Total number of printed pages: 02 **Programme(UG)/8th/UCSE814**

2025

Robotics and Computer Vision

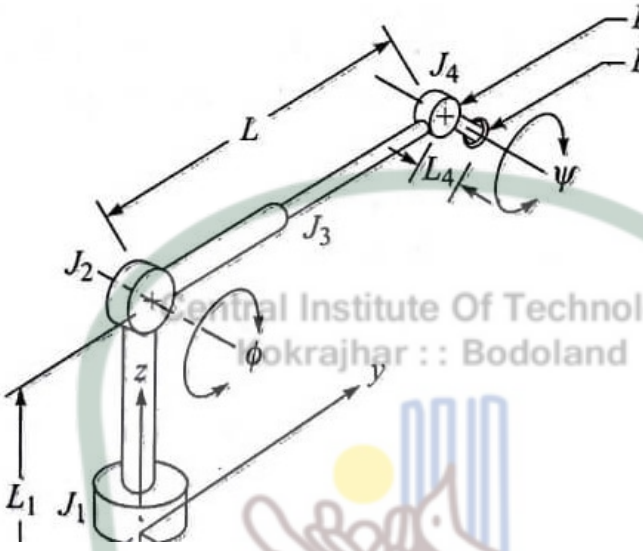
Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	**a)**	Mention the features of Traditional Industrial Robots.	6
	b)	Which key capabilities are necessary to traditional programming techniques for Industrial robots in intelligent environments?	4
	c)	Mention the examples of the Robots for Intelligent Environments.	4
	d)	How to do the modeling of the robot mechanism?	6
2.	**a)**	What do you mean by the odometry or dead reckoning in the mobile robot?	3
	b)	What do you mean by sensor-driven robot control? How to measure the robot internal configuration?	6
	c)	What types of sensor noise and uncertainty occurred for the Robot systems in intelligent environments?	3
	d)	What are an end effector and its types?	4
	e)	Explain the Metric and Topological properties of digital images.	4
3.	**a)**	Explain the coordinate transformation and also the property of dot product.	4
	b)	Write down the matrix of 'Rotation about x-axis with 'θ' with a diagram and also express in the form of equations.	5
	c)	A point $\mathbf{a_{uvw}}$ **= (6,4,2)** is attached to a rotating frame, the frame rotates 90 degree about the OZ axis of the reference frame. Find the coordinates of the point ($\mathbf{a_{xyz}}$) relative to the reference frame after the rotation.	4
	d)	What is preventive maintenance? What will happen if the MTTR will be more than the MTBF?	4
	e)	Describe the two possible positioning errors for peg-in-hole insertion task with diagrams.	3
4.	**a)**	Explain three levels of safety sensor systems in robotics.	5
	b)	Explain three Robot cell Layouts with their diagrams.	6

	c)	Find the forward kinematics of the 4-DOF arm in three dimension Space in terms of x, y, z, x_4, y_4, & z_4. At Joint1 (Type T): base rotation, θ At Joint2 (Type R): elevation angle, ϕ At Joint3 (Type L): Extension **L**, represents a combination of links 2 and 3 At Joint4 (Type R): angle makes with x-y plane called pitch angle ψ 	9
5.	Write short notes on the following (***any four***):		4x5=20
	a)	Different lighting function in Machine Vision System	
	b)	Sensor fusion	
	c)	Attributes of sensor	
	d)	Affine transformations	
	e)	Diagram of robot system with various components	
6.	Differentiate between the following (***any four***):		4x5=20
	a)	Polar Coordinate Body-and-Arm Assembly and Cylindrical Body-and-Arm Assembly	
	b)	2-DOF and 3-DOF	
	c)	Euclidean and Similarity Transforms	
	d)	Manual leadthrough and Powered leadthrough	
	e)	WAIT and SIGNAL commands with instructions	