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*

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.*

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

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

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

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

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 : 10

(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

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

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

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

(iv) If the dimension of an image is 5×8 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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