Total number of printed pages: 50

Programme(UG)/8th/UCSE814

2024

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.	**Answer the following questions:**		
	a)	**Fill in the blanks:**	1x10=10
		(i) Euclidean transform preserves _____ and _____. **(ii)** Isotropic is a _____ scaling. **(iii)** If the level of disorder, then Entropy _____. **(iv)** A topological property of digital images is not based on the _____. **(v)** Pixels carry information about the _____of a particular location in the image. **(vi)** Top surfaces mean the _____ in global properties of an image. **(vii)** Passive sensors rely on the _____. **(viii)** Sensor causes robot to miss a percept that is actually present, known as _____. **(ix)** _____sensors provide disjoint types of information about a percept. **(x)** Sensor _____ is a type of Competing sensing.	
	b)	**True or False:**	1x10=10
		(i) Revolute joint are based on 1-DOF. **(ii)** When the DOF increases the computational complexity increases. **(iii)** When the DOF decreases then the flexibility increases. **(iv)** In Revolute joints, d is the fixed variable. **(v)** In prismatic joints, d_i is the joint variable. **(vi)** Exteroception is a measurement of the position of the robot body or parts relative to the layout of the environment. **(vii)** Redundant sensors are competing sensors. **(viii)** Structured light that is projecting a known pattern on to a scene. **(ix)** A specular highlight is not important in 3D computer graphics. **(x)** Level 2 means that Intruder detection in the immediate vicinity of the robot.	
2.	**a)**	What are the learning approaches for robot systems?	3
	b)	Write down the all the attributes of Sensor Suite with a small details.	6
	c)	Describe the lower pair joint and its types.	3
	d)	Two points $\mathbf{a}_{uvw} = (5,6,8)^T$ and $\mathbf{b}_{uvw} = (6,5,4)^T$ are translated with a distance +8 unit along OX-axis & -6 unit along OZ-axis. Determine the new points $\mathbf{a}_{xyz}$ and $\mathbf{b}_{xyz}$, by applying the homogeneous transformation matrix,	4
	e)	Derive the rotation transformation for the vector, V = 30i + 20j + 10k, which is rotated by an angle of 90^0 about the y- axis.	4
3.	**a)**	Explain 4-DOF robot manipulator with a diagram and also all the joints.	6

	b)	Derive the joint angles using inverse transformation of the 2-DOF robot manipulator and the information related to Links and angles are given below here: Link 1: $\mathbf{L}_1$, Link 1: $\mathbf{L}_2$, Joint1 (Type R): θ_1, Joint2 (Type R): θ_2	10
	c)	Draw and explain a model diagram of sensing.	4
4.	**a)**	Mention all the parameters which are to be considered when selecting a RCC device.	4
	b)	What are the two possible positioning errors for Peg-in-hole insertion task?	4
	c)	What is the importance of MTBF and MTTR in PM. Calculate the industrial robot availability, if the values of MTBF and MTTR are 36 and 12 respectively?	4
	d)	Explain the robot cell layouts with the diagrams.	5
	e)	What are the three levels of safety sensor systems in robotics?	3
5.	Write short notes on the following (***any four***):		4x5=20
	a)	Object Recognition	
	b)	Hybrid control architecture	
	c)	Denavit-Hartenberg (D-H) Representation with parameters	
	d)	Convolution	
	e)	Five categories of training implementation in any industrial company	
6.	Differentiate between the following (***any four***):		4x5=20
	a)	AL and AML motion statements	
	b)	Metric and Topological properties of digital images	
	c)	Powered leadthrough and Manual leadthrough	
	d)	Traditional industrial robot and Autonomous robot	
	e)	Lateral position error and angular error	