Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

FIRST SEMESTER M.TECH. (ELECTRIC VEHICLE TECHNOLOGY)
END SEMESTER EXAMINATIONS, JANUARY 2023

ENERGY CONVERSION SYSTEMS [ELE 5182]
REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 14 January 2023** **Max. Marks: 50**

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. A circuit breaker uses a solenoid to exert force on a moving element. Identify the system configuration and analyze its power flow. ***(03)***

1B. An inductor with a toroidal core is wound with 20 turns of copper wire carrying a current of 500mA. The core has a permeability of 1500, a diameter of 10cm, and a cross-sectional area of 10mm^2. Determine the field energy and the co-energy in the inductor. ***(02)***

1C. An electrical energy conversion system is shown in Fig Q1C. The input of the system is the voltage(V) applied across the coil of N turns wound around member A. The output is the displacement of member B(x). Based on this configuration, develop a mathematical model of the system dynamics.

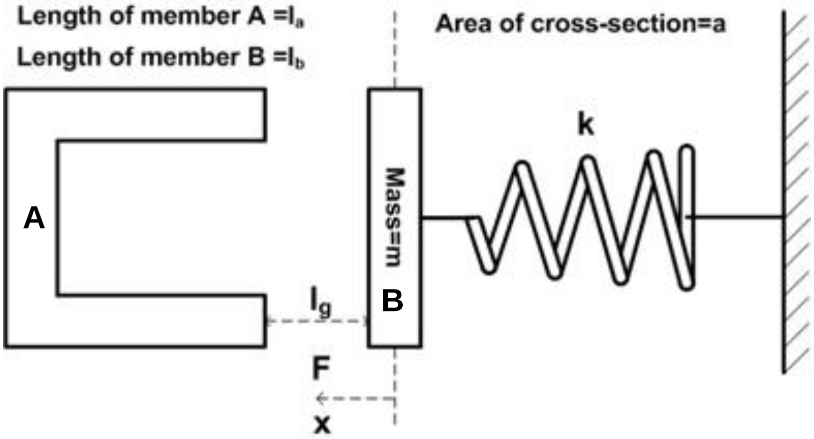

Fig Q1C. Diagram of the electrical-mechanical energy conversion system. ***(05)***

2A. A rotating machine consists of a cylindrical rotor. The stator and rotor are excited by a single-phase excitation system. Analyze with a suitable mathematical model and diagram whether this system can develop sustainable electromagnetic torque. ***(03)***

2B. A system has a six-phase sinusoidally distributed excitation. Analyze how the system can be mapped to a two-phase excitation. ***(03)***

2C. Develop the dynamic model of a two-phase machine with two axes in the stator and two in the rotor. Define the assumptions made to derive this model. ***(04)***

3A. A motor needs to be selected for the traction applications, and another motor needs to be selected for the machine tool application. Select the suitable motors for the two applications and explain their construction differences. ***(03)***

3B. Develop the small signal model of a series DC motor from the two-phase machine model. ***(03)***

3C. A 230V,40hp, 4 poles, 1500rpm dc motor is used in an application where the speed needs to be maintained constant at 1200 rpm. The source available to supply is a 230V, 50Hz single-phase AC source. Design a suitable controller to facilitate the motor to run at a constant speed. The motor parameters are: $R_a = 0.05\Omega, L_a = 6.5mH, J = 25Kgm^2, B = 0\ Nms, M = 400.4mH, T_l = 10Nm\ and\ I_f = 2.41A\ (Maintained\ constant)$ ***(04)***

4A. An AC motor needs to be selected for an elevator application, and another motor needs to be selected for a pump application. Select the suitable motors for the two applications and explain their construction differences. ***(03)***

4B. Diagrammatically explain the concept of a rotating magnetic field applied to a two-phase electrical machine with a cylindrical rotor. ***(03)***

4C. Develop the dynamic model of a stator voltage-controlled three-phase squirrel cage induction machine from a two-phase machine model. ***(04)***

5A. A 5hp, 440V, 3 phase, 50Hz, 4 pole star connected squirrel cage induction machine with the parameters $R_s = 0.5968\Omega, L_s = 35.75mH, L_r = 4.87mH, R_r = 0.6258\Omega$ and $L_m = 35.4mH$, runs at a speed of 1460 rpm. Evaluate its input power factor and efficiency. ***(04)***

5B. A high-end luxury electric car needs recommendations on the type of electrical motor used. Among the various motors available, evaluate the options and suggest a particular motor for the above-mentioned applications with proper justification. ***(04)***

5C. Compare the construction of a switched reluctance machine and a permanent magnet synchronous machine. ***(02)***