

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (OLD) EXAMINATION – WINTER 2018****Subject Code: 170902****Date: 19/11/2018****Subject Name: Electrical Machine Design-I****Time: 10:30 AM TO 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) Derive the output equation DC machine. Also explain the factors affecting the size of rotating machine. **07**
- (b) Explain the factors to be considered while selecting the number of poles in the design of DC machine. **07**
- Q.2** (a) Discuss factors to be considered while deciding the length of air gap in the design of a d.c. machine. **07**
- (b) What is the importance of temperature as a factor in the life of insulating material? Also classify insulating material as per I.S specification. **07**
- OR**
- (b) Determine the main dimensions, number of poles and length of air gap of a 600 kW, 500 V, 900 r.p.m. generator. Assume average gap density as  $0.6 \text{ Wb/m}^2$  and ampere conductors per metre as 35000. The ratio of pole arc to pole pitch is 0.75 and efficiency is 91 percent. The following are the design constraints: peripheral speed:  $\leq 40 \text{ m/s}$ , frequency of flux reversals:  $\leq 50 \text{ Hz}$ , current per brush arm:  $\leq 400 \text{ A}$  and armature mmf per pole  $\leq 7500 \text{ A}$ . The mmf required for air gap is 50 percent of armature mmf and gap contraction factor is 1.15 **07**
- Q.3** (a) Explain different types of duties and rating for rotating electrical machines. **07**
- (b) Explain guidelines or guiding factors used for the selection of number of armature slots in d.c. machine design. **07**
- OR**
- Q.3** (a) Describe the methods adopted to reduce the effect of armature reaction in DC machine. **07**
- (b) A 4 pole generator supplies a current of 140 A. It has 480 armature conductors (a) wave connected, (b) lap connected. The brushes are given an actual lead of  $10^\circ$ . Calculate the cross and demagnetizing mmf per pole in each case. The field winding is shunt connected and takes a current of 10 A, find the number of extra shunt field turns to neutralize the demagnetization. **07**
- Q.4** (a) What is design optimization? Derive necessary condition for designing a transformer with minimum cost. **07**
- (b) Derive the output equation of a 3-phase core type transformer. **07**
- OR**
- Q.4** (a) Answer the following with 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?
- (b) Calculate approximate overall dimensions for a 200 kVA, 6600/440V, 50 Hz, 3 phase core type transformer. The following data may be assumed: emf per turn=10V; maximum flux density=1.3 Wb/m<sup>2</sup>, current density=2.5 A/mm<sup>2</sup>, window space factor=0.3, overall height=overall width, stacking factor=0.9. Use a 3 stepped core. **07**

For a 3 stepped core,  
Width of largest stamping= $0.9d$  and  
Net iron area=  $0.6d^2$ , where  $d$ =diameter of circumscribing circle.

- Q.5** (a) Explain the steps involved to calculate no load current of a 3-phase transformer from its design data. **07**
- (b) Obtain the expression of leakage reactance of a 3-phase core type distribution transformer **07**
- OR**
- Q.5** (a) Discuss the steps for designing a shunt field winding of a dc machine. **07**
- (b) Discuss the importance of mitred joints in the core assembly of transformers. **07**

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