D 50529 (Pages : 3) Name..................................

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SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, NOVEMBER 2013

EE 09 704—ELECTRICAL MACHINE DESIGN

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Discuss the design of series field is a d.c. machine.
2. Write a note on three winding transformer.
3. Discuss the calculation of core area in a transformer.
4. Write a note on damper windings.
5. Write down *two* equations to find out the length of air gap of 3 ϕ Im.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. What are the guiding factors for choice of number of armature slots.
7. Write notes on squares, cruciform and stepped cores and discuss their design.
8. Write a note on choice of specific magnetic loading in a.c. machines.
9. Derive an equation for per unit leakage reactance of synchronous machine.
10. Derive an expression for end ring current.
11. What are the rules for selecting rotor slots for 3 phase squirrel cage Im.

(4 × 5 = 20 marks)

Part C

12. Calculate the diameter and length of armature for a 7.5 kW, 4 pole, 1000 r.p.m. 220V shunt motor. Given : full load η – 0.83 maximum gap flux density – 0.9 wb/m^2, specific electric loading – 30,000 ampere conductors per meter, field form factor – 0.7. Assume that the maximum efficiency occurs at full load and the field current is 2.5% of rated current. The pole face is square.

Or

Turn over

13. A 500 kW, 460V, 8 pole, 375 r.p.m. compound generator has an armature diameter of 1.1 m and a core length of 0.33 m. Design a symmetrical armature winding, giving the detail of equalizers. The ampere conductors per meter are 34,000. The internal voltage drop is 4 per cent of terminal voltage and the field current is 1 per cent of output current.

The ratio of pole arc to pole pitch is 0.7. The voltage between adjacent segments at no load should not exceed 15 V and the slot loading should not exceed 1,500 A. The diameter of commutator is 0.65 of armature diameter and the minimum allowable pitch of segments is **4** mm. Make other suitable assumptions.

14. Calculate approximate overall dimensions for a 200 KVA, 6600/440V, 50 Hz, 3 phase core type transformer. The following data may be assumed. e.m.f. per turn – 10V, maximum flux density – 1.3 wb/m^2, current density – 2.5 A/mm^2, window space factor – 0.3, overall height = overall width, stacking factor – 0.9. Use a three stepped core for a three stepped core width of largest stamping 0.9 d and net iron area 0.6 d^2.

Or

15. A single phase, 400V, 50Hz transformer is built from stampings having a relative permeability of 1,000. The length of flux path is 2.5 m, the area of cross section of the core is 2.5×10^{-3} m^2 and the primary winding has 800 turns. Estimate the maximum flux and no load current of the transformer. The iron loss at the working flux density is 2.6w/kg. Iron weighs 7.8×10^3 kg/m^3 stacking factor is 0.9.

16. Design the suitable values of diameter and length of a 75 MVA, 11kV, 50Hz, 3000 r.p.m. 3 phase Y connected alternator. Also determine the value of flux, conductors per slot, number of turns per phase and size of armature conductor.

Given average gap density	—	0.6 Tesla
Ampere conductors per m	—	50,000
Peripheral speed	—	180 m/sec
Winding factor	—	0.95
Current density	—	6A/mm^2.

Or

17. A 1250 KVA, 3 phase, 6600 V, salient pole alternator has the following data : Air gap diameter –1.6m, length of core–0.45 m number of poles – 20, armature ampere conductors per meter – 28,000, ratio of pole arc to pole pitch – 0.68, stator slot pitch -28 mm current density in damper bars–3A/mm^2. Design a suitable damper winding for the machine.

18. Calculate (i) diameter ; (ii) length ; (iii) number of turns per phase ; (iv) full load current and cross section of conductors and (v) total $I^2 R$ loss of stator of a 3 phase, 120 kW, 2200 V, 50 Hz, 750 r.p.m, star connected slip ring induction motor from the following particulars. B_{ar} – 0.48 T, ac – 26000 amp conductors / m efficiency – 92%, power factor – 0.88, L = 1.25 τ kW – 0.955. Current density – 5A/mm^2, mean length of stator conductors – 75 cm, ρ = 0.021 ohm per m and mm^2 section.

Or

19. The following design data are provided for an induction motor. Calculate

    (i) No load maximum flux.

    (ii) Length of air gap.

    (iii) Number of turns per phase.

    (iv) Rotor bar current and area

    (v) End ring current of area and

    (vi) Losses in bars and end rings.

Diameter of stator bore – 15 cm, length of stator core – 9 cm, average flux density – 0.45 Tesla, efficiency – 84% , power factor – 0.86, 3 phase 4 pole, 400 V, delta connected 10 kW frequency – 50 Hz current density – 5A/mm^2, stator slots – 36, rotor slots – 30, length of rotor bar – 15 cm, mean diameter of end ring – 12 cm.

(4 × 10 = 40 marks)