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. Make suitable assumptions wherever necessary. 2. 3. Figures to the right indicate full marks. Transformer A and B are of same type and have equal current density, flux density, **Q.1** 07 (a) 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. **(b)** Explain : 07 a. Significance of mitered joints in transformer. b. Design difference between power & distribution transformer. **Q.2** Derive equation $E_t = K\sqrt{Q}$, where Q = kVA rating of a transformer. Explain how 07 **(a)** service conditions of transformer affect the value of K. Discuss the behaviour of current transformer under system short circuit. **(b)** 07 OR The tank of a 1.25 MVA natural oil cooled transformer has the dimensions of **(b)** 07 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. What is design optimization? Derive necessary condition for designing a Q.3 (a) 07 transformer with minimum cost. Determine the main core dimensions for a 250 KVA, 6600/500V, 50 Hz, 3-phase 07 **(b)** star/delta core type transformer from the following data: Window space factor = 0.27Current density = 2.5 A/mm^2 Max. flux density = 1.25 Wb/m^2 Volts per turn = 8.5 VUse 4-stepped core limb section which has the area factor = 0.62Height of window / width of window = 2OR Calculate the main dimensions of the armature of a 400 KW, 500V, 180 rpm, 16 07 0.3 (a) poles dc generator. Use square pole-face. Efficiency = 90 % Pole-arc to pole pitch ratio = 0.7Average gap density = 0.6 Wb/m^2 Ampere-conductors per metre = 35000. Explain guidelines used for the selection of number of armature slots in D.C. **(b)** 07 machine design. Discuss design procedure for designing a commutator and brushes of a DC **Q.4** 07 **(a)** machine.

- (b) Describe steps to calculate AT required for each part and total magnetic circuit of a 07 D.C. machine.
 - 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 :	07
		1. Losses in the machine.	
		2. Weight of machine.	
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
