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10EE63

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Electrical Machine Design

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of design data book is permitted.***

PART – A

1 a. Explain the limitations in design of electrical machines. **(04 Marks)**

b. Explain the desirable properties of insulating materials used in Electrical machines. **(04 Marks)**

c. Explain the types of Magnetic materials used in electrical machines. **(06 Marks)**

d. Explain the classification of insulating materials on thermal basis. Give two examples for each class. **(06 Marks)**

2 a. Explain the factors to be considered for the choice of specific magnetic and specific electrical loadings while designing DC machines. **(05 Marks)**

b. Explain the factors to be considered for the selection of number of armature slots in DC machines and the guidelines to be followed. **(05 Marks)**

c. Determine the main dimensions of a 200 kW, 250 V, 1000 rpm DC generator. Assume the maximum value of flux density in airgap as 0.87 Wb/m^2 and specific electric loading as 31000 A/m. Take pole arc/pole pitch as 0.67 and efficiency 91%. Assume armature core length/pole pitch ratio as 0.75. Also determine the number of armature conductors and armature conductor size. **(10 Marks)**

3 a. Derive the output equation of a DC machine. **(10 Marks)**

b. Design a suitable commutator for a 350 kW, 600 rpm, 440 V, 6 pole DC generator with an armature diameter of 0.75 m and 288 number of armature coils. Assume any data required suitably. Take diameter of commutator as 64% of armature diameter. Minimum β_C is 4 mm and thickness of brush as $3\beta_C$. **(10 Marks)**

4 a. Derive expressions for output and emf per turn for a 3 phase transformer with the details of the symbols used. **(10 Marks)**

b. Design the main frame for a 3 phase, core type 300 KVA, 6600/440 V, 50 Hz, $\Delta - Y$ connected distribution transformer, with 3 stepped core. Assume window height to width ratio as 2.5, Emf/turn as 8.5 V, maximum flux density in core 1.2 wb/m^2, current density 2.5 A/mm^2, Window space factor 0.28, Stacking factor 0.9. Also determine the winding details. **(10 Marks)**

PART – B

5 a. Derive the output equation for 3ϕ induction motor with details of the symbols used. **(05 Marks)**

b. Explain briefly the factors to be considered for the choice specific magnetic and electrical loadings in the design of induction motors. **(05 Marks)**

c. Determine the stator core dimensions, the number of stator conductors and the number of stator slots for a 3 phase, 14.75 HP, 400 V, 4 pole, 1425 rpm, delta connected induction motor. Assume the specific loadings as 0.45 wb/m^2 and 23000 A/m, full load efficiency 0.85, p.f. 0.88, stator core length 60 pole pitch ratio as 1 and winding factor 0.955. **(10 Marks)**

6 a. Explain briefly the factors to be considered to select length of airgap in induction motor and the steps to determine length of airgap. **(05 Marks)**

b. Explain the factors to be considered and guidelines for selecting the number of rotor slots. **(05 Marks)**

c. Design a rotor for a 3 phase squirrel cage induction motor of 40 HP, 50 Hz, 6 pole, delta connected, having a full load efficiency 87% and full load p.f. 0.85. The diameter of stator bore is 0.33 m and length 0.17 m, with 54 stator slots and 14 conductors per slot. Assume rotor mmf as 0.85 times the stator mmf and length of airgap $l_g = 0.2+2\sqrt{DL}$. Assume current density as 4 A/mm^2. **(10 Marks)**

7 a. Discuss the types of synchronous generator and the comparison between them. **(05 Marks)**

b. Discuss the factors to be considered for the choice of specific loadings in the design of synchronous generators. **(05 Marks)**

c. Determine the diameter and axial length of stator of a 3 phase, 250 KVA, 1100 V, 50 Hz, 12 pole alternator. Assume specific magnetic loading 0.6 wb/m^2 and specific electric loading 30000 A/m and L/T ratio of 1.5. Also determine the number of stator conductors, number of stator slots and size of conductors. **(10 Marks)**

8 a. Define short circuit ratio for synchronous machines. Explain the factors affected by SCR. **(10 Marks)**

b. Discuss the factors to be considered for the choice of number of slots in stator of synchronous machines. **(05 Marks)**

c. Explain the steps in design of rotor of salient pole alternator. **(05 Marks)**

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