B.E. ELECTRICAL ENGINEERING EXAMINATION-2019

(4-TH YEAR, FIRST SEMESTER)

SPECIAL ELECTRICAL MACHINES & DRIVES

(ELECTIVE-I)

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.

b) In an electromagnetic relay shown in fig. 1, the exciting winding has 2000 turns. The cross-sectional area of the magnetic core is 10 cm × 10 cm. The reluctance of the magnetic circuit may be assumed to be negligible. Also neglect fringing effects.

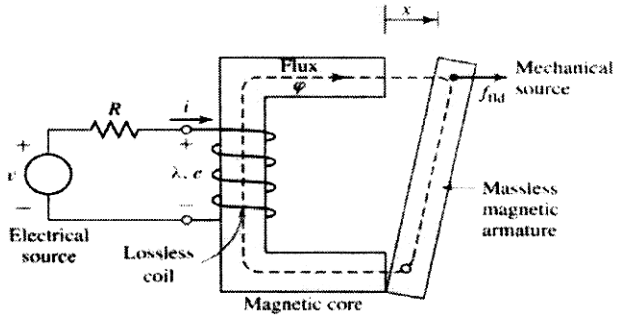

Fig.1

i) Find the coil inductance for an air-gap of x = 2cm at both ends of the plunger. What is the field energy when the coil carries a current of 100A? 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 = 2cm to x = 1cm at both ends of the plunger assuming that the coil current is maintained constant at 100A. Also find the mechanical energy output if the flux linkage is maintained constant during plunger movement.

4+12=16

2. 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 2.0 henry but the rotor is when in quadrature-axis position, the inductance is 0.8 henry. The exciting winding has N=1000 turns. Determine the maximum torque that the motor can develop with 230 volts at 50 hertz applied to its exciting winding.

12+4=16

3. a) Describe construction and working method of a Permanent magnet Stepper Motors.
   b) Describe construction and working method of a Hysteresis Motor.

8+8=16

4. a) Describe the construction and principle of operation of a Permanent Magnet DC Motor.
   b) Describe application and Permanent magnet materials of Permanent Magnet DC Motors.

8+8=16

5. Write short notes on: **8+8=16**
   a) Hybrid Stepper Motors
   b) Linear Induction 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 slip ring type induction motor starter having the starting resistances divided in three steps. Assume START, STOP and OVERLOAD as the available commands/input in the system. Also describe the operation of the same.

   b) Explain how dynamic braking can be achieved in a DC shunt machine with the help of PLC based control. Develop the power circuit also and indicate the inputs and outputs for the same. 8

7. a) Discuss with Ladder diagram the method of PLC based plug braking scheme of a DC separately excited motor. Draw the power circuit diagram and explain the operation. 8

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

8. a) A 5.5 kW, 170V, 1500 rpm DC motor with ra=0.4 ohm is operating at rated load at rated voltage when fed from a fully controlled 4 quadrant rectifier with single phase input voltage of 240V ac. Find the new triggering angle and braking resistance if plug braking is applied at this moment and the maximum machine current is limited to its full load current. 8

   b) Explain how regenerative braking can be achieved in an induction machine under operation. Discuss the same with relevant circuit diagrams and speed torque characteristics. 8

9 a) Discuss with relevant sketches how an induction motor can be operated in constant torque and constant speed operation. 8

	b) Discuss with relevant block diagram a suitable scheme for closed loop V/f control and its relevant hardware implementation for three phase induction machines.	8
10	Write short notes on any Two:	8 + 8

a) PLC based DC injection braking in a three phase induction machine.

b) Principle of field oriented control of induction machines.

c) Speed sensing techniques for three phase induction motor drives.