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

Question Paper Code : 93439

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

Seventh Semester

Electrical and Electronics Engineering

EE 1403 — DESIGN OF ELECTRICAL APPARATUS

(Regulation 2004/2007)

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

Time : Three hours Maximum : 100 marks

Suitable values for missing data (if any) may be assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Compare radial and axial cooling of machines.

2. What are the effects of open slots and ducts on magnetic circuit of a machine?

3. What is meant by unbalanced magnetic pull?

4. List the advantages of Hydrogen cooling.

5. Define Window Space factor of transformer.

6. What is the advantage of having stepped core in a transformer?

7. State the main constructional differences between cage induction motor and slip-ring induction motor.

8. What are the different losses in an induction motor?

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) (i) Derive the relationship between real and apparent flux densities in an iron path in a magnetic circuit. (8)

(ii) A 15 kW, 230 V, 4 pole DC Machine has the following data : armature dia 0.125 m; armature core length = 0.125 m; length of air gap at pole centre = 2.5mm; flux per pole = 11.7 mWb; Pole arc to pole pitch ratio = 0.66.

Calculate the mmf required for air gap if the gap contraction factor is 1.18. (8)

Or

(b) (i) Derive the relationship between reluctance of air gap of a machine with smooth armature and reluctance with the presence of slots and ducts. Give the assumptions made explain and terms involved. (8)

(ii) Determine the apparent flux density in teeth of a DC machine if the real flux density in teeth is 2.2 Wb/sq.m, slot pitch is 24 mm, slot width is 12 mm, length of armature core including 5 ducts of 10 mm each is 0.38 m. Magnetizing force corresponding to flux density of 2.2 Wb/sq.m is 70.000 AT/m and iron stacking factor is 0.92. (8)

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) Calculate the core and window areas requires for a 1000 kVA, 6600/400 V, 50Hz, 1 phase core type transformer. Assume max flux density = 1.25 Wb/m^2 and a current density of 2.5 A/mm^2 Voltage per turn is 30. Window space factor is 0.32. (16)

Or

(b) The tank of a 1250 kVA natural oil cooled transformer has the dimensions, length, width and height 1.55 m × 0.65 m × 1.85 m respectively. The full load loss is 13.1 kW. Find the number of tubes for this transformer. Assume W/m^2 – °C due to radiation = 6 and that due to convection is 6.5. Improvement in convection due to provision of tubes is 40%. Maximum Temperature rise is 40° C. Length of each tube is 1 m. Dia of the tubes is 50 mm. Neglect the top and bottom surfaces of the tank as regard to cooling. (16)

14. (a) (i) Discuss the advantages and disadvantages of having small air gap in a three phase Induction Motor. (8)

(ii) Find the main dimensions of a 15 kW, three phase 400 V, 50 Hz 2810 rpm squirrel cage induction motor having an efficiency of 88% and full load pf 0.9. Assume specific magnetic loading = 0.5 Tesla, specific electric loading = 25000 A/m. The rotor peripheral speed should be approximately 20 m/sec at synchronous speed. (8)

Or

(b) A 415 V, three phase, 50 Hz, 6 pole delta connected Induction Motor has a specific magnetic loading of 0.5 Wb/m^2 and a specific electric loading of 24000 A/m. The stator core length and diameter are 0.275 m and 0.15 m respectively. Find the output of the machine if the full load efficiency and power factor are 0.88 and 0.89 respectively.

Determine the number of stator slots, conductor per slot and length of air gap. (16)

15. (a) Compute the main dimensions of a 1000 KVA, 50 Hz, 3-phase 375 rpm alternator. The average air gap flux density is 0.55 web/m^2 and the ampere conductors per metre are 28000. Use rectangular poles. Assume the ratio of core length to pole pitch equal to 2. Maximum permissible peripheral speed is 50 m/sec. The runaway speed is 1.8 times the synchronous speed. (16)

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. Compute thickness of the conductor, number of turns and height of the winding to develop an mmf of 12000 ampere turns with a potential difference of 5 volts per coil and a loss of 1200 watts/m^2 of coil surface area. Mean length of turn is 1.2 metre. Resistivity of copper is 0.021 Ω/m/mm^2. (16)