VIT
Vellore Institute of Technology
CHENNAI

Reg. Number:	

Continuous Assessment Test (CAT) – I JANUARY 2025

Programme	:	B.Tech. (Artificial Intelligence and Machine Learning)	Semester	:	Winter 2024-25
Course Code & Course Title	:	BCSE417L-Machine Vision	Class Number	:	CH2024250502402 CH2024250502405
Faculty	:	Dr Bharadwaja Kumar Dr S.Rajarajeswari	Slot	:	A1
Duration	:	90 Minutes	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.

Answer all questions

Q. No	Sub Sec.	Description	Marks
1	a)	The company's printer uses the CMYK color model, and the image has a pixel with the following RGB values: (R,G,B)=(255,100,150) The company needs to convert the pixel color into the CMYK model to adjust the ink levels. Convert the RGB values to the CMYK color model calculate the required percentage of each ink (C, M, Y, K) for the printer to reproduce this color. **(5 Marks)**	
	b)	A photographer uses a pinhole camera to capture an image of a distant landscape. The pinhole camera has a very small aperture, leading to an image that is sharp but dim. The photographer adjusts the exposure time to capture more light, but the image becomes blurry as the light spreads. • Illustrate the relationship between the aperture size, exposure time, and image clarity in the context of the pinhole camera model. How does the size of the pinhole affect the sharpness and brightness of the image? (**3 Marks)** • Discuss the trade-off between sharpness and exposure time in pinhole photography. **(2 Marks)**	**10**
2		A robotics team is designing a vision system to analyze images captured by a drone for terrain mapping. The system processes grayscale images, where each pixel's intensity represents elevation levels which is given below. Two pixels are considered part of the same terrain feature if the **absolute intensity difference** between them is ≤ 30, indicating similar elevation levels. a) The drone identifies a key feature starting at the pixel located at (2,2) of the below table (value = 50). Using 4-**connectivity**, determine which pixels are part of this terrain feature and list the connected pixels. **(2.5 Marks)**	10

b) The team decides to explore a more comprehensive method using **8-connectivity** and **m-connectivity** to analyse the terrain feature. Determine the connected pixels using this approach and compare the size of the feature with the result from 4-connectivity.Discuss the differences in the connected components using both the methods. **(5 marks)**

c) To optimize the system for different terrains, the intensity threshold is adjusted. Discuss how the changes in the threshold affect the size and structure of the terrain feature for both 4-connectivity and 8-connectivity. **(2.5 Marks)**

(x,y)	0	1	2	3	4
0	10	20	31	4	55
1	20	30	10	90	60
2	30	40	50	60	70
3	40	55	60	85	80
4	55	60	75	85	90

3

A team of astrophysicists is analysing a grayscale image captured by a space telescope to identify faint celestial objects in the background of a star cluster. The image has low contrast, making it difficult to differentiate between objects and background noise. The team decides to use to enhance the image contrast and improve visibility.

43	65	66	113	72	76
61	187	89	64	72	76
135	137	162	154	137	35
113	43	56	128	56	43
154	162	222	132	212	132
187	128	113	196	66	65

a) Demonstrate the histogram equalization process with all intermediate steps **(7 Marks)**

b) Draw the histograms of the image before and after histogram equalization to visually compare the intensity distributions. **(3 Marks)**

10

4

A security team is working with a surveillance video feed that has been affected by motion blur and noise due to low lighting conditions. The team needs to enhance the video frames to improve the visibility of critical features, To achieve this, they plan to apply image enhancement techniques to smooth the image without losing important details. Pixel intensity values are given in a below 5x5 window.

a) Apply an Averaging Filter and calculate the new

10

intensity value at (2,2) and (4,3) of the below table (5 Marks)

b) Use a 3x3 filter that assigns different weights to surrounding pixels based on their proximity to the center. Calculate the new value for the highlighted pixel at (2,2) and (4,3) of the below table using this weighted approach. (5 Marks)

(x, y)	0	1	2	3	4
0	12	18	25	35	40
1	18	22	28	38	42
2	25	30	35	45	50
3	35	38	45	55	60
4	40	42	50	60	65

5

In a smart surveillance system, the aim is to detect object boundaries and movements in low-light conditions. The system processes a 5x5 pixel grayscale image with the following pixel intensities:

40	20	130	40	150
120	35	100	50	60
90	90	50	160	75
140	50	110	75	185
55	160	70	80	95

Extract edges in the central 3x3 region of the image using an edge detection algorithm which uses kernel with equal weights that detects intensity changes in horizontal and vertical orientations.

10

**********All the best **********