Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII • EXAMINATION – SUMMER 2013

Subject Code: 170902 **Date: 24-05-2013**

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)** Explain how following factors influence the main dimensions of a d.c. machine. **07**

(1) L/τ ratio,
(2) Peripheral speed,
(3) Moment of inertia,
(4) Voltage between adjacent segments.

(b) The output coefficient of a d.c. machine is 200 kVA/m^3- r.p.s..Its armature power ($P_{a)}$ is 1000 kW and speed is 300 rpm. Determine main dimensions (D and L) of the machine and also find main dimensions if: **07**

(1) Specific loadings are decreased by 10% each without changing speed.
(2) Speed is decreased to 150 rpm without changing specific loadings.

Assume L/D ratio = 0.2 in all cases. Comment on your answers.

Q.2 **(a)** Explain technical reasons for : **07**

(1) Low flux density is selected for yoke of a three phase transformer.
(2) Circular coils are preferred in transformer winding.
(3) Tappings are usually provided on h.v. side of transformer.

(b) From the design data discuss how no load current can be estimated in 3 phase core type transformer. **07**

OR

(b) Prepare a technical note on classification of insulating materials. **07**

Q.3 Estimate the main dimensions of complete core frame, winding conductor areas and no. of turns of a 3-phase core type delta-star transformer which is rated at 300 kVA, 6600/440 volts, 50 Hz. Use three stepped core with the diameter of circumscribing circle of 0.25 m. Assume volts/turn = 8.5 , current density of 2.5 A/mm^2, window space factor of 0.28 , stacking factor of 0.9 and height to width ratio for window =3. **14**

OR

Q.3 Determine the main dimensions, no. of poles and the length of air gap of a 500 kW, 500 V, 960 rpm d.c. generator. **14**

Assume:

1. B_{av} = 0.58 wb/m^2.
2. ac = 36000
3. Pole arc/pole pitch = 0.75
4. Efficiency = 90%

The mmf required for air gap is 50% of armature mmf and gap contraction factor is 1.15.

Design constraints (limiting values):

1. Peripheral speed : 40 m/s
2. Frequency of flux reversals : 50 Hz
3. Current per brush arm : 400 A
4. Armature mmf per pole: 7500 A.

Q.4 **(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 steps to design shunt field winding of a d.c. machine. **07**

OR

Q.4 **(a)** Explain how following points affect the dimensions of slots in a d.c. machine armature design. **07**

(1) Excessive flux density
(2) Flux pulsations
(3) Eddy current losses
(4) Mechanical issues.

(b) Briefly explain cooling methods of transformer. **07**

Q.5 **(a)** Explain how pole body height is fixed while designing field system of a d.c. machine. **07**

(b) Explain types of mechanical forces are developed in transformer windings? **07**

OR

Q.5 **(a)** Discuss the behavior of a C.T. under system short circuit. **07**

(b) From Design parameters, derive the expression of determining no. of armature winding coils. **07**

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