K 1038

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2004.

Fifth Semester

Electrical and Electronics Engineering

EE 336 — DESIGN OF ELECTRICAL APPARATUS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the major considerations to evolve a good design of electrical machine?

2. Name the types of magnetic materials based on hysterisis loops.

3. What is meant by magnetic circuit calculations?

4. Define field form factor.

5. Why circular coils are preferred in Transformers?

6. Draw the cruciform section of the transformer core and give the optimum dimensions in terms of circumscribing circle diameter d.

7. Write the expression for output equation and co–efficient of Induction motor.

8. How the induction motor can be designed for best power factor?

9. What is the limiting factor for the diameter of synchronous machine?

10. What is SCR?

PART B — (5 × 16 = 80 marks)

11. (i) Derive an expression for the thermal resistivity of winding and prove that the square of the length of the copper per metre of winding thickness is equal to space factor. (10)

(ii) What are the limitations in the design of electrical apparatus? Explain them. (6)

12. (a) (i) Derive the output equation of a D.C. machine. (6)

(ii) Determine the diameter and length of armature core for a 55 kW, 110 V, 1000 rpm, 4-pole shunt generator, assuming specific electric and magnetic loadings of 26000 amp.cond./m and 0.5 Wb/m^2 respectively. The pole arc should be about 70% of pole pitch and the length of core about 1.1 times the pole arc. Allow 10 ampere for the field current and assume a voltage drop of 4 volts for the armature circuit. Specify the windings used and also determine suitable values for the number of armature conductors and number of slots. (10)

Or

(b) (i) Calculate the mmf required for air gap of a d.c. machine with an axial length of 20 cm (no ducts) and a pole arc of 18 cm, the slot pitch = 27 mm, slot opening = 12 mm, air gap = 6 mm and the useful flux/pole = 25 mWb. Take carters co–efficient for slot as 0.3. (6)

(ii) Design a suitable commutator for a 350 kW, 600 rpm, 440 V, 6-pole dc generator having an armature diameter of 0.75 m. The number of coils is 288. Assume suitable values wherever necessary. (10)

13. (a) (i) Derive the output equation of three–phase transformer. (6)

(ii) Estimate the main dimensions including winding conductor area of a 3–phase, delta to star core type transformer rated at 300 kVA, 6600/440 V, 50 Hz. A suitable core with three steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4 m is available. δ = 2.5 A/mm^2, E.M.F. per turn = 8.5 V, K_W = 0.28, S_f = 0.9. (Space Factor). (10)

Or

(b) (i) How to design the windings of a transformer? (6)

(ii) A 250 kVA, 6600/400 V, 3–phase core type transformer has a total loss of 4800 W on full load. The transformer tank is 1.25 m in height and 1 × 0.5 m in plan. Design a suitable scheme for cooling tubes if the average temperature rise is to be 35°C. The diameter of the tube is 50 mm and is spaced 75 mm from each other. The average height of the tube is synchronous machine is 1.05 m. (10)

14. (a) Give a detailed procedure for the design of rotor bars and end rings of a squirrel cage Induction motor. (16)

Or

(b) Estimate the main dimensions, air gap length, stator slots, stator turns per phase and cross sectional area of stator and rotor conductors for a 3–phase, 15 HP, 400 V, 6-pole, 50 Hz, 975 rpm, induction motor. The motor is suitable for star delta starting. B_{av} = 0.45 Wb/m^2, L/τ = 0.85, p.f. = 0.85, η = 0.9, ac = 20,000 amp.cond./metre. (16)

15. (a) (i) Give the comparison between single and double layer winding. (6)

(ii) Determine the main dimensions for a 1000 kVA, 50 Hz, 3–phase, 375 rpm, alternator. The average air gap flux density is 0.55 Wb/m^2 and the ampere conductors per metre are 28000. Use rectangular poles and assume a suitable value for ratio of core length to pole pitch in order that bolted on pole construction is used for which the maximum permissible peripheral speed is 50 m/s. The run away speed is 1.8 times the synchronous speed. (10)

Or

(b) (i) Explain the choice of specific magnetic and electric loadings of synchronous machines. (10)

(ii) With a neat sketch, indicate the location of the damper windings in a synchronous machine and mention its uses. (6)
