

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

Term-End Examination

December, 2024

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

Time : 2 Hours

Maximum Marks : 50

Note : *Question No. 7 is compulsory. Attempt any
four questions from question nos. 1 to 6. Use
of calculator is not allowed.*

1. (a) Describe sampling in the process of digitization of an image with the help an example. If physical size of an image is 8×8 inches and the sampling resolution is 5 cycles/mm, then how many pixels per cycle are required to have a better quality image ? 5

- (b) Perform Histogram Equalization for digital image whose grey level distribution is given below : 5

Grey Levels (r_k)	Number of Pixels (p_k)
0	8
1	10
2	10
3	2
4	12
5	16
6	4
7	2

2. (a) Briefly discuss Discrete Cosine Transform (DCT). Apply DCT to the following image : 5

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

- (b) What is Mean Square Error (MSE) and Signal to Noise Ratio (SNR) ? Compute MSE and SNR for the reference image : 5

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

and the processed image :

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

3. (a) What is Discrete Fourier Transform (DFT) ? Verify whether DFT matrix of order 4 is unitary or not. 6
- (b) What is Intensity Level Slicing ? How is it different from Bitplane Slicing ? 4
4. (a) What is the purpose of histogram specification ? Write steps to perform histogram specification of any image. 5
- (b) What do you understand by the term 'Image Sharpening' ? Briefly discuss various operations, required by first derivative filters. 5
5. (a) Explain the term 'Noise' in the context of digital image processing. Give spatial and frequency characteristics of noise. 4
- (b) What is Image Segmentation ? Write the steps to perform Image Segmentation through the method of merging and splitting. 6

6. (a) Differentiate between the following : 5
- (i) Supervised Learning and Unsupervised Learning
 - (ii) Hierarchical Clustering methods and Non-hierarchical Clustering methods
- (b) Consider the coordinates of warm white (0.35, 0.5) and the coordinates of deep blue (0.25, 0.10). Find the percentage of three colours red (X), green (Y) and blue (Z). 5
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
- (a) Signal energy cannot be preserved after applying unitary transformation.
 - (b) Edge based techniques are used to find the object boundaries and locate the objects.
 - (c) K-means clustering cannot be used with arbitrary distances.
 - (d) Scilab allows the plotting using the function CONTOUR PLOT.
 - (e) An RGB cube can be transformed into its CMY cube.

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