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**MMTE-003**

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

**Term-End Examination**

**June, 2025**

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

*Time : 2 Hours*

*Maximum Marks : 50*

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**Note :** (i) *Question No. 7 is compulsory.*

(ii) *Attempt any **four** questions from  
question nos. 1 to 6.*

(iii) *Use of calculator is not allowed.*

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**D-3285/MMTE-003**

**P. T. O.**

1. (a) Define quantization in the process of digitization of image. Compute the physical size of a 2-D image with dimensions  $2400 \times 2400$ , when scanned at 300 dpi. 5

- (b) Perform multiplication and division operations on the following two images : 5

$$I_1 = \begin{bmatrix} 1 & 3 & 7 \\ 5 & 15 & 75 \\ 200 & 50 & 150 \end{bmatrix}$$

$$\text{and } I_2 = \begin{bmatrix} 50 & 150 & 125 \\ 45 & 55 & 155 \\ 200 & 50 & 75 \end{bmatrix}$$

2. (a) Perform the following :
- (i) Apply Discrete Cosine Transform (DCT) to the following image (I) : 3

$$I = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

- (ii) Determine DC component of the following image ( $f$ ) : 2

$$f = \begin{bmatrix} 1 & 3 & 4 \\ 5 & 6 & 7 \\ 8 & 9 & 11 \end{bmatrix}$$

- (b) Calculate the following for the data given below : 5

- (i) Entropy  
 (ii) Coding redundancy of Binary code  
 (iii) Coding redundancy of Huffman code

| Symbol | Huffman Code | Binary Code | Probability |
|--------|--------------|-------------|-------------|
| 1      | 0            | 000         | 0.4         |
| 2      | 10           | 001         | 0.2         |
| 3      | 110          | 010         | 0.2         |
| 4      | 1110         | 011         | 0.1         |
| 5      | 11110        | 100         | 0.05        |
| 6      | 111111       | 101         | 0.05        |

[Given :  $\log_2 0.05 = -4.32$ ].

3. (a) Write short notes on the following colour models : 6
- (i) RGB
  - (ii) CMY
  - (iii) HSI
- (b) What is histogram specification ? How is it different from histogram equalization ? 4
4. (a) What do you understand by the term 'Image smoothing' ? How do the linear spatial filters differ from non-linear spatial filters ? 5
- (b) Explain the process of filtering in the frequency domain, with the help of a suitable block diagram. 5
5. (a) Compare image enhancement with image restoration. 4

- (b) Write short notes on the following : 6
- (i) Gaussian Noise
  - (ii) Rayleigh Noise
  - (iii) Salt and Pepper Noise
6. (a) Differentiate between the following : 5
- (i) Clustering and Classification
  - (ii) Agglomerative Clustering methods and Divisive Clustering methods
- (b) Perform partition clustering using Frogy's method for the data given below with  $k = 2$  (two clusters). Use first two sample points of the given data i.e., (4, 4) and (8, 4) as seed points : 5

| $x$ | $y$ |
|-----|-----|
| 4   | 4   |
| 8   | 4   |
| 15  | 8   |
| 24  | 4   |
| 24  | 12  |

7. Which of the following statements are true and which are false ? Give a short proof or a counter-example in support of your answer :

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- (i) If each RGB is an 8 bit image, then the total number of different shades of grey is 256.

- (ii) The thresholding on image segment

$$\begin{bmatrix} 0 & 10 & 50 \\ 5 & 95 & 150 \\ 110 & 150 & 190 \end{bmatrix} \quad \text{with } t = 128 \text{ is}$$

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 255 \\ 0 & 255 & 255 \end{bmatrix}.$$

- (iii) An image is the addition of illumination and reflectance components.

- (iv) If the dimension of an image is  $5 \times 8$  inches and the frequency is 500 dots per inch in each direction, then the number of samples required to preserve the information in the image is 2500 dots.
- (v) A high contrast image has a narrow range of grey levels in its histogram.

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