

GUJARAT TECHNOLOGICAL UNIVERSITY**B. E. Sem. - V - Examination – June- 2011****Subject code: 150904****Subject Name: Elements of Electrical Design.****Date: 27/06/2011****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) Prepare a developed winding layout of mush winding for the stator of a 3 phase a.c. machine having 24 slots and 4 poles. **07**
- (b) What do you mean by “dummy coil”? What is its application? Also explain the use of equalizer connections in d.c. armature winding. **04**
- (c) What is fractional slot winding? Discuss its advantages. **03**

- Q.2** (a) Determine the mmf required for the air gap of a d.c. machine having core length of 30 cm. It includes 3 ducts of 1 cm each. Pole arc is 18.5 cm. Slot pitch is 6 cm. Slot opening is 5 mm. Length of air gap = 0.5 cm. Flux per pole is 50 mWb. Assume Carter’s co-efficient as 0.18 for opening/gap = 1 and 0.28 for opening/gap = 2. **07**
- (b) Explain various methods for calculating the mmf required for tapered teeth. **07**

OR

- (b) Define real and apparent flux densities in the tooth of a d.c. machine armature. Explain difference between them and also derive relation between them. **07**
- Q.3** (a) Derive an equation for temperature rise of an electromagnet coil. **04**
- (b) Determine the main dimensions (r_1 , r_2 , r_3 , t_1 and t_2 as usual notations) of a continuously rated flat faced armature type circular magnet with following data: **10**
- Force = 220 kg.; Stroke = 0.7 mm.; Voltage = 6 volt.;
- Temperature rise = 65° C above an ambient temperature of 20° C.
- Flux density corresponding to index no 21200 is 1.16wb/m² and to index no 28400 is 1.2 wb/m².
- You may assume $c = 0.085^\circ\text{C}\cdot\text{m}^2/\text{W}$ and space factor = 0.5.
- Mmf reqd. for iron parts are 15% of the mmf reqd. for air gap.
- The ratio of coil height to width (h_f/d_f) = 4.
- Conductor resistivity = 0.022 ohm/m/mm².

OR

- Q.3** (a) Discuss step by step complete procedure to design a horse shoe type electromagnet for a given supply voltage, required force and stroke. **08**
- (b) An electromagnet coil is wound on a former has outside diameter of 100 mm and inside diameter of 40 mm. The height of the coil is 120 mm. Determine the winding depth, gross winding area, length of mean turn, space factor and number of turns when conductors bed and when they do not bed. The coil is wound with a copper wire having a bare diameter of 0.213 mm and with insulation of 0.313 mm. **06**

- Q.4 (a)** Define and clearly explain the terms: **06**
 (1) Gap contraction factor for slots and ducts
 (2) Stacking factor
 (3) Back pitch and front pitch
- (b)** A bungalow has following load connected in it. **05**
 12 tube lights with conventional chokes, 7 fans, a 165 liter refrigerator, a T.V. set, A computer, 2 A.C.s of 1 ton each, 1 h.p. water pump. Average daily consumption of tube lights are for 4 hours, fans 6 hours, T.V. 5 hours, A.C.s 6 hours, pump 2 hours, computer 8 hours and refrigerator 24 hours. Estimate the monthly electricity bill of the bungalow if energy cost is Rs. 5 per unit.
- (c)** Discuss the factors that should be considered while selecting the type of a wiring system. **03**

OR

- Q.4 (a)** Define and clearly explain the terms : **06**
 (1) Space factor
 (2) Field form factor
 (3) Commutator pitch
- (b)** What is electric load? Giving examples classify different types of load. **04**
- (c)** Discuss the factors to be considered while designing the illumination scheme for the domestic wiring. **04**

- Q.5 (a)** Prove that the section resistances of d.c. shunt motor starters are in geometrical progression. **07**
- (b)** A single phase transformer is required to be designed to give an output of 4 A at 24 V, from 230 V, 50 Hz a.c. supply. You may assume the efficiency of transformer to be 94%, turns/volt = 4.6, $B_m = 1 \text{ wb/m}^2$. Determine the dimension of central limb, no. of turns and currents in both windings. **07**

OR

- Q.5 (a)** Explain the design procedure of a 3-phase variable choke coil. **07**
- (b)** Estimate the number of resistance sections and the resistance of each section for the starter of a 10 kW, 450 V d.c. series motor. The starting current varies from 1.5 to 2 times the full load current. The efficiency of the motor may be taken as 78% and the resistance of machine measured between terminals is 1.25 ohm. Assume that the flux rises by 10% as the current rises from 1.5 to 2 times the rated full load current. **07**
