

00902

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

Term-End Examination

June, 2013

MMTE-003 : PATTERN RECOGNITION AND  
IMAGE PROCESSING

Time : 2 hours

Maximum Marks : 50

(Weightage : 50%)

---

Note : Attempt any five questions. All questions carry equal marks. Use of Calculator is **not** allowed.

---

1. (a) Explain the following with one example of each. 4
- (i) Histogram matching.
  - (ii) Laplace filter in frequency domain.
- (b) Perform the linear convolution between 6  
 $x(m, n)$  and  $h(m, n)$  where

$$x(m, n) = \begin{pmatrix} 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \quad h(m, n) = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

2. (a) Discuss various distance measures in an image. 4

(b) A zero mean vector  $[B]_{2 \times 1}$  is unitarily 6

transformed. Given  $A = \frac{1}{2} \begin{bmatrix} \sqrt{3} & 1 \\ -1 & \sqrt{3} \end{bmatrix} B$ ,

and  $R_u = \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$ ,  $0 < \rho < 1$ .

Obtain covariance matrix  $R_A$ . Also obtain correlation between  $A(0)$  and  $A(1)$ , if  $\rho = 0.95$ .

3. (a) Derive the following properties of 2D 6  
Fourier transform.

(i) Translation

(ii) Rotation

(b) Derive the expression for optimum Notch 4  
filter.

4. (a) Compute the mean value of the masked 4

pixel given as  $\begin{bmatrix} 1 & 5 & 7 \\ 2 & \textcircled{4} & 6 \\ 3 & 2 & 1 \end{bmatrix}$  using  $3 \times 3$  mask.

(b) The basis image of 2D unitary transform of 6  
size  $2 \times 2$  are

$$H_1 = \frac{1}{2} \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, H_2 = \frac{1}{2} \begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix},$$

$$H_3 = \frac{1}{2} \begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix}, H_4 = \frac{1}{2} \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$

Determine the transform coefficient if input

image is  $\begin{bmatrix} 6 & 4 \\ 2 & 1 \end{bmatrix}$

5. (a) Obtain the median value of the marked pixel given as 4

$$\begin{bmatrix} 18 & 22 & 33 & 25 & 32 & 24 \\ 34 & \textcircled{128} & \textcircled{24} & \textcircled{172} & \textcircled{26} & 23 \\ 22 & 19 & 32 & 31 & 28 & 26 \end{bmatrix}$$

Using  $3 \times 3$  mask.

- (b) A source emits four symbols (a, b, c, d) with probability (0.4, 0.2, 0.1, 0.3) respectively. Perform arithmetic coding to encode and decode the word 'dad'. 6
6. (a) Explain any three boundary descriptors with examples. 3
- (b) Consider an image  $X = \begin{bmatrix} 5 & 0 \\ 0 & 0 \end{bmatrix}$  and the pixel value 5 has to be replicated. Write the steps involved in replication. 5
- (c) Obtain the value of pixel encircled, if it is smoothed by a  $3 \times 3$  window 2

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