Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(New) • EXAMINATION – WINTER 2016

Subject Code:2152001 Date:17/11/2016

Subject Name:Electro Mechanical Energy Conversion

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 MCQ **14**

1. Example for para-magnetic materials
(a) super conductors (b) alkali metals (c) transition metals (d) Ferrites

2. The unit for permeability is
(a) At/Wb (b) At/m (c) Wb/(At × m) (d) Wb

3. Which electromagnetic device has a movable iron core called a *plunger*?
(a) A speaker (b) A dc generator (c) A relay (d) A solenoid

4. What do you call the characteristic of a magnetic material whereby a change in magnetization lags the application of a magnetizing force?
(a) Retentivity (b) Induction (c) Hysteresis (d) Reluctance

5. What is the reluctance of a material that has a length of 0.045 m, a cross-sectional area of 0.015 m^2 , and a permeability of 2500 μWb/At·m?
(a)1200 At/Wb (b) 0.27 At/Wb (c) 833.3 μAt/Wb (d) 600 At/Wb

6. The series field of a short-shunt d.c. generator is excited by …… currents.
(a) shunt (b) armature (c) load (d) external

7. A stepper motor may be considered as a …… converter.
(a) dc to dc (b) ac to ac (c) dc to ac (d) digital to analogue

8. If the field of a synchronous motor is under excited, the power factor will be
(a) lagging (b) leading (c) unity (d) more than unity

9. The starting winding of a single phase induction motor is placed in the
(a) rotor (b) stator (c) armature (d) field

10. The frequency of voltage generated by an alternator having 4-poles and rotating at 1800 rpm is …… hertz.
(a) 60 (b) 7200 (c) 120 (d) 450

11. The shaft torque of a d.c. motor is less than its armature torque because of …… losses.
(a) copper (b) mechanical (c) iron (d) rotational

12. In a d.c. generator, the effect of armature reaction on the main pole flux is to
(a) reduce it (b) distort it (c) reverse it (d) both (a) and (b)

13. When load is removed, ……. motor will run at the highest speed.
(a) shunt (b) cumulative-compound (c) differential-compound (d) series

14. In a 3-phase induction motor, the starting torque will be maximum when
(a) $R_2 = 1/X_2$ (b) $R_2 = X_2$ (c) $R_2 = X_2^2$ (d) $R_2 = (X_2)^{1/2}$

P.T.O.

Q.2 **(a)** Explain various types of magnetic materials. **03**

(b) Explain how magnetic field is established in a long solenoid when a dc current **04**

is passes though it using suitable diagrams and expressions.

(c) State and explain different approximation made while analyzing electromagnetic devices. **07**

OR

(c) Derive expression for force on current carrying conductor placed in a magnetic field. **07**

Q.3 **(a)** Define field energy and coenergy. What is the significant of coenergy? **03**

(b) Explain the hysteresis and eddy current losses. **04**

(c) A 4-pole, 230 V, wave-connected shunt motor gives 10 kW when running at 1200 rpm and drawing armature and field currents of 50 A and 1 A respectively. It has 660 conductors. Its armature resistance is 0.3 Ω. Assuming a drop of 1 V per brush, determine: (a) total torque; (b) useful torque; (c) useful flux per pole; (d) rotational losses; (e) efficiency. **07**

OR

Q.3 **(a)** A shunt generator has a full load current of 166 A at 210 V. The stray losses are 620 W and the shunt field coil resistance is 50 Ω. If it has a full load efficiency of 85%, find the armature resistance. Also, find the load current corresponding to maximum efficiency. **03**

(b) State the principle of operation of a dc generator and derive the expression for the emf generated. **04**

(c) Draw and explain doubly excited magnetic field system. **07**

Q.4 **(a)** Define slip. Why cannot an induction motor run at synchronous speed? **03**

(b) A 6-pole, 50 Hz, 3-phase induction motor running on full load develops a useful torque of 140 Nm at a rotor frequency of 1.5 Hz. Calculate the shaft power output. If the mechanical torque lost in friction be 8 Nm, determine (a) rotor copper loss and (b) input to the motor. The total stator loss is 600 W. **04**

(c) Explain the double-revolving field theory with torque-speed curve of a single phase induction motor. **07**

OR

Q.4 **(a)** Derive e.m.f. equation for an alternator. **03**

(b) Explain with neat sketch the working principle of split phase induction motor. **04**

(c) The rotor resistance and reactance of a 4-pole, 50 Hz, 3-phase slip ring induction motor are 0.3 and 3 Ω/phase respectively. Calculate the speed at maximum torque and the ratio (max. torque)/ (starting torque). What value should the resistance per phase have so that the starting torque is half of maximum torque? **07**

Q.5 **(a)** State some important applications of stepper motors. **03**

(b) Draw and explain the torque-speed characteristic of a hysteresis motor. What are the common applications of hysteresis motor? **04**

(c) Describe the construction of a PMDC motor. What are the advantages and disadvantages of PMDC motors compared with conventional shunt dc motors? **07**

OR

Q.5 **(a)** Explain the principle of operation of a DC servomotor. Draw its torque-speed characteristic. **03**

(b) Write a short note on universal motor. **04**

(c) Name the most popular types of stepper motors. Describe the operation of a permanent magnet type of stepper motor. **07**

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