Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech(CSE)/SEM-3/CS-1111/2009-10

2009

IMAGE PROCESSING AND PATTERN RECOGNITION

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.

Answer any *five* questions. 5 ∞ 14 = 70

1. a) What are the major reasons behind image digitization ? Define the processes of sampling and quantization. 3

   b) Write down Shannon's sampling theorem. What is its significance ? 3

   c) A 4 ∞ 4 sampled image is given below : 8

2·3	3·2	10·1	9·9
1·0	1·8	9·7	8·9
9·3	10·2	2·1	1·9
8·8	9·8	1·7	1·6

Quantize this image assuming 16 quantization levels with intensities (0, 1, 2, ..., 15).

Compute the RMS value of the quantization error.

2. a) Write down the famous convolution theorem. How does this theorem simplified image processing in frequency domain ? 4

b) Consider the following one dimensional image (I) and one dimensional mask (M). Perform a linear convolution. 5

I =	1	3	5	4	2

M =	– 2	4	– 2

c) Consider that the above image and mask both converted to their frequency domain counterparts (Fourier transform). Compare the number of multiplication, to perform convolutions is spatial and frequency domains. 5

3. a) Write down the relations for forward and backward Fourier transformation relations in discrete notation. 4

b) Derive the relation for Fast Foureir Transform (FFT). 6

c) Show that a 2-D DFT (Discrete Fourier Transform) is linearly separable. 4

4. a) What is an image histogram ? What is its importance in image processing ? 4

b) Name some image enhancement techniques that depend on histogram. Do you consider that image gray level slicing can be performed by histogram processing ? Explain with an example. 4

c) A histogram is given below :

Gray level i	0	1	2	3	4	5	6	7
No. of pixels n_i	2	1	2	4	4	1	2	0

Find out the histogram of the corresponding negative image. 6

5. a) What are the differences between image smoothing and image averaging ? 4

b) Explain how noise removal can be performed by image smoothing and image averaging. 4

c) For the following one dimensional image

5	10	12	3

perform the smoothing operation using the mask 6

$\frac{1}{3} \propto$ | 1 | 1 | 1 |

6. a) In what ways boundary detection is useful in image processing ? 4

b) Write down (pointwise) the objectives and problems of boundary detection. How first and second order difference operators work for this purpose ? 6

c) Explain the effects of varying the thresholds in boundary detection. 4

7. a) Define a region in an image. Write down an algorithm to perform region splitting based segmentation. Define a suitable homogeneity property for this purpose. 6

   b) Write down the advantages and disadvantages of lossless and lossy image compression techniques. 4

   c) Write down the steps of Huffman encoding. 4

8. a) Mention the basic steps of pattern recognition and define classification. 4

   b) Draw perceptrons with and without a bias node and explain their functionality (use analytic expressions). 6

   c) Derive a suitable perceptron learning algorithm. 4