

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- VIIth SEMESTER-EXAMINATION – MAY/JUNE- 2012****Subject code: 170902****Date: 08/06/2012****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) Discuss the factors affecting the selection of specific magnetic and specific electric loadings in dc machine design **07**

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

Given data:

Efficiency = 90 %

Pole-arc to pole pitch ratio = 0.7

Average gap density = 0.6 Wb/m²

Ampere-conductors per metre = 35000.

Q.2 (a) Derive the output equation of a 3-phase core type transformer. **07**

(b) Obtain the expression of leakage reactance of a 3-phase core type distribution transformer **07**

OR

(b) Discuss the factors in brief how the number of poles affects the weight of iron and weight of copper in dc machine **07**

Q.3 (a) What is window space factor? Explain how it varies with (i) KVA rating and (ii) KV rating. **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) Discuss design procedure for designing a commutator and brushes of a dc machine. **07**

(b) Explain how pole body (shank) height is fixed while designing field system of a dc machine. **07**

Q.4 (a) Explain the steps involved to calculate no load current of a 3-phase transformer from its design data. **07**

(b) Answer the following in respect to transformer design: **07**

(i) Why cores are stepped?

(ii) Why yoke is designed for low flux density?

(iii) Why circular coils are preferred in transformer winding?

OR

- Q.4 (a)** Explain in brief the factors affecting the value of K in the expression of volt per turn in transformer design. **07**
- $$E_t = K \sqrt{\text{KVA}}$$
- (b)** Estimate the number of cooling tubes for a 250 KVA, 6600/400 V, 50 Hz, 3-phase delta / star core type oil cooled transformer from the following data: **07**
- Temp rise = 50° C
 Total losses at 90° C are 5.0 KW
 Tank size = 125 x 100 x 50 cms. (h x l x w)
 Oil level = 115 cms.
 Sp-heat dissipation of plain tank = 12.5 W/m²/°C
 Diameter of cooling tube = 5.0 cms.
- Show the tube arrangement by sketch.
- Q.5 (a)** Derive the expression of obtaining the number of coils of dc machine armature from design parameters. **07**
- (b)** Calculate (i) the number of poles and (ii) air-gap length of a 600 KW, 500 V, 900 rpm dc generator from the following data: **07**
- Average gap density = 0.6 Wb/m²
 Ampere-conductors per metre = 35000
 Pole-arc to pole-pitch ratio = 0.7
 Gap contraction factor = 1.15
 Diameter of armature core = 0.81 m
 Length of armature core = 0.325 m
 MMF for air-gap = 50% of armature MMF
- OR**
- Q.5 (a)** Discuss the steps for designing a shunt field winding of a dc machine. **07**
- (b)** Describe steps to calculate AT required for each part and total magnetic circuit of a dc machine. **07**
