Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER • 2014

Subject Code: 170902 Date: 03-06-2014

Subject Name: Electrical Machine Design - I

Time: 02:30 pm - 05:00 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)** Transformer A and B are of same type and have equal current density, flux density, frequency and window space factor. Their linear dimensions are in the ratio of 2:1. Prove that their losses will be in the ratio of 8:1. **07**

(b) Explain : **07**

a. Significance of mitered joints in transformer.
b. Design difference between power & distribution transformer.

Q.2 **(a)** Derive equation $E_t = K\sqrt{Q}$, where Q = kVA rating of a transformer. Explain how service conditions of transformer affect the value of K. **07**

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

OR

(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/m2--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. **07**

Q.3 **(a)** What is design optimization? Derive necessary condition for designing a transformer with minimum cost. **07**

(b) Determine the main core dimensions for a 250 KVA, 6600/500V, 50 Hz, 3-phase star/delta core type transformer from the following data: **07**

Window space factor = 0.27
Current density = 2.5 A/mm²
Max. flux density = 1.25 Wb/m²
Volts per turn = 8.5 V
Use 4-stepped core limb section which has the area factor = 0.62
Height of window / width of window = 2

OR

Q.3 **(a)** Calculate the main dimensions of the armature of a 400 KW, 500V, 180 rpm, 16 poles dc generator. Use square pole-face. **07**

Efficiency = 90 %
Pole-arc to pole pitch ratio = 0.7
Average gap density = 0.6 Wb/m²
Ampere-conductors per metre = 35000.

(b) Explain guidelines used for the selection of number of armature slots in D.C. machine design. **07**

Q.4 **(a)** Discuss design procedure for designing a commutator and brushes of a DC machine. **07**

(b) Describe steps to calculate AT required for each part and total magnetic circuit of a D.C. machine. **07**

OR

Q.4	**(a)**	Explain steps to design shunt field winding of a d.c. machine.	**07**
	(b)	Explain how the choice of number of poles in a d.c. machine affects : 1. Losses in the machine. 2. Weight of machine.	**07**
Q.5	**(a)**	Explain how pole body (shank) height is fixed while designing field system of a DC machine.	**07**
	(b)	Write short note on classification of insulating materials.	**07**
		OR	
Q.5	**(a)**	Write a Short Note on : Duty Cycle.	**07**
	(b)	With the help of neat sketch, explain the effect of armature reaction on air gap flux in case of D.C. machine.	**07**

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