U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

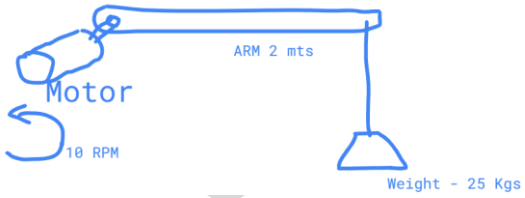
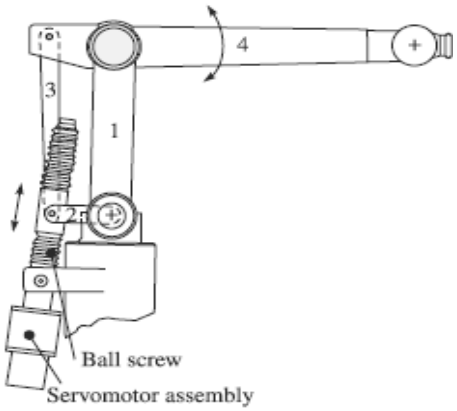
Autonomous Institute Affiliated to VTU

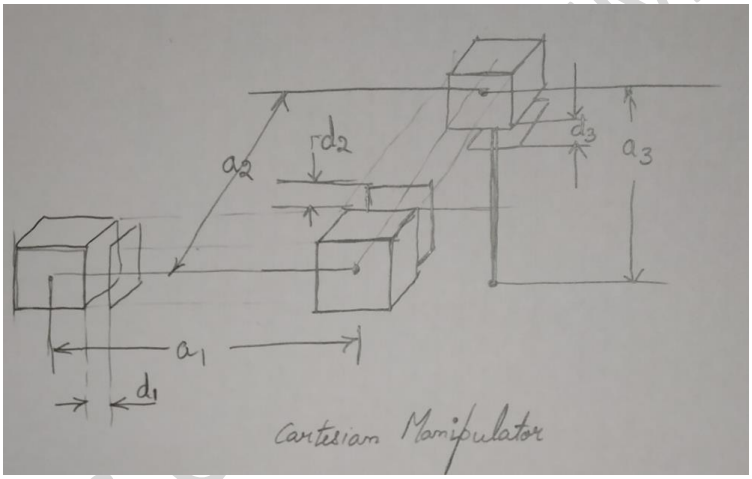
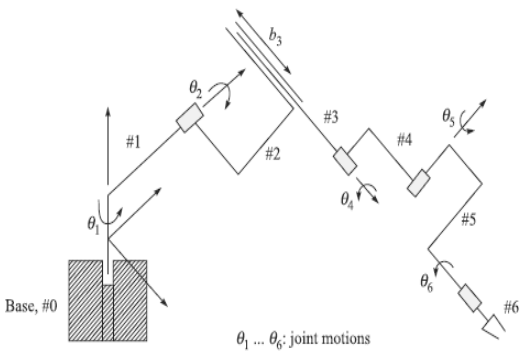
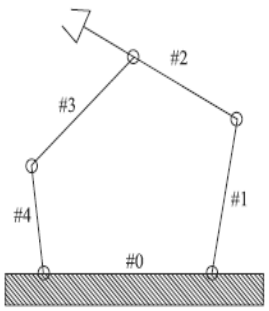
January / February 2025 Semester End Main Examinations

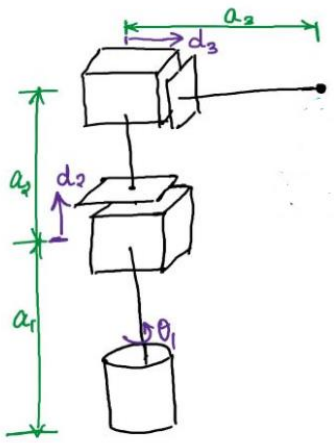
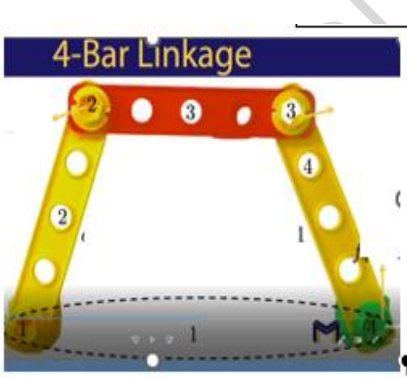
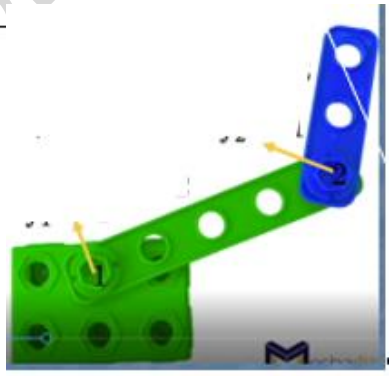
Programme: B.E. **Semester: VI**
Branch: Institutional Elective **Duration: 3 hrs.**
Course Code: 22EC6OE1IR **Max Marks: 100**
Course: Introduction To Robotics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT – I	CO	PO	Marks
1	a)	Analyze the considerations for selection of a motor for a Robotic System	CO 2	PO2	8
	b)	Classify the types of grippers applied in industrial robots.	CO 1	PO1	8
	c)	What kilowatt or horsepower is required in a motor used to drive a 2-meter robot arm lifting a 25 kg mass at 10 rpm (Figure 1)?  Fig 1.	CO 1	PO1	4
		OR			
2	a)	Analyze the working principle of DC Servo motor.	CO 2	PO2	8
	b)	With the help of a neat diagram, discuss the various subsystems of an industrial Robot.	CO 1	PO1	8
	c)	A screw mechanism for the transmission of motion from the motor to link 4 via link 3 is shown in Figure 2. If the nut on Link 3 has to be translated by 50 mm while moving on the screw of 5 mm pitch, the screw should be turned by 'θ' times. Find the value of ' θ '.  Fig 2.	CO 1	PO1	4

			UNIT – II			
	3	a)	Highlight the important characteristics to be considered for selecting a sensor for different applications.	***CO*** 1	***PO1***	**10**
		b)	Analyze the Robot Vision ecosystem, providing aspects of front-end and backend processing.	***CO*** 2	***PO2***	**10**
			OR			
	4	a)	Discuss the working principle behind the application of incremental and absolute optical encoders.	***CO*** 1	***PO1***	**10**
		b)	Analyze the working of a Non-Contact Capacitive sensor with a neat diagram and list its applications	***CO*** 2	***PO2***	**10**
			UNIT - III			
	5	a)	A cartesian manipulator is shown in Figure. 3. Perform the following for the same: (i)Assign link-frames (ii) Obtain DH-Parameter table (iii) obtain HTMs (i.e., H01, H12 & H23) and (iv) Final forward transformation matrix. [Use a kinematic diagram and label all frames].  Fig 3	***CO*** 3	***PO3***	**10**
		b)	Provide the reasoning behind the basis for calculating the DOF for a Robot Architecture using Grubler's Formula. Calculate the DOF for the Manipulators shown in Figure 4 and Figure 5 using Grubler's formula.  Fig 4  Fig 5	***CO*** 2	***PO2***	**10**

			OR			
	6	a)	A cylindrical manipulator is shown in **Fig. 6**. Perform the following for the same: (i) Assign link-frames (ii) Obtain DH-Parameter table (iii) obtain HTMs (i.e., $H^0{}_1$, $H^1{}_2$ & $H^2{}_3$) and (iv) Final forward transformation matrix. [Use a kinematic diagram and label all frames].  *Figure . : Cylindrical (R-P-P) Manipulator* Fig 6	***CO*** 3	***PO3***	**10**
		b)	Provide the reasoning behind the basis for calculating the DOF for a Robot Architecture using Grubler's Formula? Calculate the DOF for the Manipulators shown in Fig 7 and Fig 8 using Grubler's formula.  Fig 7  Fig 8	***CO*** 2	***PO2***	**10**
			UNIT – IV			
	7	a)	Analyze the Quadcopter Controls for Up/Down, Roll, Pitch and Yaw and flight modes with a neat diagram (Assume a X-configuration)	***CO*** 2	***PO2***	**10**
		b)	Analyze the Inertial Navigation System in the context of "Sensor dedicated to a Flight Controller". Use neat diagrams.	***CO*** 2	***PO2***	**10**
			OR			

	8	a)	Analyze the various types of UAVs under the fixed wing and Rotary Wing UAVs and their suitability for various applications.	***CO*** 2	***PO2***	**10**
		b)	Identify and analyze the various launching and recovery systems for an UAV	***CO*** 2	***PO2***	**10**
			UNIT – V			
	9	a)	Write short notes on ROS (a) Messages (b) Services (c) Nodes and Nodelets (d) Topics (e) Bags	--	--	**10**
		b)	Analyze how the URDF (expand it) supports 3D modeling and simulation in ROS.	***CO*** 2	***PO2***	**10**
			OR			
	10	a)	Explain briefly the important Debugging Tools available in ROS	--	--	**10**
		b)	Discuss the ROS Filesystem level with a neat Diagram, analyzing the salient features of the various elements	***CO*** 2	***PO2***	**10**

****