

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (OLD) EXAMINATION – SUMMER 2019****Subject Code: 170902****Date: 14/05/2019****Subject Name: Electrical Machine Design-I****Time: 02:30 PM TO 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) Answer the following with respect to transformer design : **07**  
(a) Why cores are stepped? (b) Why yoke is designed for low flux density?
- (b) Calculate the diameter and length of armature for a 7.5 kW, 4 pole, 1000 rpm, 220 V Shunt motor. Full load efficiency=0.83, maximum gap flux density=0.9 Wb/m<sup>2</sup>, specific electric loading =30,000 ampere conductors per meter, field form factor=0.7, assume maximum efficiency occurs at full load and field current is 2.5% of rated current. The pole face is square. **07**
- Q.2** (a) Explain how the choice of number of poles in a d.c. machine affects : **07**  
(1) Losses in the machine (2) Weight of machine
- (b) A 500 kW, 375 rpm, 8 pole D.C. generator has a flux per pole of 0.0885 wb. Determine the armature demagnetizing and cross-magnetizing mmf per pole if the brushes are given a lead of 5% of pole pitch. Assume power developed by armature to be equal to rating of machine. **07**
- OR**
- (b) A 350 kW, 500 V 450 rpm, 6 pole dc generator is built with an armature diameter of 0.87 m and core length of 0.32 m. The lap wound armature has 660 conductors. Calculate the specific electric and magnetic loadings. **07**
- Q.3** (a) Explain different methods used to improve armature reaction effect in DC machine. **07**
- (b) Write a short note on a square and stepped cores in transformer design. **07**
- OR**
- Q.3** (a) Discuss the behavior of current transformer under system short circuit condition. **07**
- (b) Derive the expression for no load current of Transformer. **07**
- Q.4** (a) Explain various factors affecting choice of Average flux density and Ampere conductors per meter for D.C. machine. **07**
- (b) Explain : (a) Significance of mitred joints in transformer. **07**  
(b) Design difference between power & distribution transformer.
- OR**
- Q.4** (a) Write a Short Note on : Duty Cycle **07**
- (b) Derive output equation of 3 –Φ Transformer. Write the significance of constant 'K'. **07**
- Q.5** (a) How will the output and losses in transformer change with the linear dimensions? **07**
- (b) The ratio of flux to full load mmf in a 400 kVA, 50 Hz single phase core type power transformer is  $2.4 \times 10^{-6}$ . Calculate the net iron area and the window area of transformer. Maximum flux density in the core is 1.3 Wb/m<sup>2</sup> current density 2.7 A/mm<sup>2</sup> and window space factor 0.26. Also calculate the full load mmf. **07**

**OR**

- Q.5 (a)** What is design optimization? Derive necessary condition for designing a transformer with minimum cost. **07**
- (b)** A 40 Hz transformer is to be used on a 50 Hz system. Assuming the Steinmetz's coefficient as 1.6 and losses at lower frequency 1.2%, 0.7% and 0.5% for  $I^2R$ , hysteresis and eddy current respectively. Find losses on 50 Hz for the same supply voltage and current. **07**

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