B.Tech.
(SEM. IV) EVEN THEORY EXAMINATION 2012-13
ELECTRO MECHANICAL ENERGY CONVERSION–I

Time : 3 Hours
Total Marks : 100

Note :– (1) Attempt all questions.
(2) All symbols have their usual meanings.

1. Attempt any four parts : (5×4=20)

(a) What is electromechanical energy conversion? State three types of electromechanical energy conversion devices with practical examples.

(b) Derive the following relation for field energy:

\[ W_f = \int_0^\lambda f d\lambda \]

where \( \lambda \) = flux linkage.

(c) For a singly excited magnetic system, establish relationship between magnetic field energy and co-energy.

(d) Show that the torque developed in doubly excited magnetic system is equal to the rate of increase of field energy with respect to displacement at constant current.

(e) The magnetic flux density on the surface of an iron face is 1.6 T which is a typical saturation level for ferromagnetic material. Find the force density on the iron face.
(f) Which are analogous quantities in electric field to flux linkages and current in magnetic field?

2. Attempt any four parts: 

(a) Derive emf equation of a d.c. generator.

(b) What do you mean by poor commutation? Discuss the reason for poor commutation.

(c) A separately excited d.c. generator has terminal voltage 250 V with constant field excitation. If the load changes from 200 kW to 225 kW, find the percentage change in speed. The armature resistance is 0.015 Ω and total contact drop at brushes is 2 V. Neglect armature reaction. The flux and total no. of armature conductors remain constant.

(d) Define armature reaction in d.c. machine and explain its effect on machine performance.

(e) What are interpoles? Why are interpoles designed to provide mmf more than the armature mmf in commutating zone.

(f) Why does the terminal voltage fall more rapidly in self-excited shunt generator than in a separately excited d.c. generator?

3. Attempt any two parts:

(a) A 250 V d.c. shunt motor has an armature resistance of 0.5 Ω and a field resistance of 250 Ω. When deriving a constant torque load at 600 rpm, the motor draws 21 Amp. What will be the new speed of the motor if an additional 250 Ω resistance is inserted in the field circuit.

(b) Explain the Hopkinson's test on d.c. machines. Also mention the significance of test.

(c) Explain Ward Leonard method to control the speed of d.c. motor. A d.c. series motor developing 40 N-m torque is subjected to the conditions that make field flux decrease by 30% and armature current increase by 15%. Calculate the new torque.

4. Attempt any two parts:

(a) A 250 V d.c. shunt motor has an armature resistance of 0.5 Ω and a field resistance of 250 Ω. When deriving a constant torque load at 600 rpm, the motor draws 21 Amp. What will be the new speed of the motor if an additional 250 Ω resistance is inserted in the field circuit.

(b) Draw the phasor diagram of a single phase step up transformer feeding a lagging power factor. With the help of circuit diagram explain short circuit test.

(c) Write the merit and demerit of autotransformer, single-phase 250/500 V transformer given following results:
Open circuit test 250 V, 1 Amp., 80 W on L.V. side. Calculate circuit constant.

(d) What do you mean by 'voltage regulation' and efficiency of single phase transformer? Determine an expression for voltage regulation and efficiency in terms of equivalent circuit parameters 1-φ transformer.

5. Attempt any two parts:

(a) Explain multicircuit transformers and mentions its desirability with examples. Also discuss various purposes which dictate the use of tertiary winding in 3-winding transformer.