Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-VII Examination-Nov/Dec.-2011

Subject code: 170902 **Date: 22/11/2011**

Subject Name: Electrical Machine Design- I

Time: 10.30 am-01.00 pm **Total marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Derive equation $E_t = k\sqrt{Q}$ where Q = kVA rating of a transformer. Explain how service condition of transformer affect the value of K. **07**

(b) A 400 kW, 500V,500 rpm, 6 pole d.c. generator is built with an armature diameter of 90 cm and core length of 36 cm. The lap wound armature has 700 conductors. Determine specific magnetic and electric loading of the machine. **07**

Q.2 **(a)** Answer the following questions with respect to transformer design. (Be brief and to the point). **07**

(1) Explain the reason for using stepped core construction.

(2) If a designer selects higher value of flux density what will be its effect on performance and cost of the transformer?

(3) Why tapings are usually provided on the h.v. winding side?

(b) Write short note on classification of insulating materials. **07**

OR

(b) Discuss the criteria for separation of D and L for d.c. machine. **07**

Q.3 **(a)** What is design optimization? Derive necessary condition for designing a transformer with minimum cost. **06**

(b) The tank of a 1.25 MVA natural oil cooled transformer has the dimensions of 155cm x 65 cm x 185 cm (length, width and height). The full load losses are 13100 watts. Estimate the number of cooling tubes required for this transformer. Assume: W/m^2--^0C due to radiation = 6 and due to convection = 6.5; improvement in convection due to provision of tubes = 40%. ; temperature rise = 40 ^0C. ; length of each tube = 1 m ; diameter of tubes = 50 mm. Neglect top and bottom surfaces of the tank as regards cooling. **08**

OR

Q.3 **(a)** A 200 kVA, 6.6kV/440volts, 50Hz, three phase core type transformer has the following design data: **12**

Max. flux density : 1.25 wb/m^2
Emf / turn : 10 volts
Stacking factor : 0.9
Window space factor : 0.32
Current density : 2.4 A/mm^2

Overall width and overall height are same. If three stepped core is used determine overall dimensions. Also show them on a sketch.

(b) Define : (1) Window space factor (2) Stacking factor. **02**

Q.4 **(a)** Discuss factors to be considered while deciding the length of air gap in the design of a d.c. machine. **06**

(b) Determine main dimensions(D and L) of a 12 kW, 230V, 2 pole, 1500 rpm D.C. shunt generator if the required data is : **08**

full load efficiency = 82%
polearc/pole pitch = 0.63
avg. flux density = 0.4 Wb/sqr m.
Ampere conductors / m =19000.
Machine is designed to have square pole face.

OR

Q.4 **(a)** Explain how the choice of number of poles in a d.c. machine affects **04**

(1) Losses in the machine
(2) Weight of machine

(b) The given details refer to the shunt field coil of a 440 volt , 6 pole d.c. machine. **10**

Mmf per pole = 7200 A
Depth of winding = 50 mm
Length of inner turn = 110 cm
Length of outer turn = 140 cm
space factor = 0.6
resistivity = 0.02 Ω/m and mm^2
loss radiated from outer surface excluding ends = 1400 W/m^2
20% of the terminal voltage drops across the field regulator.
Determine: The diameter of wire, length of coil, number of turns and exciting current.

Q.5 **(a)** Explain guidelines used for the selection of number of armature slots in d.c. machine design. **07**

(b) Discuss the behavior of current transformer under system short circuit. **07**

OR

Q.5 **(a)** Discuss the importance of mitred joints in the core assembly of transformers. **07**

(b) Briefly explain the principles of core design of a current transformer. **07**

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