2002 SCHEME

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EE6

Sixth Semester B.E. Degree Examination, Dec 08 / Jan 09
Electrical Machine Design

Time: 3 hrs. Max. Marks:100

Note : *1. Answer any FIVE full questions.*
2. Assume missing data suitably.
3. Design data book may be used if necessary.

a. What are the major considerations accounted for the good design of electrical machines? **(05 Marks)**

b. What are the desirable properties of good insulating materials? Explain the classification of insulating materials as per IS – 1271 – 1958 with examples. **(07 Marks)**

c. Derive the output equation of a d.c. machine and mention the usual values of specific loadings. **(08 Marks)**

a. Explain any four factors that influence the choice of number of poles in case of a d.c machine. **(08 Marks)**

b. Determine the main Dimensions of a number of poles and length of air gap of a 600 kW, 500V, 900 rpm d.c generator. Assume average gap density as 0.6 wb/m^2 and ampere conductors/meter as 35000. The ratio of pole are pitch is 0.75 and the efficiency is 91 percent. The design limitations are peripheral speed not to exceed 40m/sec. Armature mmf/pole not to exceed 7500. The mmf required for the air gap is 50 percent of armature mmf. Kg = 1.15. **(12 Marks)**

a. Derive the output equation of a 3-phase core type transformer. What are usual values for specific loadings? **(10 Marks)**

b. Calculate the approximate overall dimensions for a 200 KVA, 6600/440V, 50Hz, 3ϕ core type transformer. The maximum flux density = 1.3wb/m^2. Current density = 2.5A/mm^2. Window space factor = 0.3. Overall height = overall width. Stocking factor = 0.9. Use a three stepped core for which Ai = 0.6d^2 and width of the largest stamping a = 0.9d with usual notations. **(10 Marks)**

a. Explain the step by step procedure for estimating the no load current of a transformer. **(08 Marks)**

b. A 300 KVA, 11000/440V, 50Hz, 3-phase delta/star core type oil immersed, self-cooled transformer has the following data for its design. Centre to centre distance between the cores = 36cm. Height of the window = 44cm. Height of the yoke = 17cms. Total weight of the magnetic frame = 700 kgs. Average specific loss for the iron = 2.1 watts/kg. Outer diameter of the h.v. winding = 35cm. Resistance of L.V winding/phase = 0.0047Ω. Resistance of h.v winding phase = 9.71Ω. Based on the above data calculate
i) The dimensions of the tank ii) The temperature rise of the transformer with plain tank iii) Number of cooling tubes, if the temperature rise is not to exceed 35^{0}C. **(12 Marks)**

a. Derive the output equation of a 3-phase induction motor and explain the factors, which influence the choice of specific magnetic and electric loadings. **(10 Marks)**

b. A 15kW 400V 3 - ϕ, 50 Hz, 6 – pole induction motor has a diameter of 30cm and core length of 12cm. The number of stator slots is 72, with 20 conductors/slot. The stator is delta connected. Calculate the magnetizing current/phase, if the length of the air gap is 0.55mm. Assume the gap contraction factor as 1.2. Assume the mmf required for the iron parts is 35 percent of the air gap mmf. Coil span = 11 slots. **(10 Marks)**

6 a. Discuss the factors to be considered while deciding the length of air gap, number of stator and rotor slots. **(08 Marks)**

b. Determine the main dimensions, turns per phase, number of slots, conductor area, stator slot area in an induction motor rated for 250Hp, 400V, 3 - phase 1410 rpm (slip ring induction motor). Assume B average = 0.5wb/m^2. Specific electric loading = 30,000 Ac/m. Efficiency = 0.9. pf = 0.9. Winding factor = 0.955. Current density = 3.5A/mm^2. Slot space factor = 0.4. Ratio of core length to pole pitch = 1.2. The machine is delta connected. **(12 Marks)**

7 a. Define the short circuit ratio of a synchronous machine. What is its effect on the performance? **(08 Marks)**

b. The field coils of a salient pole alternator are wound with a single layer winding of the bare copper strip 30mm deep, with separating insulation 0.15mm thick. Determine a suitable winding length, number of turns and thickness of conductor to develop a mmf of 12000A with a potential difference of 5V per coil and with a loss of 1200 watts/m^2 of total coil surface. The mean length of turn is 1.2m. The resistivity of copper is 0.021Ω/m and mm^2. **(12 Marks)**

8 Write short notes on any four of the following :

a. Cooling of transformers.
b. Cogging and crawling in Induction motor.
c. Design of rotor of single phase Induction motor.
d. Design of rotor of non-salient synchronous machine.
e. Peripheral speed and its influence on design of machine.
f. Advantages of rotating field structure. **(20 Marks)**