



# CBCS SCHEME

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 insulating 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 =  $0.42 \text{ wb/m}^2$  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  $0.83 \text{ wb/m}^2$  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 1 $\phi$  core type transformer. Assume a maximum flux density of  $1.25 \text{ wb/m}^2$  and a current density of  $2.5 \text{ A/mm}^2$ . 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, 3 $\phi$  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 from the tank wall is 6 w/m<sup>2</sup>-°C and 6.5w/m<sup>2</sup> - °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, 3 $\phi$ , 4pole, 50Hz, squirrel cage I.M to be started by a Y- $\Delta$  starter. Assume flux density in the gap = 0.45wb/m<sup>2</sup> amp conduction/meter = 23000,  $\eta = 0.85$  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 3 $\phi$ IM and write few empirical formulas for the length of air gap. (08 Marks)

OR

- 8 a. With usual notation, derive the o/p equation of a 3 $\phi$  induction motor. (08 Marks)
- b. A 11KW, 3 $\phi$ . 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  $\eta = 0.86$  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<sup>2</sup>. (08 Marks)

**Module-5**

- 9 a. Define short circuit ratio in connection with 3 $\phi$  synchronous generators. Explain the factors affecting by short circuit ratio. (08 Marks)
- b. Find the main dimensions of a 2500 KVA, 187.5rpm, 50Hz, 3 $\phi$  salient pole synchronous generator. The generator is to be vertical water wheel type. The specific magnetic loading is 0.6wb/m<sup>2</sup>. 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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