MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF MECHATRONICS

II SEMESTER M. TECH (INDUSTRIAL AUTOMATION AND ROBOTICS)
END-SEMESTER EXAM – MAY-JUNE 2023

Subject: Machine Vision and Image Processing (PE-II) **Subject Code: MTE 5005**

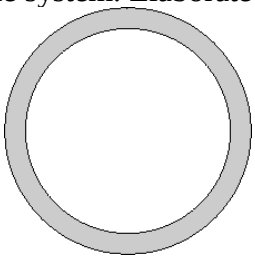
Date: 31 May 2023

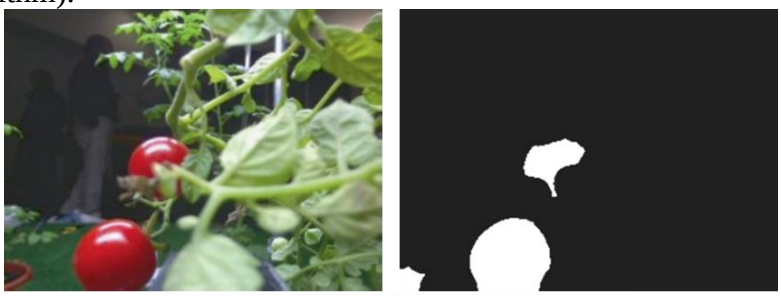
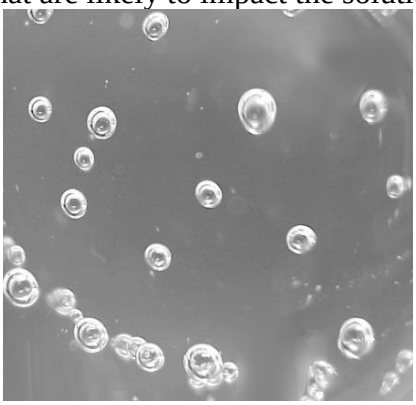
Time: 3 Hrs **Exam Time 09:30 AM to 12:30 PM** **MAX. MARKS: 50**

Name:……, Registration No:……..

Instructions to Candidates:

- ***Answer ALL the questions.***
- *Missing data may be suitably assumed and justified.*

Q. No.	Problem Statement	M	CO	PO	LO	BL
Q1A.	Analyze an industrial application, that uses image subtraction to discover missing components during product assembly. Discuss the fundamental ways of change detection. Also, identify the factors that need to be considered to be met in practice for this method to work.	**5**	**1**	**4**	**1,2**	**4**
Q1B.	A high-tech manufacturing plant is given a government contract to produce high-precision washers of the type shown in Figure Q1B. The contract specifies that the form of all washers be examined using imaging technology. Shape inspection refers to deviations from round on the inner and outer edges of the washers in this context. You may assume the following: (1) A "golden" reference image of an acceptable washer is available, and (2) the imaging and positioning components ultimately used in the system will have an accuracy high enough to allow you to ignore errors due to digitalization and positioning. Formulate the problem statement and propose a solution based on morphological/ logical operations as a consultant to help specify the visual inspection part of the system. Elaborate the algorithm used.  **Figure Q1B**	**5**	**1**	**4**	**5**	**6**
Q2A.	Tomato harvesting using robotics technology enables faster innovations toward Agriculture 5.0. To help in this revolution, analyze the red tomato image captured by using a high-quality imaging system (see **Figure Q2A (a)**) of a robotic harvesting experiment, and identify the objective of the	**5**	**2**	**3**	**1**	**3**

	problem. Explain the different image processing steps involved in converting the image (a) to (b) in detail. (using Program/ Flowchart/ Algorithm).  (a) (b) **Figure Q2A**					
Q2B.	There is a company X that wishes to automate bubble-counting in certain process for quality control. The company has solved the imaging problem, and can obtain 8-bit images of size 800 ×800 pixels, such as the one shown in **Figure Q2B**. Each image represents an area of 8 cm square. The company wishes to count the number of distinct bubbles in each image. Propose a solution to the problem. State clearly all assumptions that you make and that are likely to impact the solution you propose.  **Figure Q2B**	**5**	**2**	**4**	**5**	**6**
Q3A.	Formulate the problem arising with sensor data in the control of an autonomous car. Also, to address the problem, propose a hypothesis/design to fuse sensor readings for accurate localization, perception, and control of an autonomous car.	**4**	**3**	**4**	**5**	**6**
Q3B.	For a wildlife monitoring system, recommend an image processing-based solution to detect the presence and absence of wild animals. State clearly all assumptions that you make and that are likely to impact the solution you propose.	**4**	**3**	**3**	**2**	**5**
Q3C.	Analyze the brightness constancy constraint equation given below, and discuss the way to compute these terms. $$I_x u + I_y v + I_t = 0$$	**2**	**3**	**4**	**1,2**	**4**
Q4A.	Discuss the epipolar geometry for stereo vision. Explain a method/process to recovers the world coordinate (X, Y, Z) for every pixel in the image. Also, highlight the failure modes of proposed method.	**5**	**4**	**3**	**1**	**3**
Q4B.	Analyse the aerial image of an airport shown in **Figure 4B(a)** for autonomous air navigation**.** To help the autonomous navigation, make use	**5**	**2**	**4**	**2**	**4**

	of edge detection and linking method for extracting the two edges defining the principal runway (see Figure 4B(b)). Elaborate the method used.  (a) (b) **Figure Q4B**					
Q5A.	Determine the problem domain for which facial recognition technology can be used. Propose a design solution based on face recognition for any one problem domain. Analyze the situation clearly, clarify all assumptions, and provide a step-by-step description of the actions involved.	**4**	**5**	**4**	**5**	**6**
Q5B.	Company X wishes to develop a tool to detect and recognise licence plates from automobiles at a gate of a parking area's entrance for a smart, hassle-free parking experience. Propose an image processing-based solution to help the software designer devise his tool. State clearly all assumptions that you make and that are likely to impact the solution you propose.	**4**	**1**	**3**	**5**	**6**
Q5C.	A binary image contains straight lines oriented horizontally at 45°. Give a set of 3 × 3 kernels that can be used to detect one-pixel breaks in these lines. Assume that the intensities of the lines and background are 1 and 0, respectively.	**2**	**2**	**3**	**1**	**3**