Total number of printed pages: 2 **Programme(D/UG/PG)/Semester/UIE814**

2025

ROBOTICS

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1.	a)	What is a robot? What are the types of robots? Name a few typical applications of industrial robots.	2+2+3
	b)	What are the different subsystems of a robotic system?	3
	c)	What are the full forms of PUMA and SCARA? What type of basic arms do the PUMA and SCARA robots have?	2+2
	d)	What are the Laws of Robotics? What are the safety issues in robot usage?	3+3
2.	a)	What is an actuator? What are the different actuators used to build a robot?	2+3
	b)	List the advantages and disadvantages of electric motors?	5
	c)	Define forward kinematics and homogeneous transformation matrix.	4
	d)	If the two links of a two-link planar manipulator have equal lengths, find out the expression for the homogeneous transformation matrix.	6
3.	a)	Derive the expression of Jacobian matrix to convert the linear velocity to angular velocity of a three-link articulated robot.	6
	b)	Calculate the Jacobian of a two-link planar arm when $\Theta_1 = 45^o$ and $\Theta_2 = 20^o$.	4
	c)	Define inverse kinematics with an example.	4
	d)	The links of a 3R robotic arm are $L_1 = 250$ mm, $L_2 = 350$ mm and $L_3 = 50$ mm. The gripper is at world coordinates given as x = 300 mm, y = 400 mm and $\alpha = 30^\circ$. Determine the angles θ_1, θ_2 and θ_3, which the motor controlling the shoulder, elbow and wrist to be rotated.	6

4.	a)	Derive the dynamic model of two DoF robotic manipulator using Lagrange-Euler formulation.	15
	b)	The second joint of a SCARA manipulator is required to move from θ_2=30˚ to 150˚ in 5 seconds. Find the cubic polynomial to generate the smooth trajectory for the joint.	5
5.	a)	Discuss the control scheme of a mobile robot in detail.	10
	b)	What are the advantages and challenges mobile robots?	4
	c)	What is swarm robotics? What are the key attributes of the swarm robotics?	2+4
6.		Write short notes on any four of the following	4*5
	a)	Grippers and End effectors	
	b)	DH parameters	
	c)	DoF and workspace	
	d)	Human haptics	
	e)	SLAM robot	
7.	a)	What is Virtual Reality (VR)? Discuss about the interface to virtual world and types of interaction of VR.	2+2+2
	b)	Write some suitable applications of VR.	4
	c)	How the haptics action helps to solve different robotics application? Describe briefly with diagram.	10