

(3 Hours)

[Total Marks : 100]

N.B.:

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

- Q.1. a) Define hard/ fixed, soft/ flexible automation and hence the relative cost effectiveness of different types of automation with a neat sketch. [5]  
 b) How are robots classified? [5]  
 c) With neat sketch define the Joint and Link parameters [5]  
 d) Explain how parabolic blends eliminate infinite acceleration points on the trajectory of robots. [5]
- Q2. a) Find the joint position of the tool tip of the Adept One robot when the joint variables are  $q = [\pi/4, -\pi/3, 120, \pi/2]^T$   
 Where  $d = [877, 0.0, d3, 200]^T$   $a = [425, 375, 0.0, 0.0]^T$  [10]  
 b) Explain the basic steps involved in bounded deviation algorithm for straight line motion. [10]
- Q.2. a) Explain the conditions for the existence of the Inverse Kinematics solutions and how are they simplified for the model robot with a spherical wrist. [5]  
 b) How do you find the inverse kinematics solutions based on the numerical and analytical approaches? [5]  
 c) Explain Trajectory planning with examples. [10]
- Q. 3. a) What are the considerations for applying D+1 algorithm?  
 Explain the direct kinematic solution for a three link planar Robot. [10]  
 b) Explain noise in images. How are these classified? [10]
- Q 4 a) Explain shrink and swell operators with examples. How are these applied? [10]  
 b) Name and explain with diagrams all the lower kinematic pairs.  
 Indicate those that cannot be used in an actuated Robot joint and the reason for it. [10]
- Q.5. a) What are the important edge detection methods for polygonal objects?  
 Explain one of the edge detection technique? [10]  
 b) What are area descriptors? What are its advantages over line descriptors?  
 Explain the different moments to characterizing shape? [10]
- Q6 a) Explain the basic steps involved in bounded deviation algorithm for straight line motion. [10]  
 b) Draw & Explain the Ladder Diagram for controlling lubricating oil being dispensed from a tank [10]
- Q 7. Write notes on the following [20]  
 (a) Robot specification (b) Template matching in Robot vision  
 (d) Task planner simulation (e) Link co-ordination arm equation