BACHELOR OF ELECTRICAL ENGINEERING EXAMINATION-2018

(4-Th YEAR, 1-ST SEMESTER)

ELECTIVE-I (SPECIAL ELECTRICAL MACHINES & DRIVES)

Time:3 hours Full Marks:100

(50 marks for each part)

Use separate Answer-script for each part

PART-I

Answer any three questions. Two marks for neatness. All symbols have their usual significance.

1. a) Define field energy and coenergy. Express the energy stored in magnetic field in the various forms explaining physical significance of each in force derivation in electromechanical energy conversion.
b) Consider the operation of an **electromagnetic relay** shown in fig.1, where one winding is mounted on a stationary member of iron and a movable member of iron is attached to a wall of the relay by a spring on one side. Derive the expression for mechanical force if the plunger shown in fig.1 is allowed to move an infinitesimal distance in the direction of magnetic force acting upon it. **8+8=16**

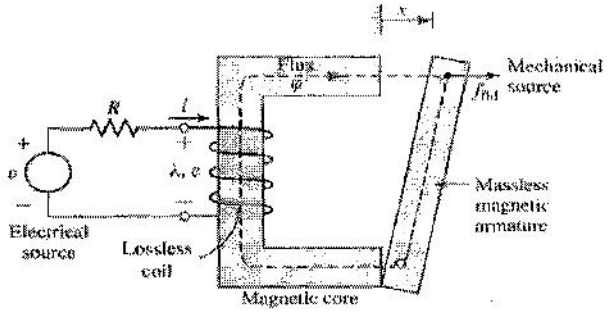

Fig.1

2. a) Explain magnetostriction stating its equation.

b) In an electromagnetic relay shown in fig. 1, the exciting winding has 5000 turns. The cross-sectional area of the magnetic core is 20 cm × 20 cm. The reluctance of the magnetic circuit may be assumed to be negligible. Also neglect fringing effects.

i) Find the coil inductance for an air-gap of x = 2 cm at both ends of the plunger. What is the field energy when the coil carries a current of 50 A? What are the forces on the plunger under these conditions?

ii) Find the mechanical energy output when the plunger moves in the direction of magnetic force acting upon it, from x = 2 cm to x = 1 cm at both ends of the plunger, assuming that the coil current is maintained constant at 50A.

Also find the mechanical energy output if the flux linkage is maintained constant during plunger movement. **4+12=16**

[Turn over

3. a) Describe the construction and principle of operation of a **single-phase reluctance motor** with the aid of flux and reluctance variation diagrams. Assume that the magnetic flux and reluctance variations are sinusoidal. Assume the necessary parameters for the system concern. Also develop an expression for reluctance torque.

   b) When a rotor of a **single-phase reluctance motor** is in the direct-axis position, the inductance of its exciting winding is 1.0 henry but the rotor is when in quadrature-axis position, the inductance is 0.4 henry. The exciting winding has N=2000 turns. Determine the maximum torque that the motor can develop with 230 volts at 50 hertz applied to its exciting winding.

   12+4=16

4. a) Describe construction and working method of a Permanent magnet Stepper Motors.

   b) Describe construction and working method of a Linear Induction Motor. **8+8=16**

5. Write short notes on: **8+8=16**
   a) Hybrid Stepper Motors;
   b) Hysteresis Motor.

PART-II.

Answer *any three* questions from this part.
Two marks are reserved for neat and well organised answer

6. Justify the following (any four) 8

a) Develop the PLC based ladder diagram for DC shunt motor starter system having the starting resistances divided in three steps. Assume START, STOP and OVERLOAD as the available commands/input in the system. Show the inputs and outputs to the system.

b) A 5.0 kW, 200V, 1200 rpm DC shunt motor with ra=0.6 ohm is operating at rated condition when fed from a fully controlled rectifier with three phase input voltage of 415V. Find the triggering angle for the converter. Now if dynamic braking is applied at this moment and the maximum machine current is limited to 2 times the full load current, find the external resistance to be connected with armature. 8

7. a) Develop the ladder diagram of a reversible DOL starter for three phase induction motor. Consider FWD, REV, STOP and OVERLOAD as available commands for the system. 8

b) Discuss with relevant diagrams the different speed sensing techniques in a DC motor drive system along with their merits and demerits *8*

8. a) Discuss with Ladder diagram the method of PLC based plug braking scheme of a DC separately excited motor. 8

b) Explain how braking can be achieved in an induction machine with the help of DC injection. Discuss the same with relevant circuit diagrams. 8

9 a) Discuss the methods to maintain constant braking torque during dynamic braking of a DC separately excited machines. Show how PLC based control can be useful for these schemes. 8

	b) What is scalar control of induction machines? Discuss with relevant block diagram a suitable scheme for the same.	8
10	Write short notes on any Two:	8 + 8
	a) PLC based DC motor speed control. b) Principle of field oriented control of induction machines. c) Current sensing techniques for three phase induction motor drives.	