

N.B.:

- (1) Question No.1 is compulsory.
- (2) Attempt any four questions out of remaining six questions.
- (3) Assume suitable data wherever required.

- Q1. a) Explain the why Inverse kinematics solution is not unique for generic robots. (5)  
 b) What is the differentiate between Hard and Soft Automation (5)  
 c) How robots are classified? (5)  
 d) Why dexterous work envelope is always smaller than the total work envelope (5)
- Q2 .a) Explain and develop DH algorithm for 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) Explain Inverse kinematic analysis of four axis Robot arm. (10)  
 (b) Find the composite rotation matrix by rotating the tool about the fixed axis of F frame, with a yaw of  $(\frac{\pi}{4})$ , followed by a pitch of  $(\frac{-\pi}{4})$  and finally a roll of  $(\frac{\pi}{2})$  radians.  
 If  $(p)^M = (0, 0, 1)^T$  Find  $(p)^F$  (10)
- Q4.(a) Explain how straight line motion can be obtained using articulated robot. (10)  
 (b) Explain linear interpolation with parabolic blends. Discuss its advantages over piecewise linear interpolation (10)
- Q5.(a) Explain shrink and swell operators. How does swell operator help in image smoothening, 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) Define moments & Identify them as a measure of similarity between any 2 regions (10)
- Q7. Write short notes on any two (20)  
 (a) Template matching (c) Workspace fixtures  
 (b) Perspective transformation (d) Gross motion planning

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