

(3 Hours)

NB.

- (1) Question No.1 is compulsory.
- (2) Attempt any three questions from remaining.
- (3) All questions carry equal marks.
- (4) Assume suitable data wherever necessary.

Q.1 Answer any **four** of the following:

- a) Define Kinematic Parameters. (5)
- b) Explain the conditions for the existence of Inverse Kinematics problem. (5)
- c) Explain repeatability, precision and accuracy. (5)
- d) Discuss briefly on wave front planner. (5)
- e) Differentiate between path and trajectory. (5)

Q.2 a) Obtain the inverse kinematic analysis of a 3 axis planar articulated robot (10)

- b) Give the steps involved in constructing homogeneous transformation matrix which maps frame k coordinates into frame k-1 coordinates and obtain the link coordinate transformation matrix T mapping coordinate frame k to coordinate frame k-1. (10)

Q.3 a) With a suitable example explain differential motions of a frame with respect to (10)

- i. Differential Translation
- ii. Differential Rotation
- iii. Differential Transformations

- b) What is Visibility graph? Explain an algorithm to construct visibility graph. (10)

Q.4 a) Explain robot motion planning using Bug 1 and Bug 2 algorithm. (10)

- b) What is a GVD? Sketch all the GVD's resulting due to the basic interactions of the obstacle .Derive the necessary equations. (10)

Q.5 a) Explain Joint Space Trajectory Planning using third order polynomial. (10)

- b) Explain iterative processing operators with examples. (10)

Q.6 Write short notes on any **four** of the following: (20)

- a) Jacobian.
- b) Tool Configuration Vector
- c) Robot Classifications.
- d) Lagrangian Mechanics.
- e) Homogeneous Coordinate Transformations.