Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

II SEMESTER M.TECH. (INDUSTRIAL AUTOMATION AND ROBOTICS)

END SEMESTER EXAMINATIONS, June 2022

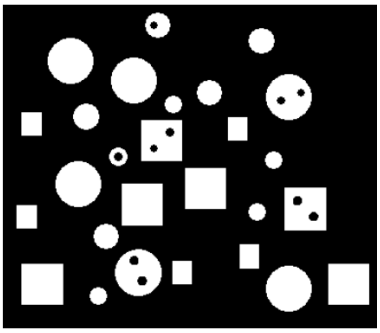
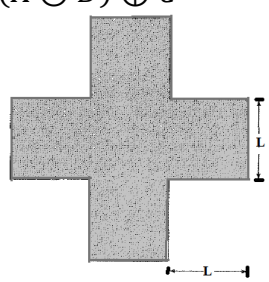
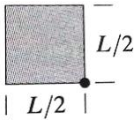
SUBJECT: Machine Vision and Image Processing [MTE 5005]

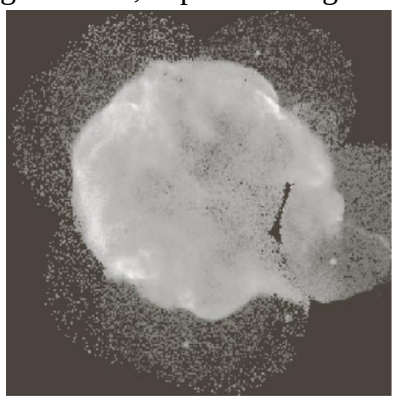
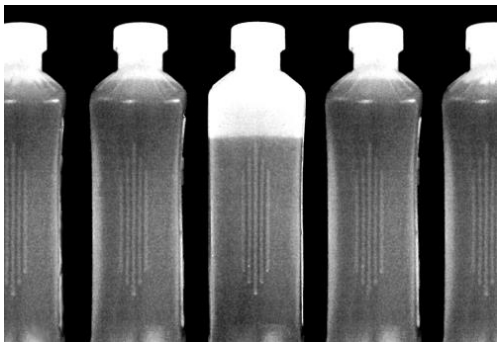
(Date: June 29, 2022)

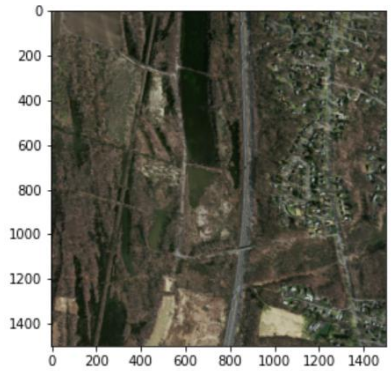
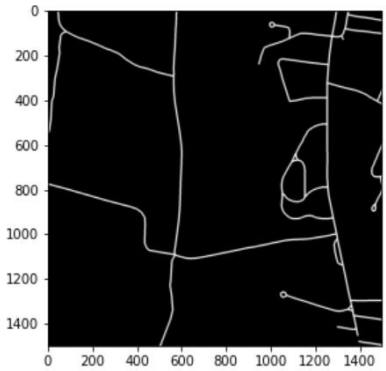
Time: 3 Hours **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed.

Q. No		M	CO	PO	LO	BL
	Descriptive Type Questions (10 × 5 = 50)					
1A.	An image with circles and squares of various sizes is shown in **Fig 1A** Some of the objects have one or two holes in them. Develop an algorithm to segment out the images which have holes. The answers may be in the form of pseudocode with a block diagram.  **Fig. 1A**	**5**	**1**	**3**	**5**	**3**
1B.	With the help of mathematical expression explain basic morphological operation: Dilation and erosion Let A denote the set shown shaded in the **Fig. Q1B(i)**. Refer to the structure elements B and C shown in **Fig. Q1B(ii)** and **Fig.Q1B(iii)** respectively (the black dot denote origin). Sketch the result of following morphological operations: (Draw the intermediate stage also). $(A \ominus B) \oplus C$  **Fig.Q1B(i)**  **Fig.Q1B(ii)**  **Fig.Q1B(iii)**	**5**	**1**	**4**	**2**	**3, 5**

<table>
<tr><td>2A.</td><td>Analyze the image shown in Fig. 2A. In the image shown consider the region of 1s resulting from the segmentation of the sparse regions. Develop a technique for using this region as a mask to isolate the three main components of the image: (1) sparse outer region, (2) background, and (3) dense inner region. Also, explain the algorithms used.
 
Fig. 2A</td><td>4</td><td>2</td><td>2</td><td>2</td><td>3, 4</td></tr>
<tr><td>2B.</td><td>Design an approach for detecting when bottles are not full. The bottles appear as shown in the Fig. 2B as they move along a conveyor line past an automatic filling and capping station. A bottle is considered imperfectly filled when the level of the liquid is below the midway point between the bottom and neck and the shoulder of the bottle. The shoulder is defined as the region of the bottle where the sides and slanted portion of the bottle intersect. The bottles are moving, but the company has an imaging system equipped with illumination flash front end that effectively stops motion, so you will be given images that look very close to the sample shown in the Fig 2B.
Propose a solution for detecting bottles that are not filled properly. State clearly all assumptions that you make and that are likely to impact the solution you propose.
 
Fig. 2B</td><td>6</td><td>2</td><td>3</td><td>5</td><td>6</td></tr>
<tr><td>3A.</td><td>Assume, we have 4 types of medicines and each object have two attributes as shown in the table below. Our goal is to group these objects into 2 groups based on their pH and weight index. Utilize k-means clustering to do the grouping.
<table><tr><th>Medicine</th><th>pH</th><th>Weight index</th></tr><tr><td>A</td><td>1</td><td>1</td></tr><tr><td>B</td><td>2</td><td>1</td></tr><tr><td>C</td><td>4</td><td>3</td></tr><tr><td>D</td><td>5</td><td>4</td></tr></table></td><td>6</td><td>3</td><td>3</td><td>3</td><td>3,4</td></tr>
</table>

3B.	The state-space signal model for Kalman filter is as given below $x_k = \mathbf{A}\, x_{k-1} + \mathbf{B}\, u_k + w_k$ $y_k = \mathbf{C}\, x_k + v_k$ (i) Analyse the requirement of modeling noise when implementing the Kalman filter? (ii) Investigate the effect of noise variance in the performance of the Kalman filter?	**4**	**3**	**2,4**	**2**	**4**
4A.	Apply the linear approach for camera calibration by considering the calibration target as a cube. The markers are its vertices, and its coordinate frame is parallel to the cube faces with its origin at the center of the cube.	**4**	**4**	**2**	**3**	**3**
4B.	For Urban planning project, Udupi district authorities hired engineers from University X and was given the task to make a roadmap from the aerial images shown in **Fig. 4B(i).** Analyze and explain the different image processing steps involved in the task for generating the road map shown in **Fig 4B(ii)**  **Fig 4B(i)**  **Fig 4B(ii)**	**6**	**4**	**3,4**	**2**	**4,5**
5A.	Compare Logarithimic transformation and Piecewise-Linear transformation methods based on their working, and application.	**4**	**1**	**1**	**2**	**4**
5B.	Analyse the image shown in **Fig. 5B.** Perform segmentation by region growing with 8-connectivety, threshold ≤ 2 and seed points as shown by bold number (0, 3 and 7). 5 7 7 5 6 7 7 6 6 **7** 6 5 2 2 7 5 5 6 7 5 0 2 5 6 5 6 0 0 1 1 7 7 2 **0** 2 0 1 **3** 7 6 0 2 1 4 3 4 4 4 2 0 2 0 4 3 5 5 5 5 4 4 5 5 4 5 **Fig. 5B**	**2**	**2**	**1,2**	**2**	**4**
5C.	For a smart hassle-free shopping experience, company X wanted to devise a tool to detect the empty slots of shopping racks and to notify the owner about the missing item and rack number. Propose an image processing-based solution to help the software designer to devise his tool. State clearly all assumptions that you make and that are likely to impact the solution you propose.	**4**	**4**	**3**	**5**	**6**