C 29726 (Pages : 2) Name.....

Reg. No.....

SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION OCTOBER 2012

EE 09 704—ELECTRICAL MACHINE DESIGN

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Write a note on interpole and interpole winding.
2. What is the function of Buchholz relay in a transformer ?
3. Write down the factors which influences specific electric loading of a synchronous machine.
4. What do you mean by cogging ?
5. Name two materials used for brush in d.c. machine.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. List out the factors to be considered while designing air gap for a d.c. machine.
7. Find the armature voltage drop of a 300 kW 500 V, 6p lap connected d.c. generator having 150 slots with 8 conductors per slot. Area of each conductor is 25 mm^2 and length of mean turn is 2.5 m. The resistivity is 0.021 Ω/m and mm^2.
8. Compare core type and shell type transformer.
9. Write notes on mechanical forces developed in transformer windings.
10. Derive the output equation of polyphase a.c. machines.
11. Discuss on selection of number of stator slots of induction motors.

(4 × 5 = 20 marks)

Part C

12. Determine the main dimensions, number of poles and the length of air gap of a 600 kW, 500 V, 900 r.p.m. generator. Assume average gap density as 0.6 Wb/m^2 and ampere conductors per metre as 35,000. The ratio of pole arc to pole pitch is 0.75 and the efficiency is 91 per cent.

    The following are the design constraints : Peripheral speed $\geq$ 40 m/s, frequency of flux reversals $\geq$ 50 Hz, current per brush arm > 400 A and armature m.m.f. per pole > 7500 A. The m.m.f. required for air gap is 50 per cent of armature m.m.f. and gap contraction factor is 1.15.

Or

13. Explain the design procedure of shunt field winding in a d.c. machine.

(10 marks)

Turn over

14. Determine the dimensions of core and yoke for a 200 kVA, 50 Hz, single-phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn 14 V, maximum flux density 1.1 Wb/m^2, window space factor 0.32, current density 3 A/mm^2 and stacking factor 0.9. The net iron area is 0.56 d^2 in a cruciform core where d is the diameter of circumscribing circle. Also the width of largest stamping is 0.85 d.

Or

15. A 100 kVA, 2000/400 V, 50 Hz single-phase shell type transformer has sandwich coils. There are two full h.v. coils, one full l.v. coil and two half l.v. coils. Calculate the value of leakage reactance referred to h.v.side. Also calculate p.u. leakage reactance. The data given is depth of h.v. coil – 40 mm, depth of l.v. coil – 36 mm, depth of duct between h.v. and l.v. – 16 mm, width of winding – 0.12 m, length of mean turn – 1.5 m. The number of turns in h.v. winding 200.

(10 marks)

16. Determine the main dimensions of a 3000 kVA 6.6 kV, 50 Hz, 187.5 r.p.m., 3-phase star-connected alternator. Also find the number of stator slots, conductors per slot and winding details. Assume average gap density 0.58 Wb/m^2, ampere conductors per slot = 35,000.

Or

17. Calculate (a) the size of armature wire ; (b) the a.c. resistance of each phase for a 3-phase, 50 Hz, 8 p star connected. Synchronous generator having the following data : Pole pitch – 0.3 m, line current – 100 A slots per pole per phase – 3, conductors per slot – 6, gross axial length – 0.3 m, length of active copper – 50 per cent of total copper length, average eddy current loss factor – 1.3, current density $\delta = \frac{43000}{ac} + \frac{V_a}{16}$, where δ is the current density in A/mm^2, a.c. ampere conductors per metre and V_a is the peripheral speed in m/s.

(10 marks)

18. Determine the main dimensions, number of radial ventilating ducts, number of stator slots, and the number of turns per phase of a 3.7 kW, 400 V, 3-phase 4-pole 50 Hz squirrel cage induction motor to be started by a star delta starter. Work out the winding details. Assume B_{av} – 0.45 Web/m^2 ac – 23000 ; efficiency – 0.85 and $P^{p-0.84}$ winding factor – 0.955, stacking factor – 0.9.

Or

19. A 15 kW, 400 V, 3-phase, 50 Hz, 6 P induction motor has a diameter of 0.3 m and the length of core 0.12 m. The number of stator slots is 72 with 20 conductors per slot. The stator is star connected. Calculate the value of magnetising current per phase if the length of air gap is 0.55 mm. The gap contraction factor is 1.2. Assume the m.m.f. required for the iron parts to be 35 per cent of the air gap m.m.f. Coil span is 11 slots.

(10 marks)

[4 × 10 = 40 marks]