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

DEPARTMENT OF MECHATRONICS

VII SEMESTER B. TECH (MECHATRONICS)
END-SEMESTER EXAMANIATION – NOV-DEC 2023
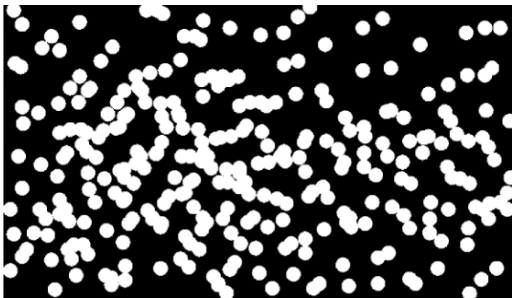### Subject: Machine Vision and Image Processing (PE-V) [MTE 4075]
(Date: 05 Dec 2023)

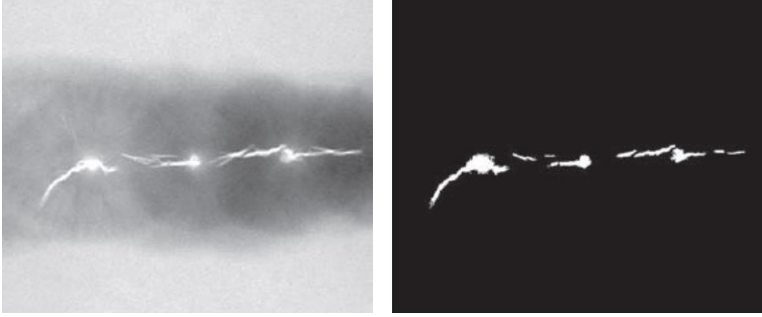**Time: 3 Hours**   **MAX. MARKS: 50**

Instructions for the Candidates:
- ❖ Answer **ALL** questions.
- ❖ Data did not provide any, may be suitably assumed.

Q. No.	Problem Statement	M	CO	PO	LO	BL
Q1A.	In a microscopy application, a pre-processing step is concerned with distinguishing individual round particles from similar particles that overlap in groups of two or more particles (see **Figure Q1A**). You may assume that all particles are of the same size. Recommend a morphological/ logical algorithm that produces three images consisting respectively of: (1) Only particles that have merged with the boundary of the image. (2) Only overlapping particles. (3) Only nonoverlapping particles. Elaborate the algorithm used. **Figure Q1A**	4	1	3	5	5
Q1B.	A trained medical technician is assigned the job of inspecting a set of images generated by an electron microscope experiment. In order to simplify the inspection task, the technician decides to use digital image enhancement and, to this end, examines a set of representative images and finds the following problems: (1) dark, isolated dots that are of no interest; (2) lack of smoothness; (3) not enough contrast in some images; and (4) shifts in the average intensity, when this value should be *V* to perform correctly certain intensity measurements. The technician wants to correct these problems and then display in white all intensities in a band between intensities I_1 and I_2, while keeping normal tonality in the remaining intensities. Apply a sequence of processing steps that the technician can follow to achieve the desired goal. State clearly all assumptions that technician can make and that are likely to impact the solution propose.	4	1	2	2	3

Q1C.	Identify two boundary shapes that have the same mean and third statistical moment descriptors, but different second moments. Justify your selection.	2	1	1	1	3
Q2A.	Analyze the 8-bit X-ray gray level image of the weld (the horizontal dark region) containing several cracks and porosities (the bright regions running horizontally through the center of the image) shown in **Figure Q2A (a)**, and identify the objective of the problem. Explain the different image processing steps involved in converting the image (a) to (b). (a)　　　　　　(b) **Figure Q2A**	5	1	2	2	4
Q2B.	Analyze a product assembly monitoring system, that determine missing components during product assembly. For such system, recommend an image processing-based solution to detect the change. State clearly all assumptions that you make and that are likely to impact the solution you propose.	3	3	3	5	5
Q2C.	Identify the challenges faced in 3D vision when employing intensity images as input.	2	2	1	1	3
Q3A.	Discuss the epipolar geometry for stereo vision. Recommend a method to recovers the world coordinate (X, Y, Z) for every pixel in the image.	4	2	3	5	5
Q3B.	Highlight the necessity of sensor data fusion in autonomous mobile robots by analysing sensors and their limitations. Propose a hypothesis/design to fuse sensor readings for accurate localization, perception, and control of an autonomous mobile robot to address the limitation.	4	3	3	5	6
Q3C.	Analyze the adverse effect of occlusion during the estimation of 3D structure in the dense stereo matching of stereo vision. Also, propose solutions to prevent the failure due to this effect.	2	2	2	2	4
Q4A.	Company X wishes to develop an automated system to recognize the pattern of printed cloth for the textile industry. Propose an image processing-based solution to help the software designer devise his tool. Analyze the situation, clearly state all assumptions, and provide a step-by-step description of the actions involved.	5	4	3	5	6
Q4B.	For an office automation system, recommend an image processing-based solution to detect the presence of a person in a small room with a single	3	3	3	5	5

	entrance/exit door. State clearly all assumptions that you make and that are likely to impact the solution you propose.					
Q4C.	Analyze the aperture problem in optical flow estimation. Discuss the way of solving the aperture problem.	**2**	**3**	**2**	**2**	**4**
Q5A.	Autonomous vehicles are gaining prominence as a solution for safer and more efficient transportation. Lane detection is an essential component for autonomous vehicles. So, to improve the present lane detection system, propose an adaptive solution. Analyze the situation, clearly state all assumptions, and provide a step-by-step description of the actions involved.	**4**	**4**	**3**	**5**	**6**
Q5B.	Garbage classification is a social issue related to waste management and sustainable development. So, propose an image-based trash segregation system to help the process of waste management. Analyze the situation, clearly state all assumptions, and provide a step-by-step description of the actions involved.	**4**	**4**	**3**	**5**	**6**
Q5C.	Explain in brief the image processing-based framework for mango grading system to automate the grading process.	**2**	**4**	**3**	**5**	**5**