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B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

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. Define the term "Specific electric loading".

2. State the relation between windows dimensions and leakage reactance in transformers.

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

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

5. Differentiate between distribution and power transformer.

6. State the condition for minimum copper loss in the design of transformer.

7. List some of the methods used for reduction of harmonic torques.

8. What is the effect of variation of power factors in the estimation of length of air gap?

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) Derive the expression for the total gap contraction factor. Also discuss the effect of saliency in salient pole machines.

Or

(b) A laminated tooth of armature steel in an electrical machine is 30 mm long and has a taper such that maximum width is 1.4 times the minimum. Estimate the mmf required for a mean flux density of 1.9 wb/m^2 in this tooth use Simpson's rule. The B at curve for the material of tooth is

B wb/m^2	1.6	1.8	1.9	2.0	2.1	2.2	2.3
at A/m	3700	10,000	17,000	27,000	41,000	70,000	1,09,000

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, 110v, 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) (i) Derive the output equation of three phase core type transformer. (8)

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

Or

(b) A 250 KVA, 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/m^2 – °C. Assume that convection is improved by 35% due to provision of tubes.

14. (a) Estimate the stator core dimensions, number of stator slots and number of stator conductors per slot for a 100 kw, 3300v, 50Hz, 12 pole star connected slip ring induction motor. Assume

Average gap density = 0.4 wb/m^2

Conductors/metre = 25,000 A/m.

efficiency = 0.9, power factor = 0.9 and winding factor = 0.9. Choose main dimensions to give best power factor. The slot loading should not exceed 500 ampere conductors.

Or

(b) A 90 kw, 500v, 50 Hz, 3 phase, 8 pole induction motor has a star connected stator winding accomodated in 63 slots with 6 conductors per slot. If the slip ring voltage on open circuit to be about 400v, find a suitable rotor winding stating (i) number of slots (ii) number of conductors per slot (iii) coil span (iv) slip ring voltage on open circuit (v) full load current per phase in rotor. Assume efficiency = 0.9; power factor = 0.86.

15. (a) Discuss in detail about different methods of cooling large alternators.

Or

(b) The field coils of a salient pole alternator are wound with a single layer winding of bare copper strip 30 mm deep with separating insulation 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of conductor to develop an mmf of 12,000A with a potential difference of 5v per coil and with a loss of 1200 w/m^2 of total coil surface,. The mean length of turn is 1.2 m. The resistivity of copper is 0.021 Ω/m and mm^2.
