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Question Paper Code : 80384

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

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. Define specific electric loading.
2. What are the factors that affect the size of rotating machines?
3. Write the expression for output coefficient of DC machines.
4. Mention guiding factors for the selection of number of poles.
5. What is window space factor?
6. How heat is dissipated in a transformer?
7. List the advantages of using open slots.
8. Why induction motor is called as rotating transformer?
9. State the factors for separation of D and L for cylindrical rotor machine.
10. Determine the total number of slots in the stator of an alternator having 4 poles, 3 phase, 6 slots per pole for each phase?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A stator of machine has a smooth surface, but its rotor has open type of slots with slot width equal to tooth width = 12 mm. and the length of airgap = 2mm. Find the effective length of airgap, if its Carter's coefficient = $1/(1 + 5(l_g/W_s))$. **(8)**

(ii) Calculate the apparent flux density at a particular section of tooth from the following data: Tooth width = 12 mm, slot width = 10 mm, gross core length = 0.32 m, No. of ventilating ducts = 4 with each 10 mm wide, real flux density = 2.2 wb/m^2. Permeability of teeth corresponding to real flux density = 31.4 × 10^{-6} H/m. Stacking factor = 0.9. (8)

Or

(b) (i) State and explain the advantages of hydrogen cooling as applied to turbo alternator. (8)

(ii) Calculate the mmf required for the airgap of a machine having core length 0.32 m including 4 ducts of 10 mm each. Pole arc = 0.19 m, slot pitch = 65.4 mm, slot opening = 5 mm, airgap length = 5 mm. flux per pole = 52 mwb. Given Carter's coefficient is 0.18 for opening/gap = 1 and is 0.28 opening per gap = 2. (8)

12. (a) Explain the procedure for the selection of number of poles in dc machine. (16)

Or

(b) For a preliminary design of a 50 HP, 230V, 1400 rpm, dc shunt motor. Calculate the armature diameter and core length, the number of poles and peripheral speed. Take Bav = 0.5 wb/sq.m, ac/m = 25000, Efficiency = 0.9. (16)

13. (a) Estimate the main dimensions including winding conductor area of a 3-phase delta-star core type transformer rated at 300 kVA, 6600/440 V. 50 Hz. A suitable core with 3 — steps having a circumscribing circle of 0.25m diameter and leg spacing of 0.4m is available. Emf per turn 8.5 V, Current density = 2.5 A/mm sq, Kw = 0.28, stacking factor S_f = 0.9. (16)

Or

(b) The tank of 1250 kVA natural oil cooled transformer has the dimensions length, width and height as 0.65 × 1.55 × 1.85 m respectively The load loss = 13.1 kW, loss dissipation due to radiations 6 W/m.sq-0 C, loss dissipation due to convection = 6.5 W/m.sq-0 C, improvement in convection due to provision of tubes = 40%, temperature rise is 40 deg C, length of each tube is 1 m, dia of each tube is 50 mm. Find the number of tubes for this transformer. Neglect the top and bottom surface of the tank as regards the cooling. (16)

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

(ii) Derive the expressions for design of rotor and end rings of squirrel cage. (10)

Or

(b) Calculate the magnetizing current of a 450 V, 4 pole, 3 phase, 50 Hz, induction motor having the following data. No of stator slots = 36, No. of stator conductors/slot = 30, stator bore diameter = 13 cm, Axial length of stator = 13 cm, effective airgap length = 0.1 cm, winding is full pitched , phase spread angle is 60°, gap contraction factor = 1, Assume that the iron loss has infinite permeability. (16)

15. (a) (i) Explain the construction of synchronous machine with neat diagrams. (8)

(ii) Discuss the choice of specific magnetic loadings of synchronous machines in detail. (8)

Or

(b) A 100 kVA, 3300V, 50 Hz, 300 rpm, 3 phase alternator has 180 slots with 5 conductors per slot, Single layer winding with full pitched coil is used. The winding is star connected with one circuit per phase. Determine the specific electric and magnetic loading, if the stator bore is 2.0 m and the core length is 0.4 m. Using the same loading, determine corresponding data for a 1250 kVA, 3300 V, 50 Hz, 250 rpm, 3 phase star connected alternator having 2 circuits per phase. The machines has 60° phase spread. (16)