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MMTE–003

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

Term-End Examination

December, 2023

**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.*

1. (a) What is meant by the digitization of images ? Why do we need digitization ? Briefly discuss the role of sampling and quantization in the process of digitization.

5

- (b) Why do we need to transform an image or signal, from spatial domain to frequency

P. T. O.

domain ? Apply the orthogonal transform on the orthogonal matrix 'O' and image matrix 'I' given below : 5

$$O = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

and

$$I = \begin{bmatrix} 1 & 3 \\ 5 & 7 \end{bmatrix}$$

Also, verify that the inverse transform gives us the original image 'I'.

2. (a) Compare Discrete Cosine Transform (DCT) and Discrete Fourier Transform (DFT). Determine the DCT matrix for order 2. 5
- (b) What is colour space ? Write classification of colour space. Given the coordinates of deep blue and warm white as (0.15, 0.2) and (0.45, 0.4), respectively. Determine the percentage of Red (R), Green (G) and Blue (B) colours. 5
3. (a) What are Digital Negatives ? Find the negative transformation of the image : 2

$$f(x, y) = \begin{bmatrix} 1 & 2 & 10 \\ 3 & 4 & 0 \\ 1 & 5 & 6 \end{bmatrix}$$

- (b) Compare Intensity Level slicing and Bit Plane slicing. 4
- (c) Discuss the relevance of image enhancement in image processing. Compare the spatial domain and frequency domain methods of image enhancement. 4
4. (a) Compare linear filters with non-linear filters. Write down the steps to carry out linear filtering. Apply these steps to perform linear filtering on image $f(x, y)$ by using mask $W(i, j)$, given below : 5

$$f(x, y) = \begin{bmatrix} 5 & 1 & 2 \\ 4 & 4 & 7 \\ 2 & 6 & 20 \end{bmatrix}; W(i, j) = \frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

- (b) Differentiate between image sharpening and image smoothing. Discuss first derivative filters for image sharpening. 5
5. (a) Write short notes on the following : 2 each
- (i) Smoothing filters
 - (ii) Sharpening filters
 - (iii) Homomorphic filters
- (b) What is Image Segmentation ? Compare image segmentation based on thresholding with image segmentation on region-growing techniques. 4

6. (a) How does classification differ from clustering ? Write Bayes' theorem. How Bayes' theorem relates to Bayesian classification ? Discuss. Given (a two class problem on binary problem) corona (c) and non-corona (c'). Feature is fever (f). Prior probability of a person having corona, $P(c) = 0.01$. Probability of having fever, given that a person has corona is $P(f/c) = 0.4$. Overall, probability of fever $P(f) = 0.02$. Determine the probability that a person has corona, given that s/he has fever. 8
- (b) Compare Classification models and Regression models. 2
7. Explain the following : $2 \times 5 = 10$
- (i) Partitional clustering
 - (ii) Properties of Linear Discriminant Analysis
 - (iii) Boundary detection in image segmentation
 - (iv) Gaussian Noise
 - (v) Low Pass filters and its applications