

- N.B. :** 1) 'Question No. 'One' is compulsory.
 2) Attempt any 'four' out of remaining 'six'.
 3) Figures to right indicate full marks, 'all' questions carry equal marks.
 4) Assume suitable data wherever necessary.

1. Answer the following questions;
 - A. Define the following terms : Tool Path, Tool Trajectory, DOF, Precision, Accuracy 05
 - B. Explain the properties of inverse kinematics solution. 05
 - C. Define kinematic parameters. What is soft home configuration? 05
 - D. Draw symbols of Input and Output devices and Switches used in ladder diagrams. 05

2. A. Compare Hard Automation and Soft Automation. State advantages and drawbacks of each. 10
 - B. Explain the screw transformation. Show that the inverse of a screw transformation is again a screw transformation. 10

3. A. Apply D-H algorithm for SCARA robot and construct a link-coordinate diagram. Compute the arm matrix for the SCARA Robot. 10
 - B. Define Tool-Configuration vector. Show how to obtain tool roll angle. What are the advantages/disadvantages of Numerical approach and Analytical approach to solve the Inverse kinematics problems? 10

4. A. Explain the shrink and swell operators with an example. How are they applied? List all the properties of these operators. 10
 - B. Explain the 4 point minimal PNP trajectory for pick and place of objects by using a robot manipulator 10

5. A. What is a GVD? Sketch all the GVD's resulting due to the basic interactions of the obstacles. Derive the necessary equations. 10
 - B. Explain in details block diagram of PLC(Programmable Logic controller), Hence write ladder diagram programs to Implement Logic functions AND, OR, NOT, NAND, NOR 10

6. A. Obtain Direct kinematics solution of three axis planer articulated robot arm. 10
 - B. Write specifications of PLC 05
 - C. Write Industrial Applications of PLC 05

7. Write short notes on (Any Two); 20
 - A. Perspective Transformation
 - B. Workspace Fixtures
 - C. Template Matching