2002 SCHEME

EE62

USN | | | | | | | | | | |

Sixth Semester B.E. Degree Examination, December 2010
Electrical Machine Design

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions.*
2. Assume missing data suitably.
3. Use of design data hand book is permitted.

1 a. Give the thermal classification of insulting materials used in electrical machines, giving an example for each class. **(05 Marks)**

b. Discuss the factors affected by the higher values of specific electric and magnetic loadings in electrical machines. **(07 Marks)**

c. Calculate the main dimensions and the number of armature conductors of a 250 kW, 500 volts, 600 rpm, 6 pole, DC generator to operate at a maximum efficiency of 94%. Assume average value of flux density as 0.63 tesla and specific electric loading as 330 Ac/cm. **(08 Marks)**

2 a. Discuss the factors affecting the choice of best number of poles in case of D.C. machines. **(10 Marks)**

b. A rectangular field coil has to produce an mmf of 7500 AT, when dissipating 220 W at a temperature of 60°C. The inner dimensions of the coil are: length = 0.24 m; width = 0.10 m and height = 0.15 m. The heat dissipation is 30 Watts/m^2/degree C rise in temperature, from the outer surface of the coil neglecting top and bottom surfaces. The ambient temperature of air is 20°C. Calculate the depth of the field coil, space factor and the current density. Resistivity of copper is 0.02 Ω/m and mm^2. **(10 Marks)**

3 a. Show that the output of a 3 and transformer is proportional to the fourth power of its linear dimensions. **(10 Marks)**

b. Calculate the overall dimensions, number of HV and LV turns and their cross sections of a 15 MVA, 33 kV/6.6 kV, 50 Hz, star/delta 5 stepped care, forced oil cooled power transformer having the following design data :

Voltage per turn	= 60 volts
Area factor of the core	= 0.8
Window space factor	= 0.35
Iron space factor	= 0.9
Current density	= 3.5 Amp/mm^2
Maximum flux density	= 1.6 tesla
Ratio of height to width of window	= 3.2

(10 Marks)

4 a. Explain, why voltage per turn is different for i) Core and shell type transformer and ; ii) Power and distribution transformer. **(06 Marks)**

b. Explain why the end turns of high voltage windings in transformers are specially insulated. **(04 Marks)**

c. Calculate active and reactive components of no load current and no load power factor of a 150 KVA, 50 Hz, 6600 V/400 volts, self cooled core type distribution transformer with the following data :

Voltage per turn	= 3.36 volts
Mean length of the magnetic flux path	= 250 cm
Cross sectional area of the core	= 140 cm^2
Maximum flux density	= 1.2 Tesla
Specific core loss at 1.2 tesla	= 2.3 Watts/kg
Amp turns for the transformer steel at 1.2 tesla	= 6.5 AT/cm.

Effect of joints is equivalent to that of an air gap of 1mm in the magnetic circuit. Density of steel is 7800 kg/m^3. **(10 Marks)**

5 a. With usual notations derive the output equation of a 3ϕ induction motor. **(10 Marks)**

b. A 15 kW 440 volts, 4 pole, 50 Hz, 3 phase, induction motor is built with a stator bore diameter of 0.25m and a core length of 0.16 m. The specific electric loading is 23000 AC/m. Using the data obtained from this machine, determine the core dimensions, number of stator slots and number of stator conductors for a 11 kW, 460 V, 6 pole, 50 Hz, 3ϕ induction motor. Assume a full load efficiency of 84% and a power factor of 0.82 for each machine. The winding factor is 0.955. **(10 Marks)**

6 a. Discuss the various considerations to be taken into account while selecting the number of rotor slots in squirrel cage induction motors. **(05 Marks)**

b. Mention the factors that are affected by the length of the air gap in 3ϕ inductor motors. List the advantages and disadvantages of larger air gap in 3ϕ induction motors. **(05 Marks)**

c. Design a cage rotor for a 40 HP, 3ϕ, 400V, 50Hz, 6 pole delta-connected induction motor having the following data :

Full load efficiency	= 87%
Full load power factor	= 0.85
Stator bore diameter	= 0.33 m
Gross core length	= 0.17 m
Number of stator slots	= 54
Conductors slot	= 14

Assume any missing data suitably. **(10 Marks)**

7 a. Define "short circuit ratio" as applied to the synchronous machines. Discuss its effect on the performance of the synchronous machines. **(10 Marks)**

b. For a 125 MVA, 6.6 kV, 50 Hz, 3 phase, 3000 rpm star connected turbo alternator, calculate bore diameter, core length, number of slots and turns per phase using the following data :
Average flux density in the air gap = 0.55 wb/m^2
Ampere conductors/m = 57,000
Length of the air gap = 3 cms
Peripheral velocity < 150m/sec. **(10 Marks)**

8 a. With usual notations, derive an expression for AT per metre height of the field winding of a salient pole syndonous machine. **(06 Marks)**

b. Discuss the factors that contribute to the production of noise in induction motors. **(06 Marks)**

c. Discuss in detail the design of a rotor of a single phase induction motor of split phase type including design of winding. **(08 Marks)**

* * * * *