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Question Paper Code : 98210

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Sixth Semester

Electrical and Electronics Engineering

080280035 — ELECTRICAL MACHINE DESIGN

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish the magnetic and electric circuits.

2. What are the factors to be considered in the design of commutator?

3. What are the factors to be considered for the selection of number of poles in a DC machine?

4. Why equalizer connections are necessary for the armature winding of a DC machine with lap winding?

5. Salient pole alternator is not suitable for high speeds. Why?

6. What are the methods used for estimating the m.m.f. for teeth?

7. Compare squirrel cage and wound rotor of 3-phase induction motor w. r. t their design.

8. What do you understand by imbalanced magnetic pull in case of 3-phase induction motor?

9. What are the different factors affecting the diameter design of salient pole machines?

10. State the relation between field mmf and the short circuit ratio.

PART B — (5 × 16 = 80 marks)

11. (a) Determine the air gap length of a dc machine from the following particulars : gross length of core = 0.12 m, No. of ducts = one and is 10 mm wide, slot pitch = 25 mm, slot width = 10 mm, carter's co-efficient for slots and ducts = 0.32, gap density at pole centre = 0.7 wb/m^2 field mmf / pole = 3900 AT, mmf required for iron pans of magnetic circuit = 800AT. (16)

Or

(b) (i) A 175 MVA, 20 pole water wheel generator has a core length 1.72 m and a diameter of 6.5 m. The stator slots (open) have a width of 22 mm, the slot pitch being 64mm and the air gap length at the centre of the pole is 30mm. There are 41 radial ventilation ducts each 6mm wide. The total mmf per pole is 27000A. The mmf required for the air gap is 87% of the total mmf per pole. Estimate the average flux density in the air gap if the field form factor is 0.7. (10)

(ii) Derive the equation for finding leakage permeance of parallel sided slots. (6)

12. (a) Discuss the different factors in detail that affects the selection of number of poles in dc machines.

Or

(b) Determine the diameter and length of armature core for a 55 KW, 110 v, 1000 rpm, 4 pole shunt generator, assuming the specific electric and magnetic loadings as 26,000 ampere conductors per metre and 0.5 wb/m^2 respectively. The pole arc should be about 70% of pole pitch and length of core about 1.1 times the pole arc. Assume a voltage drop of 4 volt for the armature circuit and allow the field current is 1% of rated full load current.

13. (a) Determine the dimensions of core and yoke of a 200 KVA 50Hz single-phase transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6time the width of core laminations. Assume voltage per turn of 14V,maximum flux density 1.1 T, window space factor 0.32, current density 3A/mm^2 and a stacking factor of 0.9.The net iron area is 0.56d^2 in a cruciform core and width of largest stamping is 0.85d.

Or

(b) A 250 KVA, 6600/400V, 3 phase core type transformer has a total loss of 4800 watt on full load. The transformer tank is 1.25m in height and 1 m × 0.5 m in plan. Design a suitable scheme for cooling tubes if the average temperature is to be limited to 35° C. The diameter of the tube is 50mm and tubes are spaced 75mm from each other. The average height of the tube is 1.05 m. Specific heat dissipation due to radiation and convection is 6 and 6.5 W/m^2-°C. Assume that convection is improved by 35% due to provision of tubes.

14. (a) Find the main dimension of a 2500KVA, 187.5 r.p.m., 50HZ, 3 phase, 3 KV, salient pole synchronous generator. The generator is to be a vertical, water wheel type. The specific magnetic loading is 0.6 W/bm^2 and the specific electric loading is 34,000 A/m. Use circular poles with ratio of core length to pole pitch = 0.65. Specify the type of pole construction used if the runaway speed is about 2 times the normal speed. (16)

Or

(b) Discuss about the effect of short circuit ratio on the performance of synchronous machine. (16)

15. (a) For what purpose damper winding is used in 3-phase synchronous motor and explain in detail about design of damper winding with all necessary equations.

Or

(b) Prove that for a 'm' phase synchronous machine, the effective rotor volume is given by :

$$\text{Volume} = \frac{Q \times 10^3}{\sqrt{2p^2 B_{av} ac n}}$$

A rough estimate of the dimensions and windings of 100 MVA 11 kV, 3000 rps star connected 3 phase turbo – alternator is required. The maximum value of flux density in the air gap of a machine is to be limited to 1.0 Wb/m^2. The specific electric loading is 80,000 ampere conductors per meter.

(i) Determine the approximate volume of the cylindrical part of the rotor.

(ii) The peripheral speed of rotor is to be limited to 200 m/s. Estimate the required diameter and length.

(iii) Calculate the number of turns per phase.
