

**M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER - 2019****MECHATRONICS (CS)**

Time : Three hours

Full Marks : 100

*Answer any Five questions.**Answer all parts of a question in the sequential order.*

1. a) "The main deliverable of Mechatronics is controlled motion"- Elucidate. What are the main participating disciplines in Mechatronics?
- b) Define the terms "mechanisms" and "machines". What are their roles in mechatronics?
- c) Explain the various kinematic pairs with suitable sketches.

[3+2+5+10=20]

2. a) What is homogeneous coordinate system?
- b) How are the link parameters of a serial-link robot manipulator specified in terms of Denavit-Hartenberg convention? How will the representation differ in the Modified Denavit-Hartenberg convention? Explain with suitable example.
- c) Derive the basic rotation matrices.

[2+6+12=20]

3. a) Explain, with two examples, the "internal state sensors" and "external state sensors" in mechatronic applications.
- b) What are the different factors that should be considered for the selection of appropriate sensors during the mechatronic design?
- c) Write a brief note on the application of various proximity sensors in mechatronic applications.

[4+6+10=20]

4. Explain the various aspects of the computer interfacing circuit design for a mechatronic system. State the assumptions, if any.

[20]

5. a) Describe, with suitable sketches, robust position control of a serial robot manipulator.

b) Explain, the basic objective of force control of a robot manipulator.

[15+5=20]

6. Explain the basic approach of trajectory planning of industrial manipulator when it is supposed to avoid obstacles.

[20]

7. a) Explain the significance of interaction control of robot manipulators in industrial environment.

b) Write a note on the basic mechanism of impedance control of serial manipulator interacting with a compliant environment.

[5+15=20]

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

a) Transmission mechanisms in mechatronic applications.

b) Universal joint.

c) Forward and Inverse Kinematics.

d) Four-bar linkage.

e) Force sensors.

[5x4=20]