TAE 2005 ROBOT DYNAMICS & CONTROL

Answer any two questions from each module

Module1

1. a) Explain the term robotics and different elements of a robot in detail. (5)

b) Explain the different types of sensors used in robots. (5)

2. Explain briefly the different actuating mechanisms used in robotics . (10)

3. Explain the representation of a rigid body in space and derive the transformation matrices for a)pure translation b)pure rotation c)combined transformation (10)

Module 2

4. Explain forward and inverse kinematics also Derive the forward and inverse kinematics for a 2-joint elbow manipulator. (10)

5. a) a point p [7 3 2] is attached to a frame (n,o,a) & is subjected to the following transformations. Find the coordinates of the point p relative to the reference frame (5)

1) Rotation of 90 degrees about z- axis.

2) Followed by a rotation of 90 degrees about y-axis.

3) Followed by a translation of [4 -3 7].

b) Explain the Denavit-Hartenberg representation of robot kinematics (5)

6. a) Derive and Explain Jacobian matrix for differential motions. (5)

b) 1. Calculate the linear & angular differential motions of the robot's hand for the given joint differential motions (3)

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

2. Find the angle of rotation and orientation about the axis for given matrices. (2)

$$\begin{bmatrix} 0.5 & 0 & 0.866 \\ 0 & 1 & 0 \\ -0.866 & 0 & 0.5 \end{bmatrix} \qquad \begin{bmatrix} 0.707 & -0.707 & 0 \\ 0.707 & 0.707 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Module 3

7. Explain joint space and Cartesian space trajectory planning in detail. (10)

8. Give the feedback control systems used to control manipulators also Derive the equation for PID control of a single link manipulator. (10)

9. Explain wheeled motor robots and obtain kinematics for single wheeled motor robots with (10)

required diagrams & equations.