23/11/

Q.P. Code :11618

[Time: 3 Hours] [Marks:80]

Please check whether you have got the right question paper.

N.B: 1. **Question No.1 is Compulsory.**
2. **Answer any three from the remaining questions.**

Q.1 (a) Define Robotics and Explain its Classification. 05

(b) How do you characterize robot specifications? 05

(c) Describe robot workspace. 05

(d) Explain various robot applications. 05

Q2 (a) Explain Robotic Components? What is forward and inverse Kinematics. 10

(b) A frame F has been moved 15 units along the Y axis and 15 units along the z axis of the reference frame. 10

Find the new location of the frame.
$$\begin{bmatrix} 0.527 & -0.574 & 0.628 & 5 \\ 0.369 & 0.819 & 0.439 & 3 \\ -0.766 & 0 & 0.643 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Q3 (a) A point P $(8, 4, 1)^T$ is attached to a frame and is subjected to the following transformations. Find the coordinates of the point relative to the reference frame at the conclusion of transformations. 10
1. Rotation of 90 degree about the Z axis.
2. Followed by a rotation of 90 degree about the Y axis.
3. Followed by a translation of [2, -1, 2].

(b) The Jacobin of a robot at a particular time is given. Calculate the linear and angular differential motions of the robot's hand frame for the given joint differential motions. 10

$$J = \begin{bmatrix} 2 & 0 & 0 & 0 & 1 & 0 \\ -1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \quad D\theta = \begin{bmatrix} 0 \\ 0.1 \\ -0.1 \\ 0 \\ 0 \\ 0.2 \end{bmatrix}$$

Q4 (a) An object, attached to a frame B, is subjected to the forces and moments given relative to the reference frame. Find the equivalent forces and moments in frame B. 10

$F^T=[0,10(lb),0,0,20(lb.in)]$ and $B = \begin{bmatrix} 0 & 1 & 0 & 3 \\ 0 & 0 & 1 & 5 \\ 1 & 0 & 0 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

1

Turn over

(b) A 2-DOF planar robot is to follow a straight line between the start (3, 10) and the end (8, 14) points of the motion segment. Find the joint variables for the robot if the path is divided into 10 sections. Each link is 9 inches long.   10

Q5 (a) Explain Concept of motion planning in robotics in brief?   10

(b) Explain bug1, bug2 and tangent bug algorithms and compare in brief.   10

Q6   Write short notes on any two: 20
   a) Generalized Voronoi Diagrams.
   b) DH Algorithm.
   c) Silhouette methods.