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Question Paper Code : 51209

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Sixth Semester

Electrical and Electronics Engineering

080280035 — ELECTRICAL MACHINE DESIGN

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is real and apparent flux density?

2. Define gap contraction factor for slots.

3. What is the relation between power developed in the armature and power output of small de generator?

4. List some factors affecting the choice of average gap density in dc machines.

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. What is the basis for selecting the number of Rotor slots in three phase induction motor?

8. State the advantages of selecting semiclosed type of slots in the stator design of three phase induction motor.

9. Why is revolving field system preferred in 3-phase synchronous machine?

10. What are the factors to be considered for selection of armature slots in 3-phase synchronous machine?

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 = 0.12m, No. of ducts = one and is 10mm wide, slot pitch = 25mm, slot width = 10mm, carter's co-efficient for slots and ducts = 0.32, gap density at pole centre = 0.7 wb/m^2 field mmf / pole = 3900AT, 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 1.72m and a diameter of 6.5 m. The stator slots (open) have a width of 22mm, 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) Explain the tentative design of field winding of a DC machine from basis and derive all necessary equations.

Or

(b) The following particulars refer to the shunt field coil for a 440 V, 6 pole, d.c. generator :

Mmf per pole = 7000 A; depth of winding = 50 mm; length of inner turn = 1.1 m ; length of outer turn = 1.4 m; loss radiated from outer surface excluding ends = 1400 W/m2; space factor = 0.62; resistivity = 0.02 Q/m and mm^2,

Calculate :

(i) the diameter of wire

(ii) length of coil

(iii) number of turns and

(iv) exciting current.

Assume a voltage drop of 20 per cent of terminal voltage across the field regulator.

13. (a) (i) Derive the output equation of three phase core type transformer. (8)

(ii) Derive the condition for minimum cost of transformers. (8)

Or

(b) A 250 KV A, 6600/400V 3 phase core type transformer has a total loss of 4800W at full load. The transformer tank is 1.25m in height and 1 m × 0.5 m in plan. Design a suitable scheme for tubes if the average temperature rise is to be limited to 35°C. The diameter of tubes is 50 mm and are spaced 75 mm from each other. The average height of tubes is 1.05 m. Specific heat dissipation due to radiation and convection is respectively 6 and 6.5 w/m² - °C. Assume that convection is improved by 35% due to provision of tubes.

14. (a) A 90 kW, 500V, 50Hz, three phase, 8 pole induction motor has a star . connected stator winding accommodated is 63 slots with a 6 conductors / slot. If slip ring voltage, an open 'circuit is to be about 400V at no load find suitable rotor winding stating number of rotor slots, number of conductors / slot, coil span, number of slots. pole slip ring voltage an open circuit , approximately full load current / phase is rotor. Assume efficiency = 0.9, P.F = 0.8.

Or

(b) A 15 kW, three phase, 6 pole, 50 Hz, squirrel cage induction motor has the following data, stator. bore dia = 0.32m, axial length of stator core = 0.125m, number of stator slots = 54, number of conductor / stator slot = 24, current in each. stator conductor. = 17.5 A, full load P.F = 0.85 lag. Design a suitable cage rotor giving number of rotor slots section of each bar and section of each ring. The full speed is to be 950 rpm, use copper for rotor bar and end ring conductor. Resistivity of copper is 0.02Ω/m and mm^2.

15. (a) A 1250 KV A, 3 phase, 50 Hz, 3300 V, 300 rpm synchronous generator with a concentric winding has the following design data

Specific magnetic loading Bav = 0.58 wb/m^2,

Specific electric loading ac = 33,000 Aim

gap length = 5.5 mm; Field terms per pole = 60; short circuit ratio = 1.2. the effective gap area is 0.6 times the actual area. Peripheral speed is 30 m/s. Find stator core length, stator bore, turns per phase mmf for airgap, armature mmf per pole and field current for no load and rated voltage.

Or

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