



Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (CSE)/SEM-2/CST-1202B2/2011

2011

IMAGE PROCESSING & COMPUTER VISION

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. Answer in Yes or No for the following : 10 × 1 = 10
- a) Image acquisition cannot be done without help of a camera.
 - b) Total number of gray levels is always factored by 3.
 - c) Non-linear operators like n th root or n th power are never used in image enhancement.
 - d) Histogram equalization is a linear process.
 - e) Median filtering is a frequency domain filtering.
 - f) Multiplication in frequency domain is equivalent to convolution in spatial domain.
 - g) Low-pass filters tend to blur images.



- h) Hadamard transform is a technique for error free image compression.
- i) A high-pass filter is called smoothing frequency domain filter.
- j) Histogram matching is a process used to compress the image.

GROUP – B

(Short Answer Type Questions)

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

- 2. Explain how from a continuous image a digital image is formed by sampling and quantization. Explain how many bits will be required to store an $M \times N$ digital image.
- 3. Explain with example what is convolution of two one-dimensional functions. Explain how and why it is used for filtering.
- 4. What is a separable median filter ? Propose a fast technique for producing median for a separable median filter as the centre of neighbourhood moves from pixel to pixel.
- 5. Explain how Huffman coding is done. Find Huffman code for a source with seven symbols $a_1, a_2, a_3, a_4, a_5, a_6, a_7$ with respective probabilities 0.1, 0.25, 0.06, 0.1, 0.04, 0.15, 0.3.
- 6. Explain how to find the resultant of two images after arithmetic and logical operation. A & B are two one-dimensional images and are given by $A = [2 \ 3 \ 7 \ 6]$ and $B = [3 \ 2 \ 4]$, find $A/B, A - B, A \vee B, A \wedge B$.



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) What are different neighbours of a pixel ? Explain $N_4(p)$, $N_D(p)$, $N_8(p)$. Write down the criteria a distance measure should satisfy. Explain what are Euclidean, D_4 (City Block) and D_8 (Chess Board) distance measures. Show that they satisfy the criteria for distance measure. 8
- b) Explain how histogram statistics could be used for image enhancement. 7
8. a) Write the expressions for first and second derivatives for digital domain. Write the properties that they should satisfy. Show with an example their efficacy in image sharpening. Explain how a Laplacian is used to sharpen an image. In this context explain Unsharp masking and High Boost filtering. 10
- b) Write down the expression for DFT & inverse DFT in one-dimension. If $f(k)$ is a function, at what point do we sample the function to get $f(k)$, if the sampling distance is Δx ? What is the relationship between Δx and Δu ? Show that if we multiply $f(x)$ by $(-1)^x$ before taking DFT then DFT shifts by $M/2$ points. For a constant function (with value A) for k points ($k < M$) what is the DFT ? What is the DFT if the constant function (value A) is over $2k$ points ($2k < M$). In both cases draw DFTs and explain them. 5



9. a) Explain the steps that are performed to filter a function $f(x, y)$ in the frequency domain. 4
- b) Briefly explain ideal high-pass filter. What are its shortcomings ? How are these shortcomings overcome in Butterworth or Gaussian high-pass filters ? 5
- c) Explain what is Hadamard Transform. Explain with example what are advantages of Hadamard Transform. Write down properties of Hadamard Transform. 6
10. a) Explain with example what is coding redundancy. Explain inter-pixel and psycho-visual redundancy. 5
- b) Show with a block diagram, how a compression system will look like. Explain Hamming's technique for channel coding. 6
- c) Write down basis vectors of DCT and Harr Transforms for a 4×4 transformation. 4
11. Write short notes on any *two* of the following : $2 \times 7 \frac{1}{2}$
- a) Image enhancement by histogram equalization
- b) Hough transform
- c) Recognition of objects by moments.
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