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Question Paper Code : 71783

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Sixth Semester

Electrical and Electronics Engineering

EE 6604 — DESIGN OF ELECTRICAL MACHINES

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the electrical properties of insulating materials?

2. Mention the different types of duties of a machine.

3. Distinguish between real and apparent flux densities in the tooth section of slot.

4. Write down the expression for brush friction losses.

5. What is window space factor in the design of transformer?

6. How magnetic curves are used for calculating the no-load current of a transformer?

7. State the rules for selecting rotor slots of squirrel cage machines.

8. What are the ranges of efficiency and power factor in induction motor?

9. What are the factors that are affected due to SCR?

10. State three important features of turbo-alternator rotors.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Classify the insulating materials based on thermal consideration. (8)

(ii) What are the major considerations to evolve a good design of electrical machine? (8)

Or

(b) (i) List the methods used for determining the motor rating for variable load drives. Explain any one method. (8)

(ii) Write a short note an standard specifications. List the Indian Standard specifications for transformer and induction motor. (8)

12. (a) (i) Derive the expressions for reluctance of airgap in machines with smooth armature and slotted armature. (6)

(ii) Determine the air-gap length of a dc machine from the following particulars: gross-length of core = 0.12 m, number of ducts = one and is 10 mm wide, slot pitch = 25mm, slot width = 10 mm, carter's coefficient for slots and ducts = 0.32, gap density at pole centre = 0.7 Wb/m^2 ; field mmf/pole = 3900 AT, mmf required for iron parts of magnetic circuit = 800 AT. (10)

Or

(b) (i) Determine the main dimensions of a 80 kW, 4 pole, 600rpm dc shunt generator, the full load terminal voltage being 220V. The maximum gap density is 0.75 Wb/m^2 and ampere conductors per metre are 27000. Assume a square pole face. (8)

(ii) Give the expression for the torque developed by a D.C. motor in terms of main dimensions of the armature. (8)

13. (a) (i) Differentiate the Design features of power and distribution type transformers. (6)

(ii) Estimate the main dimensions including winding conductor area of a 3-phase, Δ-Y core type transformer rated at 300 kVA, 6600/440V, 50 Hz. A suitable core with 3-steps having a circumscribing circle of 0.25 m diameter and a leg spacing of 0.4m is available. Emf per turn $=8.5V, \delta=2.5 A/mm^2, K_w=0.28, S_f=0.9$. (10)

Or

(b) (i) List and explain the different methods of cooling of transformers. (6)

(ii) The tank of a 500 kVA, 1ϕ, 50 Hz, 6600/400V transformer is 110 cm × 65cm × 155 cm. If the load loss is 6.2 kW, find and show the suitable arrangements for the cooling tubes to limit the temperature rise to 35°C. Take the diameter of the cooling tubes as 5cm and average length of the tube as 110 cm. (10)

14. (a) (i) Drive the expression for output equation of induction motor. (6)

(ii) 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. B_{av} = 0.4 Wb/m^2, ac = 25000 amp.dond./m, η = 0.9, pf = 0.9. Choose main dimensions to give best power factor. The slot loading should not exceed 500 amp. conductors. (10)

Or

(b) (i) What are the factors to be considered for estimating the length of air-gap in induction motor? (6)

(ii) A 90kW, 500V, 50Hz, 3-phase, 8-pole induction motor has a star connected stator winding accommodated in 63 slots with 6 conductors per slot. If the slip ring voltage on open circuit is not to exceed 400 volt, find a suitable rotor winding by estimating number of slots, number of conductors per slot, coil span, slip-ring voltage on open circuit, approximate full load current per phase in rotor. Assume η = 0.9 and pf = 0.86. (10)

15. (a) (i) Sketch the shape of salient pole rotor for synchronous machine. (6)

(ii) What are the factors to be considered for fixing the air gap length for synchronous machines? (10)

Or

(b) For a 250 kVA, 1100 V, 12 pole, 500rpm, 3-phase alternator. Determine air gap diameter, core length, Number of stator conductors, Number of stator slots and cross-section of stator conductors. Assuming average gap density as 0.6 Wb/m^2 and specific electric loading of 30,000 amp. cond./m. L/τ = 1.5. (16)
