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Question Paper Code : 23431

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Seventh Semester

Electrical and Electronics Engineering

EE 1403 — DESIGN OF ELECTRICAL APPARATUS

(Regulations 2004/2007)

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

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between real and apparent flux densities in a DC machine.

2. Mention the various cooling methods commonly used for rotating electrical machines.

3. Give the need for inter poles in a DC Machine.

4. Compare wave winding with lap winding in a DC Machine.

5. What is window space factor in a transformer?

6. What are the factors on which no load current of a transformer depend?

7. Give the relationship between dispersion co efficient and over load capacity in an induction motor.

8. What is cogging? How it is avoided in 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) A laminated steel tooth of armature of a d.c. machine is 30 mm long and has a taper such that the maximum width is 1.4 times the minimum. Estimate the mmf required for a mean flux density of 1.9 wb/m² in the tooth. B-H characteristics of steel is given below : (16)

B_{wb}/m^2 :	1.6	1.8	1.9	2.0	2.1	2.2	2.3
$H_{A/m}$:	3,700	10,000	17,000	27,000	41,000	70,000	1,09,000

Or

(b) Determine the apparent flux density in the teeth of a d.c. machine when the real flux density is 2.15 web/ms. Slot pitch is 28 mm, slot width is 10 mm and the gross core length 0.35 metre. The number of ventilating ducts is 4. Each duct is 10 mm wide. The magnetizing force for a flux density of 2.15 wb/m² is 55000 H/m. The iron stacking factor is 0.9. (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/m² 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/m²/°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 mm². (16)

13. (a) Determine the dimensions of core mid yoke for a 200 KVA, 50 Hz single phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn of 14 volts, maximum flux density of 1.1 web/m², window space factor of 0.32, current density of 3 A/mm² and stacking factor equal to 0.9. The net iron area is 0.56 d² where *d* is diameter of circumscribing circle. Width of the largest stamping is 0.85 d. (16)

Or

(b) (i) Derive the 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.

14. (a) Determine the main dimensions, number of stator turns per phase, full load current, cross section of conductors and total I^2R loss of stator of a 120 kW, 2200 V, 3-phase, 750 rpm, 50 Hz, star connected slip-ring induction motor from the following particulars :

Average flux density in the gap = 0,47 Wb/m^2 Specific electric loading = 27000 ampere-conductors per metre; Efficiency = 93%; Power factor = 0.88; Winding factor = 0.955; current density = 5 A/mm^2 mean length of stator conductors = 77 cm; Resistivity = 0.021 Ω/m and mm^2 cross section. Choose the main dimensions to give a design for best power factor. (16)

Or

(b) (i) Bring out clearly, with the help of neat sketches, the differences between the 3-phase slip ring induction motor and the 3-phase squirrel cage induction motor. (8)

(ii) A 11 kW, 3 phase, 6 pole, 50 Hz, 220 V, star connected induction motor has 54 stator slots, each containing 9 conductors. Calculate the values of bar and end ring currents. The number of rotor bars is 64. The machine has an efficiency of 0.85 and a power factor of 0.86. The rotor mmf may be assumed as 87% of stator mmf. Also find the area of each bar and end ring if the current density is 5 A/mm^2. (8)

15. (a) (i) Derive the output equation of AC Machine. (8)

(ii) Discuss the effects of specific electric loading on the performance of Synchronous Machine. (8)

Or

(b) (i) Discuss the effects of Short Circuit Ration on Stability and Short Circuit Current of Synchronous Motor. (8)

(ii) Estimate the diameter and core length of a 15 MVA, 11 kv, 50 Hz, 2 pole star connected turbo alternator with 60° winding space spread. Assume Bay = 0.55 Wb/m^2; ac = 36000 A/m and peripheral speed = 160 m/s. (8)