**MMTE-003**

# M. Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE) [M. Sc. (MACS)]
## Term-End Examination
## June, 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. All symbols used have their usual meanings.*

1.  (a) Define the terms 'Sampling' and 'Quantization' in context of digital image processing. A medical image has size $8 \times 8$ inches, the sampling reduction is 5 cycles/mm, calculate the number of pixels required for the said medical image.    6

    (b) What do you understand by the term "Entropy" in context of any digital image ? Calculate the entropy for the symbols,

where probability distribution is given below :                                    4

| Symbol | Probability |
|--------|-------------|
| 1 | 0.4 |
| 2 | 0.3 |
| 3 | 0.1 |
| 4 | 0.1 |
| 5 | 0.1 |

2. (a) What is Discrete Fourier Transform (DFT) ? Find DFT of the function :                                    5

$$f(x, y) = \sin(2\pi u_0 x + 2\pi v_0 y)$$

   (b) Apply Prewitt operators and Sobel operators for the image given below :                                    5

$$\begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{bmatrix}$$

3. (a) Briefly discuss the term Histogram stretching. Perform histogram stretching on the $8 \times 8$, 8-level grey image, whose distribution is given ahead :                                    6

| Grey levels ($r_k$) | No. of Pixels ($p_k$) |
|:---:|:---:|
| 0 | 0 |
| 1 | 0 |
| 2 | 5 |
| 3 | 20 |
| 4 | 20 |
| 5 | 19 |
| 6 | 0 |
| 7 | 0 |

(b) What is a Brand Pass Filter ? How is it related to the band reject filter ?          4

4. (a) Why do we determine Laplacian of an image ? What are the drawbacks of the Laplacian operator ? Show that subtracting the Laplacian of an image from the image concerned is proportional to the unsharp masking of the image.          6

(b) Perform Linear Convolution and also obtain the Linear correlation between the two matrices X $(m, n)$ and $h(m)$, given below :          4

$$X(m,n) = \begin{bmatrix} 11 & 12 & 13 \\ 14 & 15 & 16 \\ 17 & 18 & 19 \end{bmatrix}$$

and $h(m) = [3, 4, 5]$.

5. (a) How the Histogram stretching, Histogram equalization and Histogram specification relates to the finding of quality of any digital image ? Discuss with suitable example for each. 6

   (b) Perform Histogram equalization for the 8×8 image, whose details are given below : 4

| Grey level $(r_k)$ | No. of Pixels $(p_k)$ |
|---|---|
| 0 | 8 |
| 1 | 10 |
| 2 | 10 |
| 3 | 2 |
| 4 | 12 |
| 5 | 16 |
| 6 | 4 |
| 7 | 2 |

6. (a) Determine the Euclid, Manhattan average, and Chebychev distances, for the two objects $O_1$ and $O_2$ whose attributes $x_1$ and $x_2$ are tabulated below : 6

| Attribute Object | $x_1$ | $x_2$ |
|---|---|---|
| $O_1$ | 5 | 6 |
| $O_2$ | 2 | 3 |

    (b)  Compare clustering and classification. List at least *two* algorithms for each.     4

7.  (a)  List the steps of Canny Edge detection algorithm. Briefly discuss each stage.     4

    (b)  Compute the degree of compression of the following image using :     6

        (i)   Huffman coding

        (ii)  Run length coding,

        assuming two bits to represents the pixel value and two bits to represents the run lenght :

$$I = \begin{bmatrix} 7 & 7 & 7 & 1 \\ 1 & 7 & 7 & 7 \\ 7 & 1 & 1 & 1 \\ 1 & 5 & 5 & 0 \end{bmatrix}$$