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

Question Paper Code : P 1297

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2009.

Seventh Semester

Electrical and Electronics Engineering

EE 1403 — DESIGN OF ELECTRICAL APPARATUS

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

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions

PART A — (10 × 2 = 20 marks)

1. Define gap contraction factor for slots and ducts.
2. Define field form factor.
3. What is meant by Specific Magnetic Loading?
4. List the guiding factors in the selection of number of poles.
5. What is window space factor in a transformer?
6. What are the factors on which no load current of a transformer depend?
7. What are the effects of change of air gap length in an Induction Motor?
8. Define dispersion coefficient and give its significance in an Induction motor.
9. Define Short Circuit Ratio (SCR). What are the effects of SCR on Machine performance?
10. What is runaway speed?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive the relation between real and apparent flux densities in a DC Machine. (8)

(ii) Determine the apparent flux density in the teeth of a D.C Machine when the real flux density is 2.15 Wb/m^2 ; slot pitch 28 mm; slot width 10 mm and the gross core length 0.35. The number of ventilating ducts is 4, each 10 mm wide. The magnetizing force for a flux density of 2.15 Wb/m^2 is 55000 A/m. The iron staking factor is 0.9. (8)

Or

(b) Determine the air gap length of a DC Machine from the following particulars :

Gross Length of the core : 0.12 m; No. of ducts : 4; Width of each duct : 10 mm; Slot Pitch : 25 mm; Slot Width : 10 mm; Carter's Coefficient for slots and Ducts : 0.32; Gap Density at pole centre : 0.7 Wb/sqm.; Field MMF/pole : 3900 AT; MMF required for iron parts of the magnetic circuit : 800 AT. (16)

12. (a) Calculate suitable dimensions of armature core to give a square pole face for a 50 kW, 4 Pole, 600 rpm DC Shunt Generator with full load terminal voltage of 220 V. The maximum gap density is 0.83 Wb/sqm and armature ampere conductors per meter are 30,000. Assume full load armature voltage drop as 3% of the rated terminal voltage and that the field current as 1% of rated full load current. The ratio of pole arc to pole pitch is 0.67. (16)

Or

(b) (i) Determine the main dimensions of a 200 kW, 250 V, 6 pole, 1000 rpm generator. The maximum value of flux density in the air gap is 0.87 wb/m^2 and the ampere conductors per meter of armature periphery are 31,000. The ratio of pole arc to pole pitch is 0.67 and efficiency is 91%. Assume the ratio of length of core to pole pitch = 0.75. (8)

(ii) Discuss various methods to reduce the effects of armature reaction. (8)

13. (a) (i) Derive the output equation of a 1 phase transformer in terms of K_w and window area. (8)

(ii) Calculate the core and window areas required for a 1000 kVA, 3600/400 V, 50 Hz, 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. (8)

Or

(b) The tank of a 1250 kVA natural oil cooled transformer has the dimensions, length, width and height 1.55m * 0.65m * 1.85m 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) Estimate the stator core dimensions, number of stator slots and number of stator conductors per slot for a 100 kW, 3300 V, 50 Hz, 12 pole star connected slip ring Induction Motor. Assume : average gap density = 0.4 wb/m^2, ampere conductor per meter = 25000 A/m, Efficiency = 0.9, Power factor = 0.9, Winding factor = 0.96. Choose main dimensions to give best power factor. The slot loading should not exceed 400 Ampere Conductors. (16)

Or

(b) (i) Derive the output equation of an AC Machine in terms of its main dimensions. (8)

(ii) Determine the main dimensions of a 3.7 kW, 400 V, three phase, 4 pole, 50 Hz, squirrel cage induction motor. Assume : Average flux density in the air gap = 0.45 wb/m^2, ampere conductor per meter = 23000, efficiency = 0.85 and power factor = 0.84. Take $L/\tau = 1.5$. (8)

15. (a) (i) Discuss the factors affecting the choice of specific magnetic loading in an alternator. (8)

(ii) Calculate the peripheral speed of a 1000 kVA, 16 pole, three phase, 375 rpm alternator. The average air gap flux density is 0.55 wb/mm^2 and ampere conductors per meter are 28000. Take $L/\tau = 2$. (8)

Or

(b) (i) Compute the main dimensions of a 100 MVA, 11 kV, 50 Hz, 150 rpm three phase water wheel generator. The average gap flux density is 0.65 Tesla and ampere conductor per meter is 40000. The peripheral speed should not exceed 65 m/s at normal running speed. (8)

(ii) Give the advantages of computer aided design of electrical apparatus. (8)