B.E. (IT) (Sem -VIII) (CBSGS)

**Paper / Subject Code: 53104 / 4) Robotics**

Date-20/11/18

**( 3 Hours)** **[Total Marks: 80]**

**N.B. :** 1) Question **No. 1 is Compulsory**.

2) Attempt **any THREE** from remaining questions.

3) Assume suitable data if necessary.

Q.1 a) Explain Robot Workspace and Robot applications in detail. 10

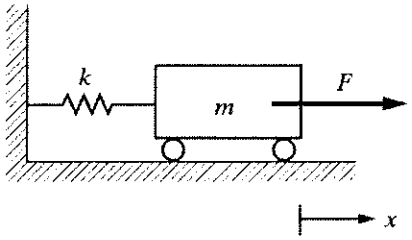
b) Describe End effectors and its types 10

Q.2 a) ) Find the new location of point $P(1,2,3)^T$ relative to the reference frame after a rotation of $30^0$ about z -axis followed by a rotation of $60^0$ about the y - axis. 10

b) ) A frame B has translated a differential amount of Trans **(0.01, 0.05, 0.03)** units. Find its new location and orientation. 10

$$B = \begin{bmatrix} 0.707 & 0 & -0.707 & 5 \\ 0 & 1 & 0 & 4 \\ 0.707 & 0 & 0.707 & 9 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Q.3 a) Derive the force-acceleration relationship for the 1-DOF system shown in figure using both the Lagrangian mechanics as well as the Newtonian mechanics. Assume the wheels have negligible inertia. 10



b) Suppose that a robot is made up of Cartesian and RPY combination of joints. 10

Find the necessary RPY angles to achieve the following:

$$T = \begin{bmatrix} 0.527 & -0.574 & 0.628 & 4 \\ 0.369 & 0.819 & 0.439 & 6 \\ -0.766 & 0 & 0.643 & 9 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Q.4 a) What is Jacobian? Describe Jcobian in terms of D-H matrix. 10

b) A point P in space is defined as ${}^{B}P = (2, 3, 5)^{T}$ relative to the frame B 10

which is attached to the origin of the reference frame A and is parallel to it.

Apply the following transformations to frame B and find ${}^{A}P$.

1) Rotate $90^{0}$ about x - axis, then

2) Rotate $90^{0}$ about a - axis, then

3) Translate 3 units about y-axis, 6 units about z -axis and 5 units about x - axis.

Q.5 a) Explain with the block diagram, different parameters involved in trajectory planning 10

problem. Explain different steps in Trajectory planning.

b) Differentiate among BUG1 , BUG 2 and Tangent Bug algorithm. 10

Q.6 Write short notes on any TWO 20

1) Visibility Graphs

2) Canny's Roadmap Algorithm

3) Trapezoidal Decomposition with example

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