CBCS SCHEME

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15EE64

Sixth Semester B.E. Degree Examination, June/July 2018
Electrical Machine Design

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are the limitations involved, in design of electrical machines? **(08 Marks)**

b. List the insulating materials and how they classified based on thermal consideration and list the properties of insulting materials. **(08 Marks)**

OR

2 a. What are the advantages of modern trends in design and manufacturing technique? **(08 Marks)**

b. Distinguish between aluminum and copper wires. **(08 Marks)**

Module-2

3 a. Discuss how specific magnetic and specific electric loading plays an important role in the design of electrical machine. **(08 Marks)**

b. A 5KW, 250V, 4pole, 1500rpm, shunt generation is designed to have a square pole face. The loadings are average flux density in the gap = 0.42 wb/m^2 and ampere conductors per meter is 15000. Find the main dimensions of the machine. Assume full load efficiency = 0.87 ratio of pole arc to pole pitch = 0.66. **(08 Marks)**

OR

4 a. With usual notations, derive output equation for a DC machine. **(06 Marks)**

b. A design is required for a 50KW, 4pole, 600rpm DC shunt generator, the full load terminal voltage being 220V, if the maximum gap density is 0.83 wb/m^2 and the armature ampere conductors per meter are 30000, calculate suitable dimensions of armature core to give a square pole face. Assume that the full load armature voltage drop is 3% of the rated terminal voltage and that the field current is 1% of rated full load current, ratio of pole arc to pole pitch is 0.67. **(10 Marks)**

Module-3

5 a. What is windows space factor? Find the width of the window for the optimum output of a transformer. **(08 Marks)**

b. Calculate the core and window arc as required for a 1000KVA, 6600/400V, 50Hz 1ϕ core type transformer. Assume a maximum flux density of 1.25wb/m^2 and a current density of 2.5A/mm^2. Voltage/turn = 30V windows space factor = 0.32. **(08 Marks)**

OR

6 a. Derive an expression for the leakage reactance of a core type transformer with concentric coils of equal height state clearly the assumptions made. **(09 Marks)**

b. Design a suitable cooling tank with cooling tubes for a 500KVA, 6600/440V, 50Hz, 3ϕ transformer with the following data :
Distance between centre of adjacent limbs = 0.47m
Outer dia of H.V. winding = 0.44m
Height of frame 1.24m
Core loss = 3.7KW a I^2R loss = 10.5KW
Temperature rise of oil should not exceed 35°C. Take dia of tube is 50mm and l_t = 1.4m. The specific heat dissipation form the tank wall is 6 w/m^2–°C and 6.5w/m^2 - °C due to radiation and convection respectively. Assume that the dissipation is improved by 35% due to convection. **(07 Marks)**

Module-4

7 a. Determine the main dimensions, number of stator slots, and the number of turns/phase of a 3.7KW, 400V, 3ϕ, 4pole, 50Hz, squirrel cage I.M to be started by a Y-Δ starter. Assume flux density in the gap = 0.45wb/m^2 amp conduction/meter = 23000, η = 0.85 p.F = 0.84 choose the main dimensions to give a cheap design. Winding factor 0.955, stacking factor = 0.9. **(08 Marks)**

b. Explain the factors which influence the length of air gap of 3ϕIM and write few empherical formulas for the length of air gap. **(08 Marks)**

OR

8 a. With usual notation, derive the o/p equation of a 3ϕ induction motor. **(08 Marks)**

b. A 11KW, 3ϕ. 6poles, 50Hz, 220V, star connects induction motor has 54 slots, each containing 9 conductors. Find the current in rotor bar and end rings. The number of bars is 64 η = 0.86 and pF = 0.85. Assume rotor mmf as 0.85 times stator mmf, Also find the size of each rotor bar and end ring if current density is 5A/mm^2. **(08 Marks)**

Module-5

9 a. Define short circuit ratio in connection with 3ϕ synchronous generators. Explain the factors affecting by short circuit ratio. **(08 Marks)**

b. Find the main dimensions of a 2500 KVA, 187.5rpm, 50Hz, 3ϕ salient pole synchronous generator. The generator is to be vertical water wheel type. The specific magnetic loading is 0.6wb/m^2. And specific electric loading is 34,000 Ac/m, use circular poles with ratio of core length to pole pitch = 0.65. Specify the type of pole construction used if the run away speed is about two times the normal speed. **(08 Marks)**

OR

10 a. Discuss any five factors to be considered in selection of number of slots in sync. Machines. **(08 Marks)**

b. What are steps involved, in design of field windings of a synchronous machine? **(08 Marks)**

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