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 | Time: 3 Hours
Date: 30-04-2008 | Session: AN

PART – A (10 x 2 = 20)

Answer All the Questions

1. Define specific magnetic loading.

2. List out any two standard specifications as per BIS of three phase induction motor.

3. Write down the equation for the output coefficient of a dc machine.

4. What are the points to be considered in selecting the length of air gap of a dc machine?

5. Why limb part of the transformer core is stepped?

6. Mention the advantages of using sandwich coils for the shell type transformer.

7. State various types of windings used for three phase induction phase.

8. What is the significance of B_{30°?

9. State various methods of cooling of turbo alternators.

10. What is meant by run away speed?

PART – B (5 x 12 = 60)

Answer All the Questions

11. (a) Derive an expression for air gap contraction factor for slots in electrical machines.

(b) Discuss the factors affecting the choice of the specific electric loading in dc machines.

(or)

12. (a) Discuss various methods employed for calculation of mmf for tapered teeth.

(b) Calculate the apparent flux density in the teeth of a dc machine when the real flux density is 2.18 Wb/m^2. The given data are slot pitch = 30mm, slot width = 10mm, gross core length = 0.38m, number of ventilating ducts = 4, width of each duct 10mm. Iron stacking factor =0.9. The magnetizing force for a flux density of 2.18 Wb/m^2 is 58000 A/m.

13. (a) Discuss the factors affecting the choice of number of poles in a dc machine.

(b) Find the main dimensions and the number of poles of a 37kW, 230V, 1400rpm dc sunt motor so that a square pole face is obtained. The average gap density is 0.5 Wb/m^2 and the ampere conductors per metre are 22000. the ratio of pole arc to pole pitch is 0.7 and the full load efficiency is 90%.

(or)

14. (a) Explain the procedure for the design of shunt field coil of a dc machine.

(b) The following particulars refer to the shunt field coil for a 440V, 6pole, dc generator: mmf per pole = 7000A depth of the winding = 50mm, length of the inner turn = 1.1m, length of the outer turn = 1.4m; loss radiated from the outer surface excluding the ends = $1400W/m^2$, space factor = 0.62, resistivity = 0.021 ohm – m. Calculate

(i) the diameter of wire

(ii) height of the coil
(iii) number of turns.
Assume a voltage drop of 20% of terminal voltage across the field regulator.

15. (a) Derive the output equation for a three phase transformer.
(b) Estimate the overall dimensions of the core type 3 phase, 200kVA, 6.6/0.4kV, 50Hz transformer. Assume 10.5 volts/ turn, maximum flux density 1.2 T, current density of 3A/mm^2, window space factor 0.3, overall height is equal to overall width. Assume a two stepped core.

(or)

16. A 250 kVA, 6600/400V, 3 phase core type transformer has a total loss of 4800W at full load. The transformer tank is 1.25m in length and 1m x 0.5m in plan. Design a suitable scheme for tubes if the average temperature rise is to be limited to 35°C. The diameter of the tube is 50mm and are spaced 75mm from each other. The average height of tubes is 1.05m.

17. (a) Derive an expression to find the equivalent cage rotor resistance
(b) Determine the main dimensions for a 15HP, 400V, 3 phase, 4 pole, 1425 rpm induction motor. Adopt the flux density as 0.45 Wb/m^2, amp-conductors as 23000. Assume a full load efficiency of 85% and a full load power factor of 0.88 will be obtained.

(or)

18. (a) Discuss the factors which govern the selection of stators slots and rotor slots for a cage induction motor.
(b) Explain how performance characteristics can be predicted from the circle diagram.

19. A 1250 kVA, 3 phase, 50Hz, 3300V, 300rpm synchronous generator with a concentric winding has the following design data. Specific magnetic loading and electric loading are 0.45

Wb/m^2 and 23000 amp – cond/ m respectively. Air gap length = 6mm, field turns per pole = 60, SCR = 1.2. The effective gap area is 0.6 times the actual area. The peripheral speed is 30m/s. Find the stator bore, core length, turns / phase, mmf for airgap, armature mmf per pole and field current at no load.

(or)

20. (a) What is SCR? Explain the effect of SCR on machine performance in synchronous machines.

(b) Estimate the diameter, core length, size and number of conductors, number of slots of a 15MVA, 11kV, 50Hz, two pole star connected turbo alternator with 60° space spread. Assume B_{av} = 0.55 Wb / m^2, ac = 36000 amp – cond/m, current density = $5A/mm^2$, peripheral speed = 160m/s. The winding should be arranged to eliminate 5^{th} harmonics.