

Duration:- Three Hours

Total Marks Assigned:- 80

**NOTE**

1. Question No 1 is Compulsory.
2. Solve any three out of the remaining.
3. Figure to the right side indicates marks.
4. Assume the suitable data and mention the same if required

**QNo 1 Answer the following**

- a. Discuss the classification of insulating materials based on temperature [5]
- b. What is gross and net iron area? How stepping of core affects it? [5]
- c. What are the various factors affecting the sizing of a machine? [5]
- d. How the relationship between D and L affect the design of motor? [5]

Q2a Derive the output equation of a three phase transformer. [10]

Q2b Calculate the overall dimensions of a 200 KVA, 6600/440V, 50 Hz, 3 phase core type transformer with data, emf per turn= 10V, maximum flux density=1.3 Wb/m<sup>2</sup>, current density=2.5 A/mm<sup>2</sup>, window space factor=0.3, overall height =overall width, stacking factor=0.9.Use three step core. [10]

Q3a What are the various assumptions in the leakage reactance calculation for a transformer. [10]

Q3b 250KVA, 6600/400V, 3 phase, core type transformer has a total loss of 4,800 W at full load. The transformer tank is 1.25m in height and 1m x 0.5m in plan. Design a suitable scheme for tubes if the average temperature rise is to be limited to 35° C. The diameter of tube is 50mm and is spaced 75mm from each other. The average height of tube is 1.05m. Specific heat dissipation due to radiation and convection is 6 and 6.5 W/m<sup>2</sup>-°C.Assume that convection is improved by 35% due to provision of tubes. [10]

Q4a Derive the output equation for a three phase induction motor. [10]

Q4b Determine the main dimensions, total conductors, area of a slot and conductor area, for a 250 HP, 400V, 3 phase, 4 pole, 50Hz, delta connected squirrel cage induction motor with the data, average flux density in air gap= 0.5 Wb/m<sup>2</sup>, ampere conductor per meter=30,000A/m, efficiency= 0.9, power factor=0.9, winding factor = 0.955, current density= 3.5A/mm<sup>2</sup>, slot space factor =0.4, ratio of length of core to pole pitch=1.2, Assume 5 slots per pole per phase. [10]

Q5a Explain the terms total magnetic loading, total electric loading, specific magnetic loading, and specific electric loading in case of motors [10]

Q5b A 11 KW, 3 Phase, 220V, 6 Pole, 50Hz, 220V, Star connected squirrel cage induction motor has following data. The machine has efficiency of 0.86 and power factor of 0.85. The other data is **Stator Data**:-Number of slots = 54, conductor per slot = 9; **Rotor Data**:- Number of slots= 64, rotor mmf= 0.85 times stator mmf. Find the area of rotor bar, area of end ring if current density is 5A/mm<sup>2</sup>. [10]

Q6a Discuss the design features of cross over winding and helical winding [10]

Q6b Discuss the design modification in the stator and rotor of a energy efficient motor. [10]