



NAME OF THE SCHOOL
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2024-2025

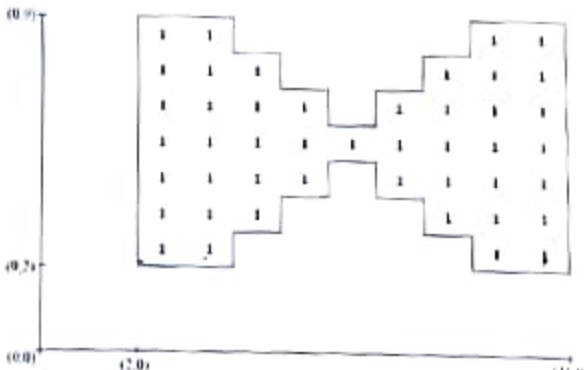
SLOT: A2+TA2

Programme Name & Branch : B.Tech (ECE)
Course Code and Course Name : Robotics and Automation (BECE312L)
Faculty Name(s) : Dr. Shanidul Hoque, Dr. Kalyanbrata Ghosh, Dr. Mohiul Islam
Class Number(s) : VL2024250104129/4133/4209
Date of Examination : 13/10/2024
Exam Duration : 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO - Course Outcome; BL - Blooms Taxonomy Level (1 - Remember, 2 - Understand, 3 - Apply, 4 - Analyse, 5 - Evaluate, 6 - Create)
- Course Outcomes (Type the CO statements covered in this question paper. Use the CO number as per the syllabus copy)
CO-3: Distinguish and interpret the sensors for various applications in robotics and automation.
CO-4: Determine the mathematical model of robotic systems and analyze their kinematic behavior.

Q. No	Question	M	CO	BL
1.	For the schematic of the image shown in Figure 1, calculate the following features: (i) Area and Minimum Aspect Ratio, (ii) CG_x, (iii) CG_y, (iv) Thinness and (v) Compactness  Figure 1	10	3	3
2.	Apply split and merge technique to segment the 8×8 image as illustrated in Figure 2. Splitting operation should be performed until all the pixels in the region have the same intensity. Give the result after each split and merge step. Also, draw the Quadtree representation of the entire split-and-merge procedure considering circle for different intensity level and square for same intensity level.  Figure 2	10	3	3



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3.	a) The coordinate of a point P in the reference frame {M} is $(3, 3, 3)^T$. Find the corresponding point with respect to the rotated frame {N} if it has been obtained by rotating 120° about X-axis of frame {M}.	5	4	3
	b) Verify whether the following matrix is a rotation matrix or not. $\begin{bmatrix} 0.926 & -0.304 & 0.226 \\ 0.363 & 0.881 & -0.304 \\ -0.107 & 0.363 & 0.926 \end{bmatrix}$	5		
4.	A frame is rotated 30° about y-axis, then it is translated a vector $(4, 2, 6)$ with respect to the current frame. Again it is rotated 45° about current z-axis. Then, it is again rotated 60° with reference to the fixed x-axis. Find the Homogenous Transformation Matrix (HTM) that describes the new frame with respect to the reference frame.	10	4	3
5.	Derive the expression of the rotation matrix equivalent to the YZX Euler angles (ϕ_1, ϕ_2, ϕ_3) . Also compute the values of YZX Euler angles for the following end effector orientation and position $\begin{bmatrix} 0.354 & -0.674 & 0.649 & 4.33 \\ 0.505 & 0.722 & 0.475 & 2.5 \\ -0.788 & 0.160 & 0.595 & 8 \\ 0 & 0 & 0 & 1 \end{bmatrix}$	10	4	4
