**Duration – 3 Hours** **Total Marks – 80**

**N.B.:-** (1) Question No.**1** is compulsory.
(2) **Attempt** any **three** questions out of remaining **five** questions.
(3) Assume suitable data if necessary and justify the same.

**Q 1.** Answer the following questions. **20**

**a)** Define the term total magnetic loading, total electric loading, specific magnetic loading and specific electric loading.

**b)** Explain effect of short circuit ration on performance of synchronous machine.

**c)** What are the desired properties of conducting materials and insulating materials used in electric machines?

**d)** Explain the need for CAD analysis

**Q 2 a)** Derive output equation of single-phase transformer and specify the various terms used. **10**

**Q 2 b)** Calculate approximate overall dimensions for a 200 kVA, 6600/440V, 50Hz, three phase core type transformer. The following data may be assumed: **10**
Emf per turn = 10V, maximum flux density = 1.3 $Wb/m^2$, current density = 2.5 $A/mm^2$, window space factor = 0.3, overall height = overall width, stacking factor = 0.9. Use a 3 stepped core. For 3 stepped core width of largest stamping = 0.9d, and net iron area = $0.6d^2$ where d is diameter of circumscribing circle.

**Q 3 a)** Derive the output equation for a three-phase induction motor and specify the various terms used. **10**

**Q 3 b)** Determine the main dimensions and number of turns per phase of a 3.7 kW, 400V, three phase 50Hz, squirrel cage induction motor to be started by star delta starter. Assume following data: **10**
Average flux density in the gap = 0.45 $Wb/m^2$, ampere conductors per meter = 23000, efficiency = 85%, power factor = 0.84, winding factor = 0.955, stacking factor = 0.9, ratio of core length to pole pitch is 1.5.

**Q 4 a)** Define dispersion coefficient? Explain effect of dispersion coefficient on **10**
i) Maximum power factor ii) Overload capacity

**Q 4 b)** Explain different cooling methods of transformer. **10**

**Q 5 a)** Write a short note on design of field winding of synchronous machines. **10**

**Q 5 b)** Determine the main dimensions, flux per pole and turns per phase of a 75000 KVA, 13.8 KV, 50 Hz, 62.5 rpm, 3 phase, star connected alternator. The peripheral speed should be about 40 m/s. Assume average gap density= 0.65 $Wb/m^2$, ampere conductors per meter= 40000 and current density= 4 $A/mm^2$ **10**

**Q 6 a)** Write a short note on design of EV grade induction motor. **10**

**Q 6 b)** With a flowchart explain synthesis method of computer aided machine design. **10**

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