# NPTEL Course

## Robotics and Control: Theory and Practice

## Assignment 1

1. Degree of freedom for a rigid body in space is:
   a. Three
   b. One
   c. Six
   d. Four

2. Which of the following quantities not taken into account for Kinematics of a rigid body?
   a. Position
   b. Velocity
   c. Acceleration
   d. Torque

3. Two vectors are orthonormal if:
   a. Their cross product is zero.
   b. Their dot product is zero.
   c. Their cross product is one.
   d. Their dot product is one.

4. Select True or False:
   Statement: While performing successive translations and rotation, we can change the sequence of Homogeneous transformations.
   a. True
   b. False

5. Consider following differential coordinate transformation Matrix represented by Vectors n, o, a and p. Which of the following is not true?

$$T = \begin{bmatrix} n_x & o_x & a_x & p_x \\ n_y & o_y & a_y & p_y \\ n_z & o_z & a_z & p_z \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

   a. $n \times o = a$
   b. $a \times n = o$
   c. $o \times a = n$
   d. $a \times o = n$

6. In case of Inverse Kinematics:
   a. Base frame position and orientation known; find end-effector position and orientation
   b. Joint Variables values known; find end-effector position and orientation.
   c. End -Effector position and orientation known; find values of joint variables.

    d. End-Effector position and orientation known; find base frame position and orientation.

7. A triangle with coordinates A(0,0), B(4,0) and C(2,2) rotated about z-axis by $90^0$ anticlockwise, now triangle will be described by:
    a. A(0,0),B(2,-2),C(0,4)
    b. A(0,0),B(-2,2),C(0,4)
    c. A(0,0),B(0,4),C(-2,2)
    d. A(0,0),B(0,-4),C(2,-2)

8. Let F be the coordinate frame with $\vec{i}$ ,$\vec{j}$ ,$\vec{k}$ as the coordinate axes and M be the coordinate frame with $\vec{k}$ ,$\vec{j}$ ,$-\vec{i}$ as its coordinate axes. Suppose the coordinates of point p with respect to frame M are $^M[p] = [2\ 1\ 3]^T$. What are the coordinates of p with respect to fixed frame F.
    a. $[-3\ 1\ 2]^T$
    b. $[3\ 1\ 2]^T$
    c. $[2\ 1\ 3]^T$
    d. $[-2\ 1\ 3]^T$

9. If the work space of a 3 dof manipulator is a cylinder, then its configuration is given by:
    a. PPP
    b. RRP
    c. RPP
    d. RRR

10. If the matrix for a general rotation about a unit vector angle θ is given by

$$\begin{bmatrix} \frac{1}{\sqrt{3}} & -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{6}} \\ \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{6}} \\ \frac{1}{\sqrt{3}} & 0 & -\frac{2}{\sqrt{6}} \end{bmatrix}$$

Then approximate value of 1+2cosθ will be:
    a. 0.467
    b. 0.934
    c. 0
    d. 0.783