Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (CSE)/SEM-7/CS-704G/2010-11

2010-11

IMAGE PROCESSING

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Objective Type Questions)

1. *State* True *or* False *for any* ten *of the following :* 10 × 1 = 10

   i) Quantization is a measure of no. of points with same gray level.

   ii) An *N*th power transformation of the input gray level makes the image brighter.

   iii) Histogram equalization is done to enhance brightness.

   iv) A 2nd order operator is more potent than the 1st order derivative operator as a sharpening spatial filter.

   v) In DFT of an image noise represents low frequency components.

   vi) A median filter is a linear filter.

vii) Huffman coding is a technique for error free image compression.

viii) Hough transform is used to find boundary of a region.

ix) A highpass filter is called smoothing frequency domain filter.

x) In a coloured image every pixel will have 5 gray levels associated with it.

xi) Fourier transform is linear.

xii) The gray level of 8 bit image is ranging from 0 to 256.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Explain how to shrink an image.

3. In histogram equalization, explain properties of the transform that produces new gray level. Show for continuous PDF how the previous transformation can be achieved to equalize histogram.

4. Explain the terms 'adjacency', 'connectivity' in the aspect of digital images.

5. Write down the 2-dimensional DFT and inverse DFT expressions of some function. Show that DFT and its inverse are linear processes.

6. Write down the Hadamard transformation H_1. Show how H_2 is obtained from H_1. What will be the Hadamard transform of $[1\ 2\ 3\ 4]^T$ by H_2 ? Write the Hadamard matrix H_3.

7. Write briefly about colour image processing.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

8. a) What is meant by histogram matching ? Explain how it could be done. We have $r_k = z_k, k = 0, 1, 2, 3.$ $P_r(r_i) = 0 \cdot 25, i = 0, 1, 2, 3.$ $P_z(z_0) = 0 \cdot 5, P_z(z_1) = 0 \cdot 25, P_z(z_2) = 0, P_z(z_3) = 0 \cdot 25.$ Show how can the histogram (r, P_r) could be matched to histogram (z, P_z). 7

b) How does single derivative and double derivative perform as sharpening spatial filter ? Compare their performances. For the one dimensional image shown below compute single and double derivative. Comment on both the image and its single and double derivative. 6

5	5	4	3	2	1	0	0	0	6	0	0	0	0	1	3	1	0	0	0	0	7	7	7

c) What is image sampling and quantization ? 2

9. a) Briefly explain ideal highpass filter. What are their shortcomings ? How these shortcomings are overcome in Butterworth or Gaussian highpass filter ? 6

b) What conditions does distance measure between pixel satisfy ? How are Euclidean, City Block and Chess Board distances defined ? For the latter two write matrices to elucidate. 5

c) A & B shown below are two images, find A/B, $A - B$, $A \vee B, A \wedge B$.

$$A = \begin{bmatrix} 7 & 6 & 3 \\ 2 & 1 & 4 \\ 5 & 7 & 1 \end{bmatrix} \& B = \begin{bmatrix} 4 & 2 & 1 \\ 5 & 3 & 6 \\ 7 & 1 & 2 \end{bmatrix}$$ 4

10. a) If $f(x, y)$ & $h(x, y)$ are two images and $f(x, y) * h(x, y)$ is their convolution, then show $f(x,y)*h(x,y) \leftrightarrow F(u,v)H(u,v)$ constitute a DFT pair where $F(u, v)$ & $H(u, v)$ are the DFT of $f(x, y)$ and $h(x, y)$ respectively. 5

    b) Let $H(u,v)$ be a filter function and suppose $H(u,v) = A$. So the net effect of filtering will be to multiply the image by a constant. Explain using convolution theorem why in spatial domain as well the image is multiplied by the same constant. 4

    c) Consider a binary source alphabet $A = \{ 0, 1 \}$. Consider a binary symmetric channel. Show that when there is no possibility of channel error the capacity is maximum, whereas when there is possibility of error = 1/2, no information can be transferred. 6

11. a) Discuss briefly about Huffman code with suitable example. 6

    b) Explain what is Haar transform ? Write down the properties of Haar transform. 5

    c) Explain Hough transform and its use. 4

12. a) Explain how segmentation is done by region spliting and merging. 5

    b) Explain how a gradient operator detects edges. Discuss different kinds of gradient operators for detecting edge. Explain function of compass operators by showing compass operators for N, NW, W, SW, S, SE, E and NE. 8

    c) What is histogram ? 2

13. Write short notes on any *three* of the following : 3 × 5

    a) Lossy compression

    b) Fidelity criteria

    c) Discrete cosine transform

    d) Sharpening spatial filters

    e) Least mean square filters.