ROBOTICS -1 [MTE 2154] – Dec 2022

EXAM QUESTIONS MARKS : 50

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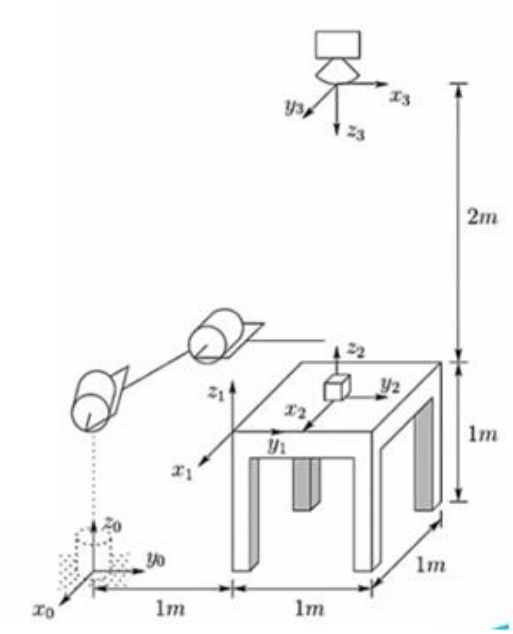
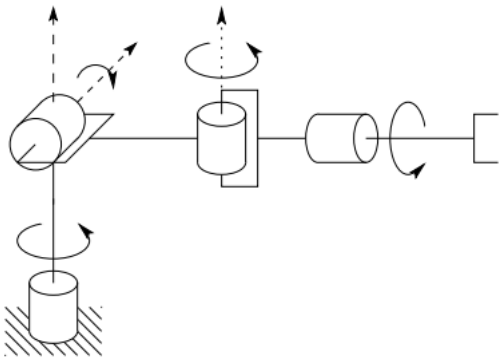
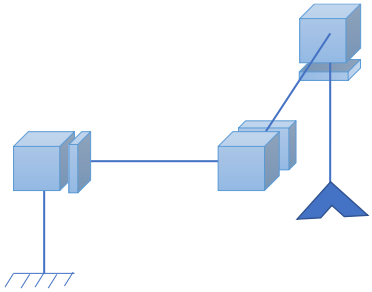
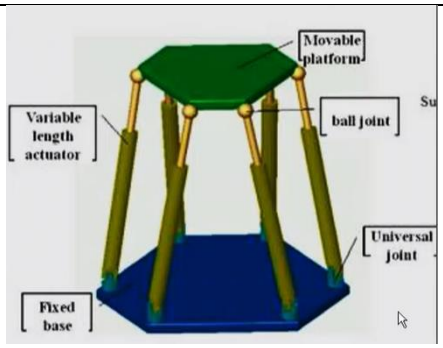
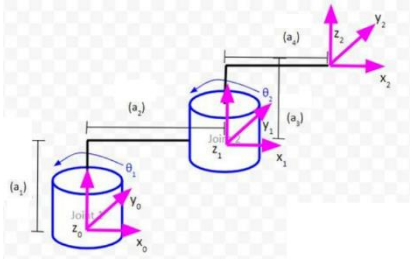
SL.NO.	QUESTIONS	MARKS	CO	LO	PO	BL
1A	The coordinates of point P_{LMN} = (9,5,3)T, in the body coordinate frame OLMN are rotated through ά=90° about OX-axis. Articulate the coordinates of the vector P **xyz** with respect to base reference coordinate frame.	2M	CO2	1,2,3	1,2	2
1B	Depict the required work volume of the given robotic arm configuration. a) PRR b) PLP c)RRR	3M	CO1	1,5,18	1,2,5,6,12	1
1C	Fig. 1. below shows a robot whose base is 1m away from the base of the table. The height of the table is 1m and its surface is a square. Frame 1 is fixed on a corner of the table. A 20cm cube is located on the middle of the table, and it has frame2, attached to its center. A camera is located 2m above the table, just over the cube and it has frame 3 attached to it. a) Compute the homogeneous transformations (HT) that relate each of these frames with the base system 0. b) Compute homogeneous transformations (HT) that relates the cube frame 2 with respect to the camera frame3.  Fig.1. Robotic Arm 1	5M	CO2	1,2,3	1,2	3

2A	Estimate the DH-Parameter Table for the below given manipulator in Fig. 2. by applying DH rules and also determine the overall system Homogeneous Transformation Matrix for it.  Fig. 2. Robotic Arm 2	4M	CO3	1,2,3,12	1,2,3,10	5
2B	Apply Jacobian table for the below given robotic arm in Fig. 3., through the velocity propagation method, find out its linear and angular velocity components in all the three axis.  Fig. 3. Robotic Arm 3	4M	CO4	1,2,3,5	1,2,3,5	3
2C	Recall the three types of trajectory planning with equations.	2M	CO5	1,4,18	1,2,12	1
3A	Determine the forward and inverse kinematics of Robotic arm having PRP joint configuration. Also validate the same, when displacement of it along x-axis is 5units, twist and displacement about z-axis are 45 degrees and 10 units respectively.	4M	CO3	1,2,3,12	1,2,3,10	4,5
3B	Demonstrate that $i^2 = j^2 = k^2 = ijk = -1$, through Quaternion Matrix Multiplication approach.	4M	CO2	1,2,3	1,2	2,3
3C	For the given Stewart platform in Fig. 4, implement the Grubler's equation to compute the DoF.	2M	CO1	1,5,18	1,2,5,6,12	2,3

	 Fig. 4. Stewart platform					
4A	One of the axis of robot requires a linear displacement of 30cm over a prismatic joint, with its kinematic parameter being, velocity 15cm/s and acceleration 20cm/s^2. Determine the time required, for its displacement to be largely linear with parabolic blends at its start and end. Also plot the trajectories of velocity, displacement and acceleration by considering discrete intervals during the task. (Assume the time intervals in terms of 0.25)	4M	CO5	1,4,18	1,2,12	4,5
4B	Apply the graphical method approach of inverse kinematics for the below given robotic arm in Fig. 5, to find out its transformation parameters.  Fig. 5. Robotic Arm 4	4M	CO3	1,2,3,12	1,2,3,10	3
4C	List any 4 differences between internal and external holding grippers.	2M	CO1	1,5,18	1,2,5,6,12	1
5A	Derive the kinetic and potential energy for a single link of 2R planar robotic arm.	3M	CO4	1,2,3,5	1,2,3,5	1,2,3
5B	As a continuation of Q. derive the Legrangian equation for 2R planar robotic arm.	5M	CO4	1,2,3,5	1,2,3,5	1,2,3
5C	For the robotic arm diagram shown in Fig. 6., below, Illustrate Frames as per the standard rules discussed in the class.	2M	CO1	1,5,18	1,2,5,6,12	2,3

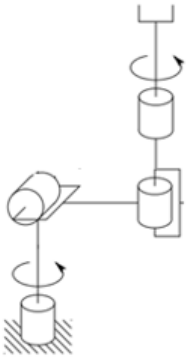


Fig. 6. Robotic Arm 5