M.E. (ETRX) Sem I (R)
Image Processing

Con. 5731–09. BB–6113

(4 Hours) [Total Marks : 100

16/12/09

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** out of remaining **six** questions.
(3) Make **suitable** assumptions wherever **necessary** and **state** it.

[20]

1. a) List any FOUR applications of Image Processing (not in same area) and explain ONE in detail

   b) Explain why brightness discrimination is poor at low level illumination

   c) Justify/contradict the following statement – "Quality of picture depends on the number of pixels and number of gray levels that represent the picture."

   d) Compare between contrast stretching and histogram equalization.

2. a) Name and explain any four zero memory operations [06]

   b) Histogram of an image with 8 quantization levels is shown below. Perform histogram equalization.
   $f(x,y) = |i - j|$; $i = j = 0, 1, 2, 3, 4, 5, 6, 7$ [08]

   c) Explain convolution in the spatial domain and the frequency domain. Derive the relationship between the two domains. [06]

3. a) Why FT and frequency domain tools are so useful for image enhancement. With the help of neat block diagram explain the basic filtering in the frequency domain. Give the reasons for shifting the origin. [08]

b) Using 4-point FFT algorithm, evaluate 2-D DFT of the following image :- [06]

0	1	2	1
1	0	1	2
2	1	0	1
1	2	1	0

c) Prove 2-D energy conservation relation [06]

$$\sum_{m,\,n=0}^{N-1} \sum |u(m, n)|^2 = \sum_{k,\,l=0}^{N-1} \sum |v(k, l)|^2$$

[TURN OVER

4. a) Find Hadamard transform for $f = [1\ 0\ 2\ 3\ 4\ 1\ 3\ 1]^T$ [06]

b) Write an expression for 2-D DCT. What is the relationship with 1-D DCT ? Find DCT for the image : [06]

2	0	1	0
1	1	0	1
1	0	0	1
2	1	2	3

c) Three column vectors are given below [08]

$$\Phi_0 = \begin{matrix} W^0 \\ W^0 \\ W^0 \end{matrix} \qquad \Phi_1 = \begin{matrix} W^0 \\ W^1 \\ W^2 \end{matrix} \qquad \Phi_2 = \begin{matrix} W^0 \\ W^2 \\ W^4 \end{matrix}$$

Where $W = e^{-j2\pi/3}$. Prove that they are orthogonal. Using these vectors generate 3 X 3 nine orthogonal patterns

$p_{ij}(x, y)$; $i, j, x, y = 0, 1, 2$

5. a) Detect the boundary and segment of the given image using graph theoretical approach. Also draw the graph for the given image [06]

$$\text{Image} = \begin{pmatrix} 7 & 2 & 2 \\ 5 & 7 & 2 \\ 5 & 1 & 0 \end{pmatrix}$$

b) Given below is the table of eight symbol and their frequency of occurrence. [06]

Symbol	S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7
Frequency	0.25	0.15	0.06	0.08	0.21	0.14	0.07	0.04

Give Huffman code for each eight symbols.

Evaluate minimum number of average bits sequence per symbol.

What is coding efficiency for the code ?

c) Draw and explain block diagram of JPEG encoder and decoder. [08]

6. a) Define Dilation and Erosion. Illustrate these operations on the following object :
Circular shape with radius '2r'
Structuring element – circular shape with radius 'r/2' [06]

b) Discuss thinning algorithm for finding the skeleton of a region. Apply it to a square and a triangle. [08]

c) Explain 'Signature'. Draw signature of Square and a Circle [06]

7. Write short notes on: [20]

a) Karhunen-Loeve Transform (Hotelling Transform)

a) Transform coding

c) Hit and miss transform

d) Image Restoration.