No. of Printed Pages : 4

MMTE-003

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

00331

Term-End Examination

December, 2017

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) Prove that the convolution of any 2-D image with an impulse signal gives rise to the same image, i.e., $x(m, n) * \delta(m, n) = x(m, n)$, where $x(m, n)$ is any signal and $\delta(m, n)$ is impulse signal. *5*

(b) Check whether the Discrete Fourier Transform (DFT) matrix of order 4 is unitary or not. *5*

2. (a) Suppose an image of dimension 4×6 inches has details to the frequency of 400 dots per inch in each direction. How many samples are required to preserve the information in the image ? [Take bandwidth = 400 Hz in both directions] *4*

(b) Analyse a 3×3 mean filter in the frequency domain and prove that it behaves like a low-pass filter. *6*

3. (a) Consider the following table for arithmetic coding :

Source Symbol	Probability
a	0·2
b	0·2
c	0·4
d	0·2

Encode a five-symbol message a b c c d using arithmetic coding scheme. *6*

(b) Obtain the Huffman code for the word "COMMITTEE". *4*

4. (a) What is the effect on the histogram of an image when all the pixels of the image are shuffled ? Explain with the help of a suitable example. *3*

(b) What is Image Restoration ? Briefly discuss the need of image restoration. List all the techniques of image restoration and classify them. *4*

(c) What is the difference between Image Restoration and Image Enhancement ? What is the similarity between the two ? *3*

5. (a) What is the difference between Basic Global Thresholding method and Optimum Global Thresholding method using Otsu's rule ? Derive conditions of thresholding for Otsu's method. 6

(b) Show that the Laplacian of a continuous function f(t, z) of continuous variables t and z satisfies the following Fourier transform pair :

$$\nabla^2 f(t, z) \Leftrightarrow -4\pi^2(\mu^2 + \eta^2)\, F(\mu, n),$$

where $F(\mu, n)$ is the Fourier transform of f(t, z). 4

6. (a) Apply the Bayesian classifier to predict the class of (2, 2) from the dataset given below :

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

Assume both the classes follow multivariate normal density functions. 5

(b) Specify the structure and weights of a neural network capable of performing exactly the same function as a minimum distance classifier in n-dimensional space. 5

7. (a) Show that redefining the starting point of a chain code, so that the resulting sequence of numbers forms an integer of minimum magnitude, makes the code independent of the initial starting point on the boundary. Find the normalized starting point of the code given below : 5

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(b) Differentiate between string matching and matching shape number for the recognition of boundary shapes based on string representations. 5