

MASTER IN CONTROL SYSTEM ENGG FIRST YEAR SECOND SEMESTER – 2024
PRINCIPLES OF MECHATRONICS & ROBOTICS

Time : Three hours

Full Marks : 100

Answer Any Five Questions. Answer all parts of a question in sequential order.

1. a) Define mechatronics. In this context explain its objective. Give examples of few mechatronic systems.
b) “Mechatronics is a multi-disciplinary subject” – elucidate.
c) Explain with suitable sketches, the various types of kinematic pairs often found in mechatronic applications. Also, state their degrees-of-freedom.

[$(2+1+2)+5+10=20$]

2. a) What factors should be considered while selecting an actuator for any mechatronic design?
b) Explain the merits and demerits of employing hydraulic actuators in mechatronics.

[$8+12=20$]

3. a) Classify various sensors often found in mechatronics.
b) Write a brief note on the various type of motion sensors in mechatronic design.

[$8+12=20$]

- 4.a) Explain with suitable sketches, the Denavit-Hartenberg (D-H) and the Modified Denavit-Hartenberg (M D-H) conventions for serial manipulator.

- b) Derive the basic rotation matrices. How the homogeneous transformation matrices are derived?

[$6+ 14 = 20$]

5. a) Explain the forward kinematics and inverse kinematics solution of robotic systems.

- b) Explain the rules for derivation of composite rotation matrices. Hence derive the composite rotation matrix for rotation about an arbitrary axis.

[$6+(4+10)=20$]

[Turn over

6. Describe the various steps for smooth trajectory planning of industrial manipulator for pick and place operation employing cubic polynomials.

[20]

7. Write short note **on any two** from the following:

[10x2=20]

- a) Four Bar Linkage and its significance in Mechatronics.
- b) Role of mechanisms in mechatronics.
- c) Dynamic Model of Robot Manipulator.
- d) Role of mechatronics in Robotics.
- e) Selection of sensors for mechatronic applications.