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.

(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?

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

Grey Levels	Number of Pixels
(r_k)	(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:

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

(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.
 - (b) What is Intensity Level Slicing? How is it different from Bitplane Slicing?
- 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. (a) Explain the term 'Noise' in the context of digital image processing. Give spatial and frequency characteristics of noise.
 - (b) What is Image Segmentation? Write the steps to perform Image Segmentation through the method of merging and splitting.

- 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.

