Reg. No. : | | | | | | | | | | | |

V 4171

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Seventh Semester

(Regulation 2004)

Electrical and Electronics Engineering

EE 1403 — DESIGN OF ELECTRICAL APPARATUS

(Common to B.E. (Part-Time) Sixth Semester — Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Distinguish between continuous rating and short time rating of an electrical machine.

2. What is the difference between real and apparent magnetic flux densities in rotating machines?

3. State different losses in a dc machine.

4. What are the main parts of a DC generator?

5. Why is the core of a transformer laminated?

6. What are the advantages of three phase transformers over single phase transformers?

7. What are the merits of slip-ring induction motor over cage-induction motor?

8. How does the external resistance of slip-ring induction motor influence the motor performance?

9. Define short-circuit ratio of a synchronous generator.

10. State merits of computer aided design of electrical machines.

PART B — (5 × 16 = 80 marks)

11. (a) A three phase 50 Hz core type transformer has the following data :

Width of H.V. winding = 25 mm

Width of L.V. winding = 16 mm

Height of the coils = 0.5 metre

Length of mean turn = 0.9 metre

H.V. winding turns = 830.

Width of duct between HV and LV windings = 15 mm. Compute leakage reactance of the transformer referred to H.V. side. The transformer ratings are 300 KVA, 6600/400 volts, Delta/Star. (16)

Or

(b) Calculate the mmf required for the air gap of a salient pole synchronous machine having core length of 0.32 metre including 4 ducts of 10 mm each ; pole arc = 0.19 metre. Slot pitch = 65.4 mm. Slot opening = 5 mm. Air gap length = 5 mm. Flux per pole = 52 mwb.

Carter's coefficient is 0.18 for $\frac{\text{opening}}{\text{gap}} = 1$

Carter's coefficient is 0.28 for $\frac{\text{opening}}{\text{gap}} = 2$. (16)

12. (a) Find the main dimensions of a 200 kW, 250 volts, 6 pole, 1000 rpm DC generator. The maximum value of flux density in the air gap is 0.87 wb/m^2 and the ampere conductors per metre length of armature periphery are 31000. The ratio of pole arc to pole pitch is 0.67 and the efficiency is 91 percent. Assume that the ratio of length of core to pole pitch = 0.75. (16)

Or

(b) A rectangular field coil of a dc machine is to produce an mmf of 7500 ampere turns when dissipating 220 watts at a temperature of 60°C. The inner dimensions of the coil are : length = 0.24 metre. Width = 0.1 metre. Height of the coil = 0.15 metre. The heat dissipation is 30 w/m^2/°C from the outer surface neglecting the top and bottom surfaces of the coil. The temperature of the ambient air is 20°C. Compute the thickness of the coil. Resistivity of copper is 0.02 Ω/m and mm^2. (16)

13. (a) Determine the main dimensions of the core of a 5 KVA, 11000/400 volts, 50 Hz, single phase core type distribution transformer having the following data :

The net conductor area in the window is 0.6 times the net cross sectional area of iron in the core. The core is of square cross section, maximum flux density is 1 wb/m^2. Current density is 1.4 A/mm^2. Window space factor is 0.2. Height of the window is 3 times its width. (16)

Or

(b) (i) Derive output equation of a three phase transformer. (8)

(ii) State different methods of cooling the transformers and explain each method with relevant diagrams. State merits and limitations of each method. (8)

14. (a) Determine diametre and length of the stator core for a 11 kW, 400 V, 3 phase, 4-pole, 1425 rpm induction motor. Specific magnetic loading is 0.45 wb/m^2 and specific electric loading is 23000 ac/m. Full load efficiency is 0.85 and full load power factor is 0.88. The ratio of core length to pole pitch = 1. (16)

Or

(b) A 90 kW, 500 volts, 50 Hz, three phase, 8 pole slip-ring induction motor has star connected stator accomodating 6 conductors per slot. The number of stator slots = 63. If the slip ring voltage on open circuit is to be about 400 volts, find the number of rotor slots and the number of conductors in each rotor slot. (16)

15. (a) Compute the main dimensions of a 2500 KVA, 187.5 rpm, 50 Hz, three phase, 3 KV salient pole synchronous generator. The specific magnetic loading is 0.6 web/m^2 and the specific electric loading is 34000 ac/m. The ratio of core length to pole pitch = 0.65. (16)

Or

(b) (i) State and explain the main factors which influence the choice of specific magnetic loading and specific electric loading in a synchronous machine. (8)

(ii) Explain the role of digital computers in the design of electrical machines. (8)
