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MMTE-003

**M. SC. (MATHEMATICS WITH
APPLICATIONS IN COMPUTER
SCIENCE) [M. SC. (MACS)]**

Term-End Examination

December, 2025

**MMTE-003 : PATTERN RECOGNITION AND
IMAGE PROCESSING**

Time : 2 Hours

Maximum Marks : 50

Note : Attempt any *five* questions. All questions carry equal marks. Use of calculator is not allowed. Symbols have their usual meanings.

C-2759/MMTE-003

P. T. O.

1. (a) Differentiate between analog image and digital image. Also, discuss the process of digitization of any analog image. Determine the storage space required to store 1024×1024 pixels of a binary image. 6
- (b) Explain unitary transforms for 1-D signals. List any property of the transformations that are both orthonormal and unitary. Check whether the matrix $A = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$ is unitary or not. 4
2. (a) What is the utility of Discrete Fourier Transform (DFT) ? Discuss any *two* properties of DFT. Compute the DFT of the 1-D sequence $f(x) = [1, 0, -1, 0]$. 4

- (b) List the fundamental colour quantities used to define any colour. Briefly discuss any *three* of the listed quantities. Given the coordinates of warm white and deep blue as (0.35, 0.55) and (0.25, 0.35). Find the percentage of red, green and blue colour. 6
3. (a) Explain the term 'Digital Negatives'. Also, compare intensity level slicing with bit plane slicing. Perform intensity level slicing on image : 6

$$f(x, y) = \begin{bmatrix} 10 & 25 & 45 & 110 \\ 15 & 105 & 250 & 220 \\ 130 & 170 & 210 & 250 \\ 215 & 215 & 255 & 115 \end{bmatrix}$$

based on transfer function :

$$S = \begin{cases} 185; & 80 \leq r \leq 175 \\ 0; & \text{otherwise} \end{cases}.$$

- (b) Describe the importance of histograms in image processing. Determine the histogram and normalized histogram of the image $f(x, y)$ given below : 4

$$f(x, y) = \begin{bmatrix} 1 & 2 & 3 & 6 \\ 2 & 1 & 0 & 0 \\ 2 & 2 & 3 & 3 \\ 4 & 4 & 1 & 0 \end{bmatrix}$$

4. (a) Describe the term 'Histogram Specification'. Apply histogram specification on the image $f(x, y)$: 8

$$f(x, y) = \begin{bmatrix} 0 & 2 & 2 & 1 \\ 3 & 0 & 1 & 2 \\ 1 & 3 & 0 & 2 \\ 1 & 3 & 0 & 0 \end{bmatrix};$$

Given $r_i = z_i = 0, 1, 2, 3$

$$p_r(r_i) = 0.25 \text{ for } i = 0, 1, 2, 3$$

$$p_z(z_0) = 0; p_z(z_1) = 0.5; p_z(z_2) = 0.5;$$

$$p_z(z_3) = 0$$

Where, given symbols have their usual meaning.

- (b) What is image smoothing ? List the filters used for image smoothing. 2
5. (a) Write steps to perform filtering in frequency domain. Also, draw corresponding block diagram. Discuss the benefits of frequency domain analysis of any image. Compare low pass filters and high pass filters. Give utility of both. 6
- (b) Explain image degradation model with suitable block diagram. 4
6. (a) Write the steps of Moore boundary tracking algorithm for a binary region R. 5

- (b) What is partition clustering ? Write Frogy's algorithm for partition clustering. Perform *two* iterations of partition clustering for the data given below :

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x	4	8	15	24	24
y	4	4	8	4	12

with $k = 2$ (two clusters).

Note : Use (4, 4) and (8, 4) as seed points.

7. (a) Describe the role of Discriminant Functions in classification. Compare Linear Discriminant Function with a Quadratic Discriminate Function. Give any *two* situation where Linear Discriminant Analysis (LDA) is useful.

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(b) Find the segmented image of :

$$\begin{bmatrix} 7 & 6 & 0 & 2 & 2 \\ 6 & 5 & 1 & 1 & 2 \\ 6 & 7 & 1 & 2 & 0 \\ 7 & 5 & 2 & 0 & 1 \\ 5 & 5 & 2 & 1 & 1 \end{bmatrix}$$

Given that $T = 4$ and seed point is $(3, 2)$.

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