Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – WINTER 2015

Subject Code: 170902 Date: 07/12/2015

Subject Name: Electrical Machine Design – I

Time: 10:30am to 1:00pm 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 various factors affecting selection of number of poles for D.C. machine. **07**

(b) Explain how following factors influence the main dimensions of a D.C. machine. **07**
(1) L/ζ ratio,
(2) Peripheral speed,
(3) Moment of inertia,
(4) Voltage between adjacent segments.

Q.2 **(a)** Explain guidelines used for the selection of number of armature slots in D.C. machine design. **07**

(b) Determine the main dimensions, number of poles and length of air gap of a 600 kW, 500 V, 900 rpm generator. Assume average gap density as 0.6 Wb/m^2 and ampere conductors per metre as 35000. The ratio of pole arc to pole pitch is 0.75 and efficiency is 91 percent. **07**
The following are the design constraints: peripheral speed: ≤ 40 m/s, frequency of flux reversals: ≤50 Hz, current per brush arm: ≤ 400 A and armature mmf per pole ≤ 7500 A.
The mmf required for air gap is 50 percent of armature mmf and gap contraction factor is 1.15.

OR

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

Q.3 **(a)** Discuss factors to be considered while deciding the length of air gap in the design of a D.C. machine. **07**

(b) Explain diff. methods used to improve armature reaction effect in dc machine. **07**

OR

Q.3 **(a)** Briefly explain cooling methods of transformer. **07**

(b) Explain effect of change in frequency on losses, voltage & leakage impedance of transformer. **07**

Q.4 **(a)** What is design optimization? Derive necessary condition for designing a transformer with minimum cost. **07**

(b) Explain : **07**
a. Significance of mitered joints in transformer.
b. Design difference between power & distribution transformer.

OR

Q.4 **(a)** Derive equation Et = k $\sqrt{Q}$ where Q = kVA rating of a transformer. **07**
Explain how service condition of transformer affect the value of K.

(b) Determine the main core & yoke dimensions for a 200 KVA, 50 Hz, 1-phase core type transformer. **07**
Window space factor = 0.32 Current density = 3 A/mm^2
Max. flux density = 1.1 Wb/m^2 Volts per turn = 14 V
Stacking factor = 0.9 Net iron area = 0.56*d2
Cruciform core with distance between adjacent limbs = 1.6 times width of core

Q.5 **(a)** Define specific electric and specific magnetic loading. Also state advantage sand disadvantages of these loadings. **07**

(b) Estimate the per unit regulation, at full load and 0.8 power factor lagging, for a 300 kVA, 50 Hz, 6600/400 V, 3 phase, delta/star, core type transformer. The data given is: **07**

H.V. winding: outside diameter=0.36m, inside diameter=0.29m, area of conductor=5.4mm^2

L.V. winding: outside diameter=0.26m, inside diameter=0.22m, area of conductor=170mm^2

Length of coils=0.5 m, voltage per turn=8V, resistivity=0.21 Ω/m/ mm^2.

OR

Q.5 **(a)** Briefly explain the principles of core design of a current transformer. **07**

(b) What is window space factor? Explain how it varies with (1) KVA rating (2) KV rating **07**

****