

No. of Printed Pages : 5

MMTE-003

**M. Sc. (MATHEMATICS WITH
APPLICATIONS IN COMPUTER
SCIENCE) M. Sc. (MACS)**

Term-End Examination

December, 2022

**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. Symbols used have their usual meaning.*

1. (a) What is histogram equalization ? Does discrete histogram equalization, yield a uniform histogram ? Justify your answer. 4
- (b) Briefly discuss Discrete Fourier Transform (DFT). Apply DFT to the following sequence 'x' and verify whether it works : 6

$$x = \{1, 2, 8, 9\}$$

P. T. O.

2. (a) How Bayesian classifier performs classification ? Discuss. Apply the Bayesian classifier on the following dataset, and predict the class of (2, 2) : 6

a_1	a_2	Class (i)
2	0	C_1
0	2	C_1
2	4	C_2
0	2	C_2
3	2	C_2

- (b) What are Median filters ? Compute the median value of the pixel circled below,

using the 3×3 mask $\begin{bmatrix} 1 & 5 & 7 \\ 2 & \textcircled{4} & 6 \\ 3 & 2 & 1 \end{bmatrix}$. 4

3. (a) Write formula for MSE, SNR and PSNR, use them to compute MSE, SNR and PSNR for the 8 bit reference image given below :6

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

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

- (b) Give *two* similarities and *two* differences between spatial convolution and spatial correlation. 4
4. (a) Compare Wiener filtering with inverse filtering. Give limitations of Inverse filtering and describe how Wiener filter overcome the identified limitations of inverse filtering. 4
- (b) What is 'Huffman Coding' ? Calculate the number of bits required to code the data given below, by using Huffman coding : 6

Symbol	Frequency
<i>a</i>	21
<i>b</i>	16
<i>c</i>	15
<i>d</i>	18
<i>e</i>	32
<i>f</i>	8

5. (a) State whether the following statements are true *or* false. Give reason for your answer :

4

- (i) 2-D Gaussian operator is separable
 (ii) Laplacian of a Gaussian operator is non-separable

- (b) What is Radon transformation ? Show that the Radon transform of Gaussian shape $f(x, y) = Ae^{-(x^2+y^2)}$ is $g(\rho, \theta) = A\sqrt{\pi} e^{-\rho^2}$.

6

6. (a) Distinguish between the decision-theoretic approach and the structural approach of Pattern recognition. Give suitable example for each.

4

- (b) What is KL transform ? Compute the KL transform for the input data :

6

$$X_1 = (4, 4, 5)^T$$

$$X_2 = (3, 2, 5)^T$$

$$X_3 = (5, 7, 6)^T$$

and $X_4 = (6, 7, 7)^T$.

7. (a) What is digital image watermarking ?
Draw and discuss block diagram for embedding and extraction of a digital image watermark. 6
- (b) Consider the following five training sets as shown below : 4

S. No.	Inputs		Output
	I_1	I_2	0
1	0.4	- 0.7	0.1
2	0.3	- 0.5	0.05
3	0.6	0.1	0.3
4	0.2	0.4	0.25
5	0.1	- 0.2	0.12

- (i) Draw the neural network architecture.
- (ii) Obtain the updated weights, error and training set for second iteration.