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## M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)

M.Sc. (MACS)

## **Term-End Examination**

June, 2021

## 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) Define the following intensity transformation functions, with suitable examples: 4
  - (i) Log Transformations
  - (ii) Power-Law (Gamma) Transformations
  - (b) What is Histogram Equalization? Why is it performed? Perform histogram equalization of the following image:

 $\begin{bmatrix} 1 & 3 & 5 \\ 4 & 4 & 3 \\ 5 & 2 & 2 \end{bmatrix}$ 

**2.** (a) Find the DFT to the following image:

Hence, find its inverse DFT.

(b) Compare high pass filters with low pass filters, with suitable examples.

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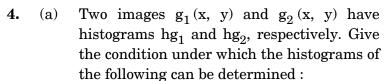
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3. (a) Compute the degree of compression that can be achieved using (i) Huffman coding, and (ii) Run length coding, assuming two-bits to represent the pixel value and two-bits to represent the run length.

$$I = \begin{bmatrix} 3 & 3 & 3 & 2 \\ 2 & 3 & 3 & 3 \\ 3 & 2 & 2 & 2 \\ 2 & 1 & 1 & 0 \end{bmatrix}$$

(b) Find the entropy of the image

 $\begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 3 \\ 1 & 2 & 2 & 3 \end{bmatrix}.$ 



(i) 
$$g_1(x, y) + g_2(x, y)$$

(ii) 
$$g_1(x, y) - g_2(x, y)$$

(iii) 
$$g_1(x, y) \times g_2(x, y)$$

(iv) 
$$g_1(x, y) \div g_2(x, y)$$

Hence, obtain the histogram in each case in terms of hg<sub>1</sub> and hg<sub>2</sub>.

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- (b) Construct a 4-directional and 8-directional chain code for the shape of the alphabet 'C'. Hence, obtain its difference code and shape number.
- **5.** (a) Compute MSE and SNR for the images given below:

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

- (b) What do you understand by the term Data Compression? How is relative data redundancy (R) related to the compression ratio (C)?

$$\mathbf{F} = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

(b) Find the minimum  $D_4$  and  $D_8$  distances between the marked pixels 1 and 5 for the image

$$\begin{bmatrix}
1 & 2 & 4 & 8 \\
2 & 6 & 4 & 2 \\
1 & 3 & 4 & 5 \\
2 & 2 & 1 & 5
\end{bmatrix}.$$

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(c) A  $4 \times 4$  image is given by  $\begin{vmatrix} 2 & 3 & 4 & 5 \\ 1 & 2 & 4 & 6 \\ 2 & 3 & 2 & 4 \\ 1 & 5 & 7 & 6 \end{vmatrix}$ .

If this image is filtered by a min filter with a mask \_\_\_\_\_, find the resultant image, assuming zero padding.

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**7.** (a) Write short notes on the following:

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- (i) Feature Selection Criteria
- (ii) Principal Component Analysis
- (iii) Wiener Filtering
- (b) Find the value of x for which the mask

acts as a high pass filter.

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