

NOTE: 1. Question no. one is compulsory.

2. Solve any four questions out of the remaining six questions.

3. Assume suitable data where necessary and justify the same.

Q1. (a) Explain the process of edge detection. [05]

(b) Explain programming languages used for PLC, explain any one language in brief. [05]

(c) Explain the following terms, Tool path, Tool trajectory, DOF, TCV, TWE. [05]

(d) Write any three points why inverse kinematic solution is not unique [05]

Q2. (a) Using DH algorithm perform direct kinematic analysis of four axis ADAPT-1 SCARA robot. [10]

(b) Compute the joint variable vector $q = [q_1, q_2, q_3, q_4]^T$ for the following tool configuration vector of

SCARA. $w(q) = [692.82, 25, 527, 0, 0, -1.6487]^T$, where

$a_1 = 425\text{mm}, a_2 = 375\text{mm}, a_3 = 0, a_4 = 0$, and $d_1 = 877\text{mm}, d_2 = 0, d_3 = q_3, d_4 = 200\text{mm}$. [10]

Q3. (a) Discuss Inverse kinematic analysis of five axis Microbot α -II Articulated Robot arm. [10]

(b) Find the composite rotation matrix by rotating the tool about the fixed axis of F frame, with a yaw of $\left(\frac{\pi}{2}\right)$, followed by a pitch of $\left(\frac{-\pi}{2}\right)$ and finally a roll of $\left(\frac{\pi}{2}\right)$ radians. If $(p)^M = (0, 0, 0.6)^T$ Find $[p]^F$ [10]

Q4. (a) Explain how straight line motion can be obtained using articulated robot. [10]

(b) Differentiate between path and trajectory. Define SDF. Explain in brief how continuous motion path trajectory is generated. [10]

[TURN OVER

Q5.(a) Explain shrink and swell operators. How does swell operator help in image smoothing, explain with an example. [10]

(b) What are advantages of PLC's explain with examples, also state the specifications of PLC with Industrial application and manufacturer. [10]

Q6.(a) Compare traditional ladder diagram and PLC ladder diagram with examples.

[10]

(b) Write short note on corner point detection.

[10]

Q7. Write short notes on any two

[20]

(a) Template matching

(c) Workspace fixtures

(b) Screw transformation (d) Gross motion planning
