CBCS SCHEME

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15EE64

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
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. Mention any six factors which imposes limitations on design. **(06 Marks)**

b. What are the desirable properties of a conducting materials? **(05 Marks)**

c. Give the classification of Ferro magnetic materials. Mentioning atleast 3 example in each. **(05 Marks)**

OR

2 a. List the factors to be considered while designing. **(05 Marks)**

b. What are the desirable properties of insulating materials? (Any six) **(06 Marks)**

c. Give the classification of insulating materials based on thermal consideration with 2 examples on each class. **(05 Marks)**

Module-2

3 a. Derive the output equation of a DC machine. **(06 Marks)**

b. Determine the main dimensions of the armature core, number of conductors and commutator segments of a 350KW, 500V, 450rpm, 6 pole shunt generator assuming square pole faces with pole are 70% of pole pitch. Assume the mean flux density to be 0.7 Tesla and ampere conductor/cm to be 280. **(10 Marks)**

OR

4 a. Mention any six factors which influence the selection of number of poles in a DC machine. **(06 Marks)**

b. A 8 pole 500V, DC shunt generator with all field coils connected in series requires 5000AT/pole. The poles are of rectangular dimensions (12 × 20)cm and the winding cross section 12 × 2.5 cm. Determine the cross section area of wire, number of turns and dissipation in watts/cm^2 based on the outside and the 2 end surfaces of the coil. A conductor of circular cross section is to be used. Resistivity in 0.021Ω/m/mm^2 and insulation increases the diameter by 0.02cm. Allow a voltage drop in the field regulator of 50V. **(10 Marks)**

Module-3

5 a. Derive the output equation of a 3 – ϕ core type transformer. **(05 Marks)**

b. Prove that emf per turn of a single phase transformer = $K\sqrt{KVA \mid ph}$. **(06 Marks)**

c. Calculate the percentage reactance of a 15KVA, 11000/440V, Y–Δ 50Hz, transformer with cylindrical coils of equal length given the following data. Height of coil = 25cm, thickness of LV = 4cm, thickness of HV = 3cm. Mean diameter of both secondary and primary together = 15cm. Insulation between HV and LV = 0.5cm, volt/turn = 2 transformer is of core type. **(05 Marks)**

OR

6 a. Drive the equation for calculation of No-load (Io) of single phase transformer. **(06 Marks)**

b. Design a suitable cooling tank with cooling tubes for a 500KVA, 6600/440V, 50Hz, 3–ϕ transformer with the following data dimensions of transformer are 100cm height 96cm length, 47cm breadth. Total losses = 7KW. Allowable temperature rise for tank walls is 35°C, 5cm diameter tubes are used. Determine number of tubes required and their possible arrangement. **(10 Marks)**

Module-4

7 a. What are the factors to be considered for estimating the length of air gap for induction motors? Explain these factors. **(10 Marks)**

b. A 6–pole, 3–ϕ, squirrel cage induction motor has 72 slots on stator with 15 conductors/slot. There are 55 rotor slots. Determine the current in bars and endrings if the equivalent stator current is 25A and $Kw_1 = 0.96$. **(06 Marks)**

OR

8 a. With usual notations, derive the output equation for a 3–phase induction motor. **(06 Marks)**

b. Design a suitable slip ring rotor for a 400Hp, 2000V, 8–pole 50Hz, 3–ϕ, Delta connected induction motor. Take D = 74cm, L = 35cm, number of stator slots = 96 with 14 conductors/slot $\eta = 0.93$ and power factor = 0.92. **(10 Marks)**

Module-5

9 a. Explain the factors that influence the selection of "Specific Magnetic Loading" and "Specific Electric Loading" for synchronous machines. **(10 Marks)**

b. A 500KVA, 3.3KV, 50Hz, 600rpm, 3–ϕ, salient pole alternator has 180 turns/ph. Estimate the length of air gap. If the average flux density = 0.575 wb/m^2 $\frac{\text{pole arc}}{\text{pole pitch}} = 0.66$. Short circuit ratio = 1.2 gap expansion factor = 1.15. mmf required for gap is 82% of No-load field mmf $kw_1 = 0.955$. **(06 Marks)**

OR

10 a. Define "Short Circuit Ratio" (SCR) for a synchronous machine. Explain its effect on machine performance. **(08 Marks)**

b. Calculate the main dimensions of a 1000KVA, 50Hz, 3–phase, 375rpm alternator. The average air gap flux density is 0.55wb/m^2. Ampere conductors/meter are 28,000. Assume ratio of core length to pole pitch = 2 and winding factor = 0.955. Permitted maximum peripheral speed is 50m/s. **(08 Marks)**

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