Ref. No. : Ex/PG/EE/T/129E/2018

M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM - 2018

MECHATRONICS

Time : Three hours Full Marks : 100

*Answer any **Five** questions.*

Answer all parts of a question in a sequential order.

1. a) Explain the terms "mechanism" and "machine", hence explain their inter-relationship.

b) Describe, with suitable sketches, various kinematic pairs indicating their role in mechatronic design of robotic systems.

c) Write a note on four-bar linkage.

[5+10+5=20]

2. a) What is the significance of Denavit-Hartenberg representation for robot manipulator? Explain, with suitable example, how the configuration of a planar manipulator can be described with the help of Denavit-Hartenberg representation.

b) Derive the basic rotation matrices.

[8+12=20]

3. a) Why the sensors are so important building blocks in mechatronic design? List, with proper justification, the various types of sensors that could be utilized for the design of a wheeled mobile robot for its autonomous operation.

b) Write a brief note on range sensing in mechatronic applications.

[8+12=20]

4. a) What factors should be considered while selecting an actuator for a particular mechatronic design?

b) Write a brief note on electrically powered actuators in mechatronic applications.

c) Explain the merits and demerits of employing hydraulic actuators in mechatronics.

[5+10+5=20]

[P.T.O.]

5. a) Explain, the independent-joint control method for serial link manipulators. What are its limitations? How they can be overcome?

b) Explain, how the basic idea of feedback linearization can be utilized for control of a robot manipulator.

[12+8=20]

6. a) Explain the forward kinematics and inverse kinematics solution of robotic systems. How they are utilized to perform mechatronic design of robotic systems?

b) Derive the kinematic equation of motion of a serial link manipulator in terms of homogeneous transformation matrices.

[6+14=20]

7. Describe the various steps for smooth trajectory planning of industrial manipulator traversing through obstacles.

[20]

8. Write a brief note on **any two** from the following:

a) Computer interfacing in mechatronic design.

b) Robust control of robotic systems.

c) Equation of motion of n-link robot manipulator.

d) Engineering scope of mechatronics.

[10x2=20]