

(3 Hours)

[Total Marks : 80

N.B. : (1) Question No.1 is **compulsory**.(2) Attempt **any three** from remaining **five** questions.(3) Assume any **data** if **needed**, **justify** it.

1. (a) Explain repeatability, precision and accuracy. 20
 (b) Distinguish between reach and stroke.
 (c) Compare joint space work envelope, dexterous work envelope and total work envelope.
 (d) Explain briefly line descriptors and area descriptors.
2. (a) What are the different drive technologies used in robotics. 07
 (b) Let F and M be two initially coincident mutually orthogonal co-ordinate frames, 07
 where F is fixed and M is mobile co-ordinate frames. The mobile co-ordinate
 frame is rotated about f_2 by $\frac{\pi}{6}$ and translated by 3 units along f_3 and followed
 by rotation about m_1 by $\frac{\pi}{4}$ radians in that order. If the co-ordinate of the
 point P w.r.t. M are given by $[P]^M = [0.6, 0.5, 1.4]^T$, find the co-ordinate of the
 point P w.r.t. F after the transformation.
 (c) Explain screw transformation matrix. 06
3. (a) Explain D-H algorithm and draw the link co-ordinate diagram for 4-axis SCARA 10
 robot.
 (b) Explain Tool Configuration Vector (TCV) and arm matrix. 06
 (c) Distinguish between direct kinematics and inverse kinematics. 04
4. (a) Explain different work space fixtures used in robotics. 06
 (b) Explain briefly the structured illumination techniques used in robotics. 07
 (c) Explain grasp planning problem. 07
5. (a) Write short notes on perspective transformation. 06
 (b) Explain Bounded Deviation Algorithm used for approximating straight line 06
 path in TCS.

- (c) Consider the problem of performing a piecewise - linear interpolation with a parabolic blend on the following three point trajectory. Here $T_1 = 1$, $T_2 = 1$, $\Delta T = 0.5$ **08**

$$W^0 = [10, 0, 10, 0, 0, -0.368]^T$$

$$W^1 = [10, 10, 10, 0, 0, -1]^T$$

$$W^2 = [0, 10, 10, 0, 0, -0.368]^T$$

Find the required acceleration 'a' during the blend.

6. (a) Explain the application of robotics in surgery. **07**
(b) Explain briefly the clinical application of robotics. **07**
(c) What are the types of robot programming languages? **06**
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