Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent institution of MAHE, Manipal)

IV SEMESTER B.TECH. (OPEN ELECTIVE)

END SEMESTER EXAMINATIONS, JUNE 2018

SUBJECT: INTRODUCTION TO ROBOTICS [MTE 3283]

June, 2018

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably justified and assumed

1A A velocity vector is given by: **03**

$$A_V = \begin{bmatrix} 10.0 \\ 20.0 \\ 30.0 \end{bmatrix}$$

Given

$$^{A}_{B}T = \begin{bmatrix} 0.866 & -0.500 & 0.00 & 11 \\ 0.500 & 0.866 & 0.00 & -3 \\ 0.00 & 0.00 & 1.00 & 9 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Calculate B_V.

1B A vector A_P is rotated about$\hat{Y}_A$by 30 degrees and is subsequently rotated About $\hat{X}_A$by 45 degrees. Find the rotation matrix that accomplishes these rotations in the given order. **03**

1C A fifth order polynomial is to be used to control the motions of the joints of a robot . Find the coefficients of the fifth order polynomial that allow a joint to go from 0^o to 50^o in 4 seconds, while the initial and final velocities are zero the initial acceleration and deceleration are 7 and 8 degrees/sec^2 respectively. **04**

2A. Write down the general form of EoM(Equation of Motion) for a multi-link manipulator. Illustrate the method for finding out the individual components in the equation. **05**

2B. Find the inertia tensor for the rectangular body of uniform density ρ with respect to the coordinate system shown in Figure. Q2B(l=1;w=.5,h=2) **05**

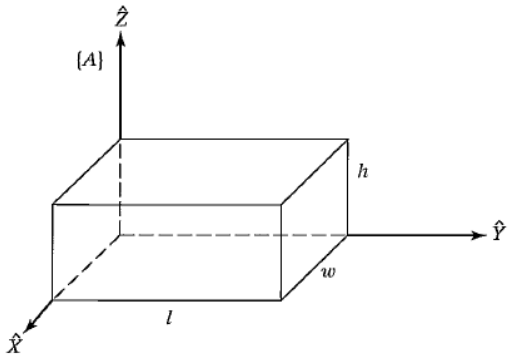

Figure .Q2B

3A. Write down the forward kinematic equation for a three link planar manipulator and derive its complete Jacobian matrix. **05**

3B. Illustrate an inverse kinematics scheme (flow-chart/algorithm/pseudo code) employing Jacobian of the manipulator. **05**

4A. Elaborate the concept of Model Based Control using flowchart. **03**

4B. Write short notes on: **04**

i. Forward Kinematics using D-H Table
ii. Position Regulation System

4C. Determine the motion of the system in Figure.Q4C. if parameter values are in m= 1, b = 4, and k = 3 and the block (initially at rest) is released from the position x = 5. **03**

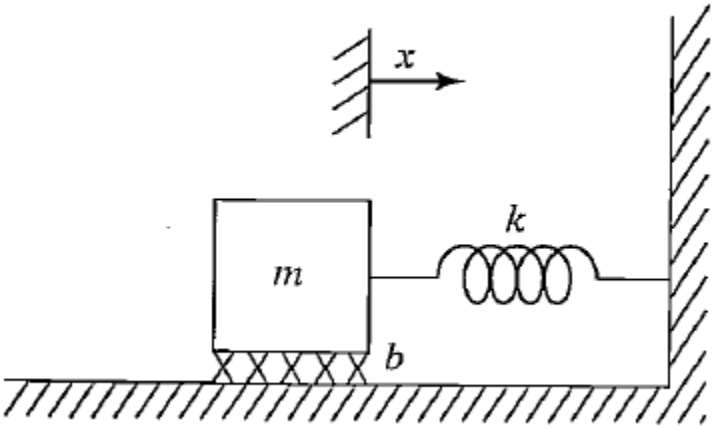

Figure. Q4C.

5A. Define pictorially the four parameters in a D-H Table. Calculate the D-H Table for the PUMA 560 as shown in Figure Q.5A and derive the forward kinematics for the same.(Assume various parameters). **07**

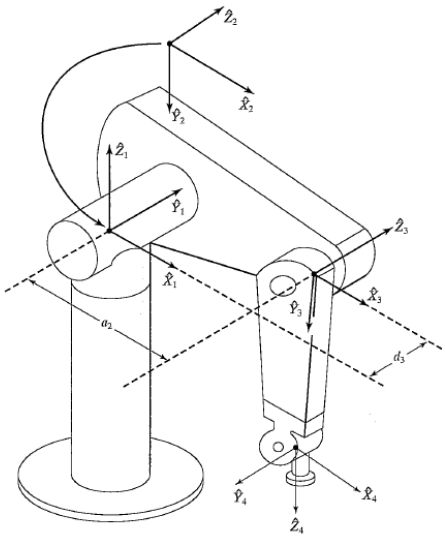

Figure Q.5A

5B. Sketch the workspace for three link planar manipulator. **03**