U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**

Branch: Institutional Elective **Duration: 3 hrs.**

Course Code: 23EC6OE1IR / 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)	How are the thumb rules applied on the decisions of robot usage? "Hardware implementations of a robotic system involves various subsystems". Highlight the significance and interactions of the subsystems involved in the same.	*1*	*1*	**10**
	b)	Analyze the various fundamental Robot Arms based on the coordinate system classification.	*2*	*2*	**10**
		OR			
2	a)	Suggest the kind of control method suitable for each application below and describe the control method: (a) Pneumatic actuators for opening/closing motions of jaws in gripper of a robot (b) Spot welding job performed for a car assembly	*1*	*1*	**10**
	b)	Analyze the types of Motion Control for industrial robotic arms. Indicate the use of suitable motion control strategy, taking suitable examples.	*2*	*2*	**10**
		UNIT - II			
3	a)	Discuss the Robot Vision ecosystem, providing aspects of front-end and backend processing	*1*	*1*	**10**
	b)	The displacement of one of the prismatic joints in a Cartesian Robot used for a precision machining application is to be measured. Analyze the requirement to determine which sensor to use? Briefly describe the mechanism and operation of this sensor. Suggest a suitable variant which supports a rotary movement of +/-40 degree instead of the prismatic joint.	*2*	*2*	**10**
		OR			

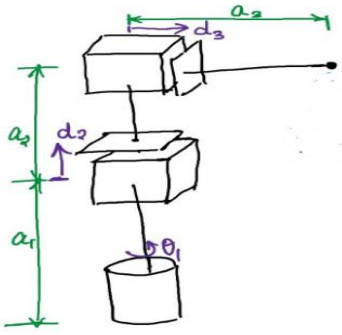
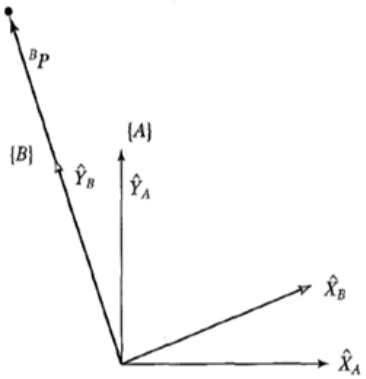
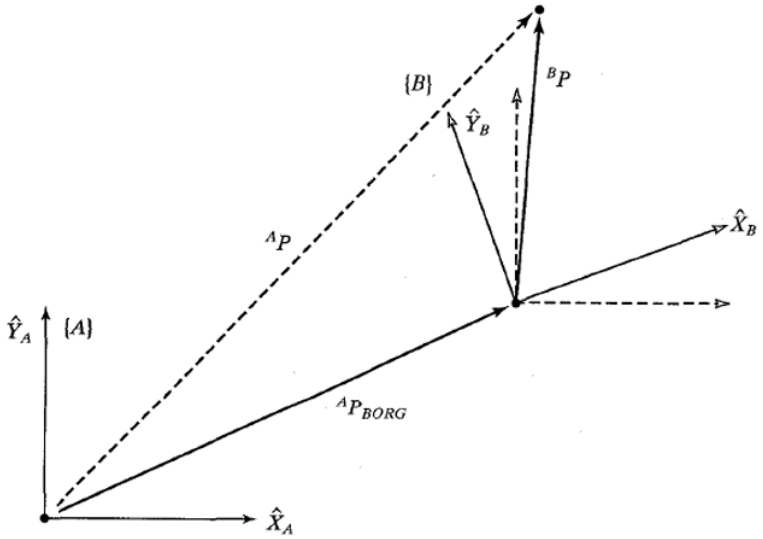
	4	a)	Discuss the working of a Non-Contact Inductive Proximity sensor with a neat diagram and with its applications	*1*	*1*	**10**
		b)	Analyze the working of a Hall effect sensor and its use in measuring velocity.	*2*	*2*	**10**
			UNIT - III			
	5	a)	Discuss Degree of Freedom of a Mechanical System. Represent i) A planar five-bar mechanism ii) A double parallelogram mechanism Determine the Degree of Freedom for the same.	*1*	*1*	**10**
		b)	Analyse the inverse kinematics problem? Illustrate why the Inverse Kinematics is complex.	*2*	*2*	**10**
			OR			
	6	a)	A cylindrical manipulator is shown in **Fig-1**. Perform the following for the same after analysis: (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].  *Figure . : Cylindrical (R-P-P) Manipulator* **Fig-1**	*2*	*2*	**10**
		b)	Define a Mechanism. **Fig-2 s**hows a frame {B} that is rotated by 30 degrees about the $\hat{Z}$ Axis. $\hat{Z}$ axis is pointing out of the page. If a point is given by [0 2 2] in the frame {B}, find its coordinates in frame {A}.  **Fig 2**	*1*	*1*	**10**

			Fig-3 shows a frame {B} which is rotated relative to frame {A}. about $\hat{Z}$ by 30 degrees, translated 10 units in $\hat{X}_A$ and translated 5 units in $\hat{Y}_A$. Find ^{A}P, where $^{B}P = [3.0 \quad 7.0 \quad 0.0]^{T}$.  **Fig-3**			
			UNIT - IV			
	7	a)	Analyze the Quadcopter Controls for Roll, Pitch, Yaw, and flight modes with a neat diagram.	*2*	*2*	**10**
		b)	Identify and discuss the various launching and recovery systems for an UAV.	*1*	*1*	**10**
			OR			
	8	a)	Analyze the Inertial Navigation System in the context of "sensor dedicated to a Flight Controller". Use a neat diagram.	*2*	*2*	**10**
		b)	Briefly Discuss the various types of UAVs under the fixed wing and Rotary Wing UAVs.	*1*	*1*	**10**
			UNIT - V			
	9	a)	Analyze how the URDF supports 3D modeling and simulation in ROS.	*2*	*2*	**10**
		b)	Elaborate the three broad categories of Architecture/Conceptual design of ROS.	*1*	*1*	**10**
			OR			
	10	a)	Analyze the ROS Computation Graph Level and its versatility with a neat diagram.	*2*	*2*	**10**
		b)	Discuss the roles of ROS Master and ROS Parameter Server.	*1*	*1*	**10**

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