Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER 2013

Subject Code: 160804 **Date: 03-06-2013**

Subject Name: Electrical Machine Design

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)** Define heating time constant and explain how it can be evaluated from heating curve. **07**

(b) A 15KW, 230V, 4-pole d.c. machine has the following data: **07**
Armature diameter 0.25m, armature core length 0.125m, air gap length at pole centre 2.5mm, flux per pole 11.7mWb, ratio of pole arc to pole pitch 0.66. Calculate the mmf required for air gap (i) if the armature surface is treated to be smooth (ii) if the armature is slotted and the gap contraction factor is 1.18.

Q.2 **(a)** State the advantages of hydrogen cooling in alternators. **07**
Explain radial and axial ventilation with the help of sketches.

(b) Explain with necessary diagrams different cooling methods used for transformer. **07**

OR

(b) Explain : **07**

a. Significance of cruciform core in transformer.
b. Design difference between power & distribution transformer.

Q.3 **(a)** Derive output equation of 3 ï ū Transformer. Write significance of constant ðKô **07**

(b) Determine the dimensions of the core and yoke for a 100 KVA, 50 Hz, Single phase, core type transformer. A square core is used with distance between the adjacent limbs equal to 1.6 times the width of the laminations. Assume voltage per turn of 14 volts, maximum flux density 1.1 wbm^2, window space factor 0.32 and the current density $3A/mm^2$. Take stacking factor = 0.9.Flux density in the yoke to be 80% of flux density in core. **07**

OR

Q.3 **(a)** What are the important considerations in choosing number of poles in D.C. machine? **07**

(b) Determine the dimensions of core and yoke for a 200KVA, 50Hz single phase transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn 14V, maximum flux density $1.1Wb/m^2$, window space factor 0.32, current density $3A/mm^2$. The net iron area is 0.56d2 in a cruciform core and the width of the largest stamping is 0.85d, where d is the diameter of the circumscribing circle. **07**

Q.4 **(a)** Explain the design procedure in the design of field windings for a D.C. shunt machine. **07**

(b) What are the factors that affect the size of rotating machines? **04**

Mention various factors on which brush friction loss depends. **03**

OR

Q.4 **(a)** Define specific magnetic loading (Bav) and specific electric loading (ac) and obtain an expression for the ñoutput co-efficient for a D.C. machine. **07**

(b) Explain various factors affecting selection of Numbers of armature slots for D.C. machine. **07**

Q.5 **(a)** Discuss the factors that determine the choice of air-gap in induction motor. **07**

(b) A single phase, 400V, 50 Hz transformer is built from stampings having a relative permeability of 1000. The length of the flux path is 2.5m, the area of cross section of the core is $2.5x10^{-3}$ m^2 and the primary winding has 800 turns. The iron loss at the working flux density is 2.6 W/Kg and iron weighs 5.8×10^{-3} Kg/m3. Stacking factor is 0.9. Estimate the maximum flux and no load current of the transformer. **07**

OR

Q.5 **(a)** Explain how eddy current loss occurs and derive an expression for eddy current loss in a magnetic material. **07**

(b) What are the factors that limit the design of an electrical machine? **07**

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