



VIT[®]

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Reg. No.

Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BCSE417L	Faculty Name	Prof. Amutha S
Course Title	Machine vision	Slot	A2+TA2
		Class Nbr	CH2024250502412
Time	3 hours	Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

- CO1: Understand the basics of how an image is processed
- CO2: Enhance, Analyze and segment the image using algorithms
- CO3: To interpret the image and transform it using the mathematical knowledge
- CO4: Extract the features from the image and represent using morphological operations
- CO5: Apply the concept in understanding the scene and process the background part of the image

Answer all Questions (10 × 10 Marks)

01. i.) A camera has a Field of View (FoV) of 120° and which is placed 7 meters away from a wall. Calculate the width of the area covered by the camera on the wall. (2 marks)
- ii.) The distance between the pinhole and the camera sensor is 40 mm. The object has a height of 70 mm and is positioned 750 mm away from the camera. The camera sensor has dimensions of 32 mm × 24 mm. Determine whether the entire image of the object will fit within the sensor. (3 marks)
- iii.) Describe the CMY color model and compare it with the RGB color model. Furthermore, if a color in the RGB model is given as (100, 150, 200), calculate its corresponding CMY values using the standard conversion formula. (5 marks)

[10] (CO1/K2)

02. Consider that you are given the following image

21	155	31	51	21
155	189	213	189	51
85	116	134	176	67
134	198	11	213	198
189	176	85	11	116

- i) Apply histogram equalization on the given image. [4 Marks]
- ii) Apply Contrast stretching on the given image [4 Marks]
- iii) Observe the differences in pixel intensity distribution and write your inferences. [2 Marks]

[10] (CO2/K3)

03. Given the following image matrix representing pixel intensities:

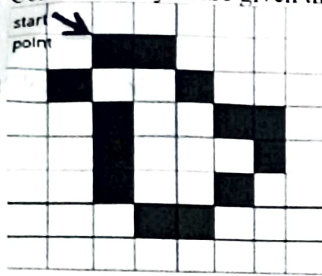
$$I = \begin{bmatrix} 50 & 80 & 100 \\ 90 & 120 & 150 \\ 130 & 160 & 200 \end{bmatrix}$$

- (i) Resample the pixel intensity value image at a non-integer position (x,y)=(1.5,1.5) using bilinear interpolation. [6 Marks]

- (ii) Compare and contrast bilinear interpolation to nearest-neighbor and bicubic interpolations in terms of aliasing effects, computational complexity, and image quality preservation when up-scaling an image? [4 Marks]

[10] (CO2/K3)

04. Consider that you are given the following image



- Compute the 4-connectivity chain code of the given object and the shape number [4 Marks]
- Compute the 8-connectivity chain code of the given object and the shape number [4 Marks]
- Explain the advantages of shape number representation of boundary of object in image with suitable reasoning. [2 Marks]

[10] (CO2,3/K3)

05. Considering the challenge of capturing robust and discriminative texture features for image analysis, elucidate a methodology to develop a context-aware descriptor that efficiently encodes local spatial relationships while remaining invariant to illumination and viewpoint variations. Apply the proposed methodology on the highlighted pixels of the following image and compute the output value.

21	155	31	51	21
155	189	213	189	51
85	116	134	176	67
134	198	11	213	198
189	176	85	11	116

[10] (CO3,4/K3)

06. How can the given image patch be segmented using the center of the image as the seed point given the following two conditions? Apply the algorithm and show the output.

20	20	20	20	20	20	20
20	20	20	65	70	20	20
58	20	70	61	59	55	60
20	40	50	55	51	62	60
20	55	60	55	51	48	20
20	20	20	20	20	20	20
20	20	20	20	20	20	20

- Region is grown in horizontal and vertical directions when the difference between two pixel values is less than or equal to 7. (5 Marks)
- Region is grown in horizontal, vertical and diagonal directions when the difference between two pixel values is less than or equal to 7. (5 Marks)

[10] (CO3,4/K3)

07. Suppose that you are given the following image.

10	6	14	17
21	180	150	20
2	117	129	5
31	13	11	8

- Convert the given image into frequency domain using 4-point DFT. [4 Marks]
- Convert back the output of part-a into spatial domain using suitable method. [4 Marks]
- Explain about where the smooth regions and edges & details will be located if you visualize the frequency domain output. [2 Marks]

[10] (CO3,4/K3)

08. A drone-based surveillance system needs to quickly identify objects in aerial images, even when the images are captured from different angles and orientations. The feature description method must be fast and invariant to rotations to ensure reliable performance in the context of real-time applications on resource-constrained devices. Explain the suitable feature detection and description algorithm in detail with necessary equations and its key differences over other feature descriptor methods.

[10] (CO4,5/K4)

09. Imagine that you are designing a system that needs to analyze the apparent motion of objects across successive frames, enabling it to identify the trajectory of specific objects over time that is useful for tracking vehicles, people, or other targets. Elucidate any methodology to accurately estimate the motion of *every pixel* in an image when there are large displacements between frames and also explain the steps that are required to ensure accurate motion estimation with necessary equations and also limitations of the proposed method. [10] (CO5/K3)
10. Considering the challenge of robustly identifying and localizing arbitrary shapes within images, especially in scenarios with significant noise, occlusion, and shape variations, elucidate a learnable, parameter-space based approach that efficiently maps image features to shape descriptors such as lines, circles, and ellipses which enables real-time detection of complex objects without relying on predefined shape models. Give proper justification of the proposed model and also write all the necessary steps of the proposed model. [10] (CO5/K4)

BL-Bloom's Taxonomy Levels - (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)

