A 265

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005

Fifth Semester

Electrical and Electronics Engineering

EE 336 — DESIGN OF ELECTRICAL APPARATUS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. State the electrical engineering materials used in the construction of A.C. generators and A.C. motors.

2. Define window space factor and state its importance.

3. State two factors which should be considered while selecting the number of poles in a d.c. generator.

4. State the relative merits of lap and wave windings of armature of a d.c. generator.

5. Define voltage regulation of a transformer and state its importance.

6. State the factors on which the thermal time constant of a transformer depends.

7. How is leakage reactance different from magnetising reactance in the case of a three phase induction motor?

8. State two rules for selecting the number of rotor slots in the case of three phase cage induction motor.

9. How does damper winding improve the performance of a synchronous machine?

10. State the factors that must be considered in choosing air gap length in the case of a synchronous generator.

PART B — (5 × 16 = 80 marks)

11. (i) Derive output equation of a single phase transformer and point out salient features of this equation. (4)

(ii) Explain different methods of cooling a transformer with relevant sketches. State relative merits and limitations of these methods. (4)

(iii) Compute the main dimensions of the core of a 5 kVA, 11000/400 volts, 50 Hz single phase core type transformer. Window space factor = 0.2.

The height of the window is 3 times its width.

Current density = 1.4 A/mm^2

B_{max} = 1.0 Tesla

Stacking factor = 0.9

Net conductor area in the window = 0.6 times the net cross sectional area of iron in the core

Assume square cross section for the core. (8)

12. (a) (i) State different kinds of insulating materials used in the manufacture of generators and motors of a.c. and d.c. type and transformers. (8)

(ii) A field coil has a cross section of 100 mm × 50 mm. It has length of mean turn equal to 1 m. Estimate the hot spot temperature above that of the outer surface of the coil if the total loss in the coil is 120 watts. Space factor = 0.56. Thermal resistivity of insulating material = 8 Ω m. (8)

Or

(b) (i) State different kinds of magnetic materials used in the construction of rotating machines and transformers. Point out their salient properties. (8)

(ii) What are the different conductor materials used in the construction of transformers and DC and AC machines? Point out salient properties of these materials. (8)

13. (a) (i) Derive output equation of a dc generator and point out salient features of this equation. (8)

(ii) State and justify the criteria for selection of a suitable diameter of armature of a d.c. generator. (8)

Or

(b) A 5 kW, 250 V, 4–pole, 1500 rpm dc shunt generator is designed to have B_{av} = 0.42 Tesla

Ampere conductors per metre = 15000

Full load efficiency = 87%

Ratio of pole arc to pole pitch = 0.66

Compute the main dimensions of the armature. (16)

14. (a) (i) Derive output equation of a three phase induction motor and point out salient features of this equation. (8)

(ii) State and justify the criteria for selection of average flux density in the air gap of three phase induction motor. (8)

Or

(b) Compute main dimensions D and L of a 3.7 kW, 400 V, 3–phase, 4–pole, 50 Hz squirrel cage induction motor.

B_{av} = 0.45 Tesla

Electrical loading = 23000 Amp–conductors/metre

Efficiency = 85%

Power factor = 0.84

Winding factor = 0.955

Stacking factor = 0.9. (16)

15. (a) Compute D and L for a three phase alternator which is rated 1000 kVA, 50 Hz, 375 rpm.

Average air gap flux density is 0.55 Tesla.

Ampere conductors per metre. are 28000

The ratio of core length to pole pitch = 2

Winding factor $K_w = 0.955$. (16)

Or

(b) A 500 kVA, 3.3 kV, 50 Hz, 600 rpm, three phase salient pole alternator has 180 turns per phase. Estimate the length of air gap if the average flux density is 0.54 Tesla. The ratio of pole arc to pole pitch is 0.65. The short circuit ratio is 1.2. The gap contraction factor is 1.15. Winding factor is 0.955. The MMF required for air gap is 80 per cent of no load field MMF. (16)