dimensions, turns/phase, number of slots, conductor across section and slot area of a 250 h.p., 3 phase 50 hz, 400V, 1410 rpm slip ring induction motor. Assume Bav = 0.5 wb/m^2, ac = 30000 Am, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5 A/mm^2. The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected.

19. (a) Discuss the choice of specific magnetic loading of synchronous motor.

(b) Discuss the factor to be considered for the selection of armature slots.

(or)

20. Determine the main dimensions of a 75000 kVA, 13.8kV, 50Hz, 62.5 rpm, 3 phase, star connected alternator. Also finc the number of stator slots, conductors per slot, conductor area and workout the winding details. The peripheral speed should be about 40m/sec. Assume, average gap density = 0.655Wb/m^2, Ampere conductors per meter = 40000 and current density = 4 A/mm^2.